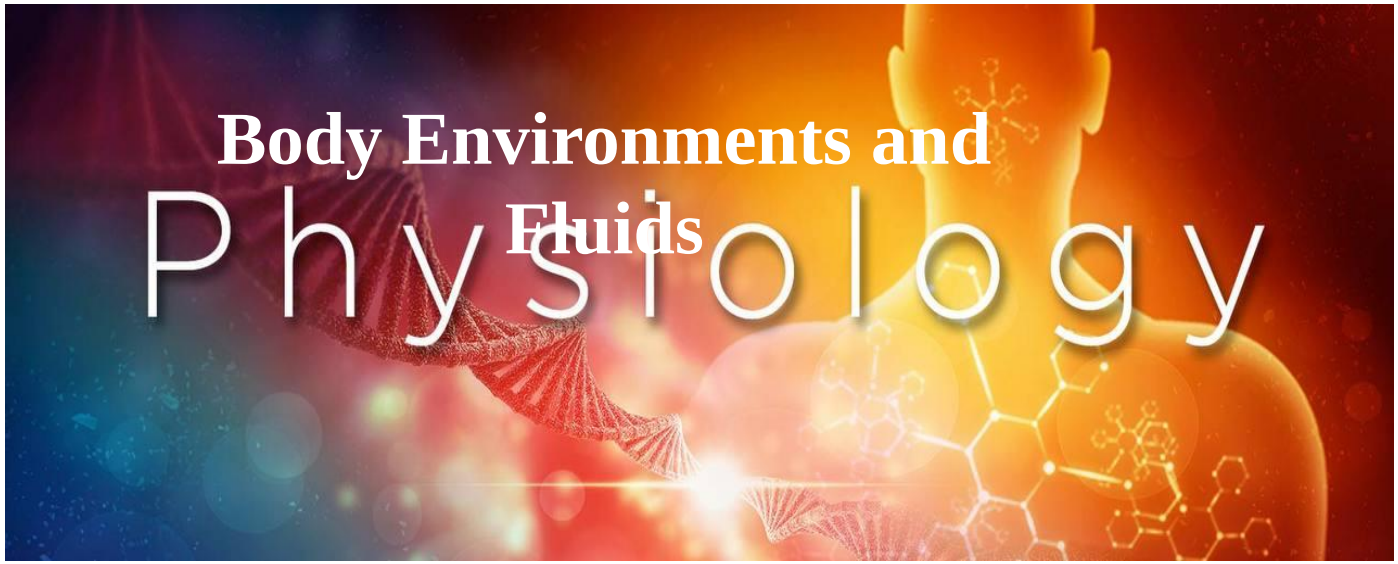
University of Al- Mustaqbal
College Of Nursing

First stage/2nd semester

Lecture two



Body Environments and Fluids

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Body Environments and Fluids

- **External environment :The air in which we live.**
- **The internal environment: according to** Claude Bernard **Body fluids represent the internal environment.**
- Body fluids consist of water, electrolytes, blood plasma and component cells, proteins, and other soluble particles called **solutes**.
- Body Fluid account **about (55- 60%)** of a person's total body weight!

Body fluids are found in:

Two major compartments:

a)Intracellular fluid - cytosol; fluid within cells (28 L=**67%**)

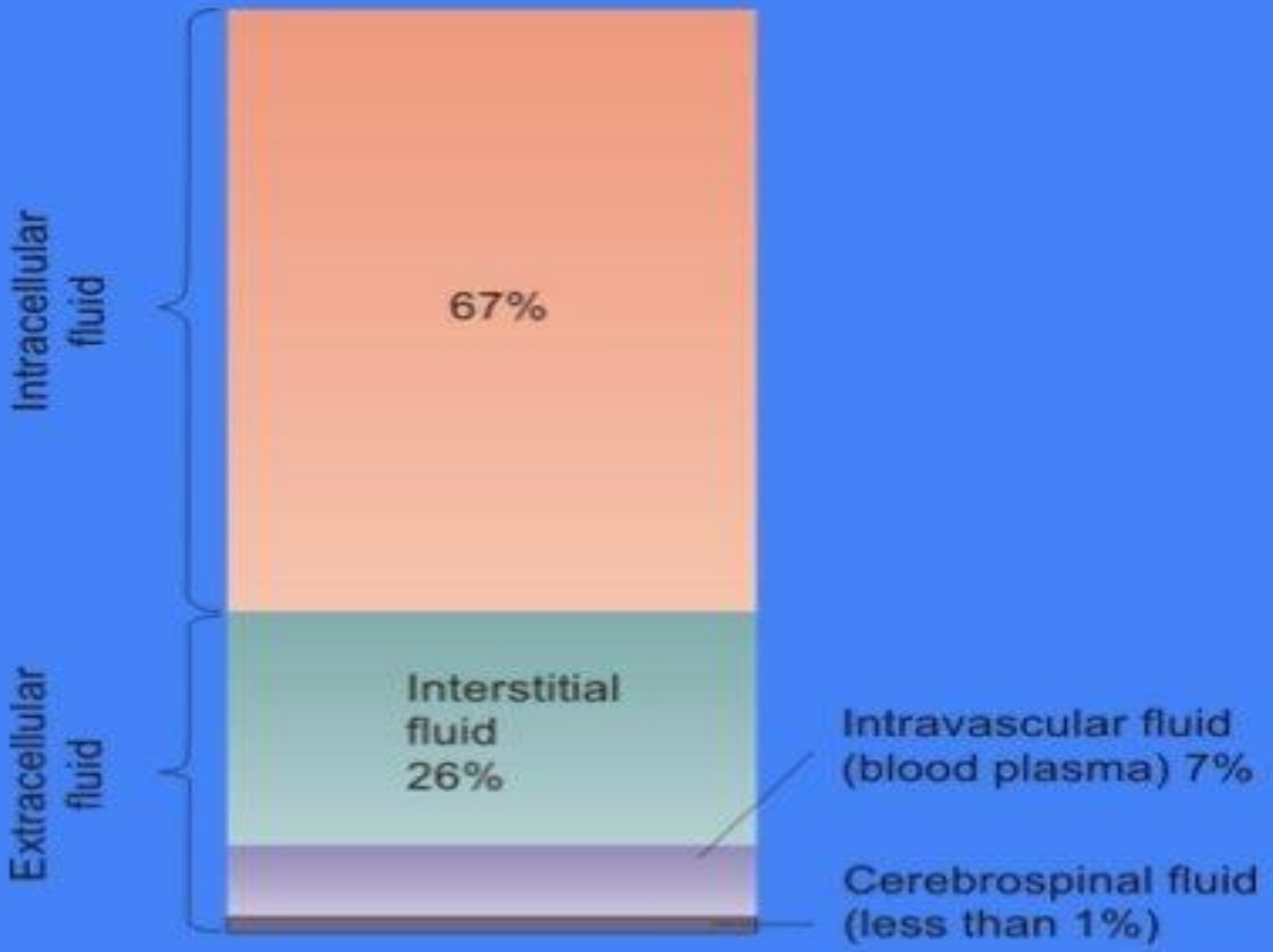
b)Extracellular fluid - all fluid outside cells of the body(**33%**):

- Plasma - liquid component of blood (3L=**7%**)
- Interstitial fluid - tissue fluid; fluid bathing cells (11L=26%).

There is a constant interaction between these 3 fluids.

They are separated form one another only by cell membranes.

Therefore, changing one (especially tissue fluid) has effects on the other two.


Intracellular fluid
67%
Extracellular fluid
Interstitial fluid 26%
Intravascular fluid (blood plasma) 7%
Cerebrospinal fluid (less than 1%)

Two major compartments

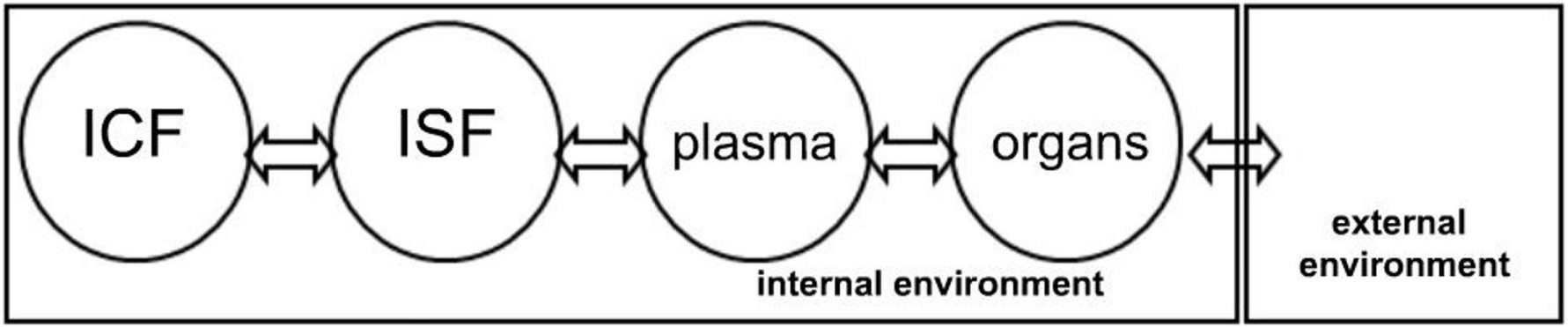
- **Intracellular fluids (ICF)** are found inside cells and are made up of protein, water, electrolytes, and solutes. The most abundant electrolyte in intracellular fluid **is potassium**. In fact, intracellular fluid accounts for 67% of the volume of body fluids and (35- 40%) of a person's total body weight!·
- **Extracellular fluids (ECF)** : are fluids found outside of cells. (33%)from the volume of body fluids and (20%) of a person's total body weight!·. The most abundant electrolyte in extracellular fluid is **sodium**.

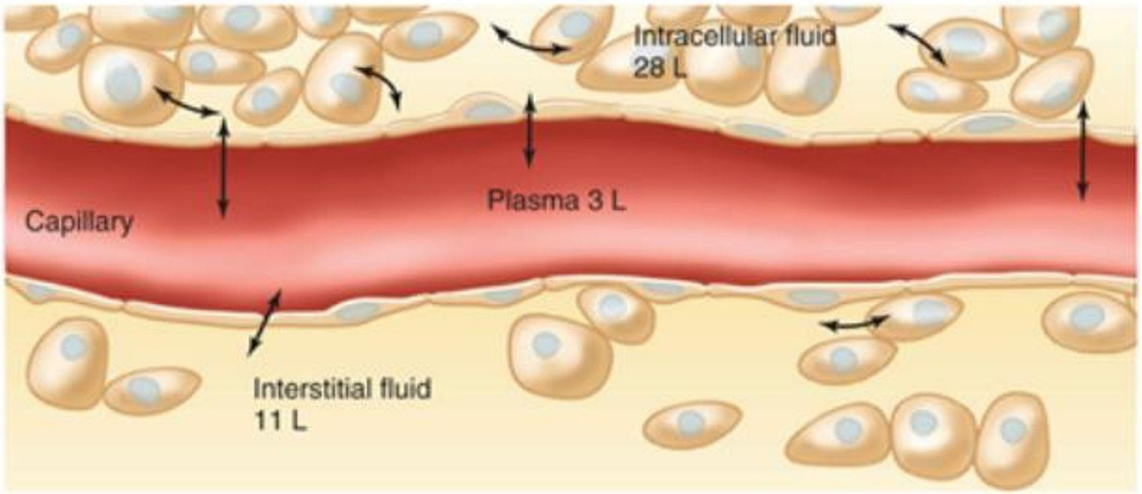
Extracellular fluids types:

1) **Intravascular fluid:** fluid found in the vascular system. Intravascular fluid is whole blood volume. Intravascular fluid is the most important component of the body's overall fluid balance.

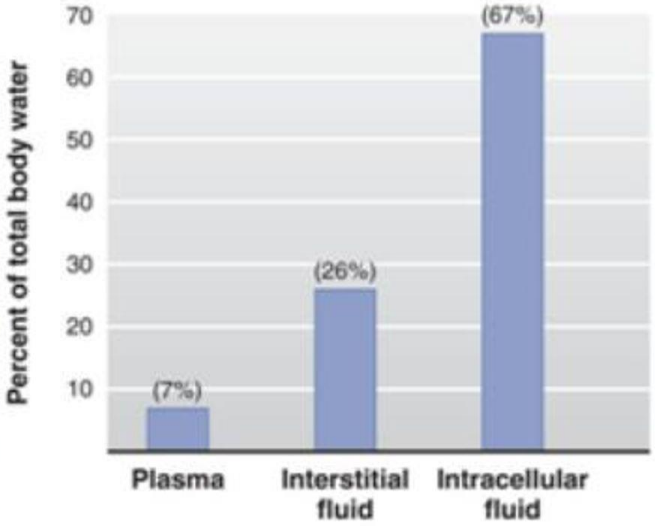
2) **Interstitial fluid**: fluid outside of blood vessels and between the cells. For example excess interstitial fluid referred to as edema in HF.

3) **Transcellular fluid**: fluid in areas such as cerebrospinal, synovial fluid of joint, gastrointestinal system secretion, and exocrine secretion such sweating and tears.





(a)



(b)

Exchange and communication are key concepts for understanding physiological homeostasis.

Transport across cell membranes

Two type of transport across cell membranes :

a)Passive transport

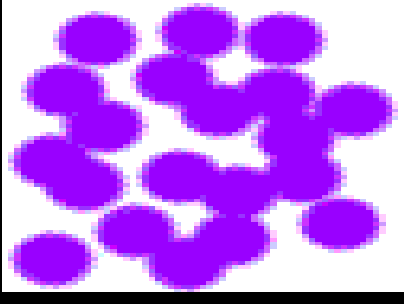
b)Active transport

Transport across cell membranes

a). Passive transport: A process that does not require energy to move molecules from a **HIGH to LOW** concentration.

1. **Simple diffusion** : is the movement of **molecules** across a **selectively permeable** membrane from an area of **high concentration** to an area of **low concentration** until **equilibrium** is reached.

DIFFUSION



HIGH to LOW concentration

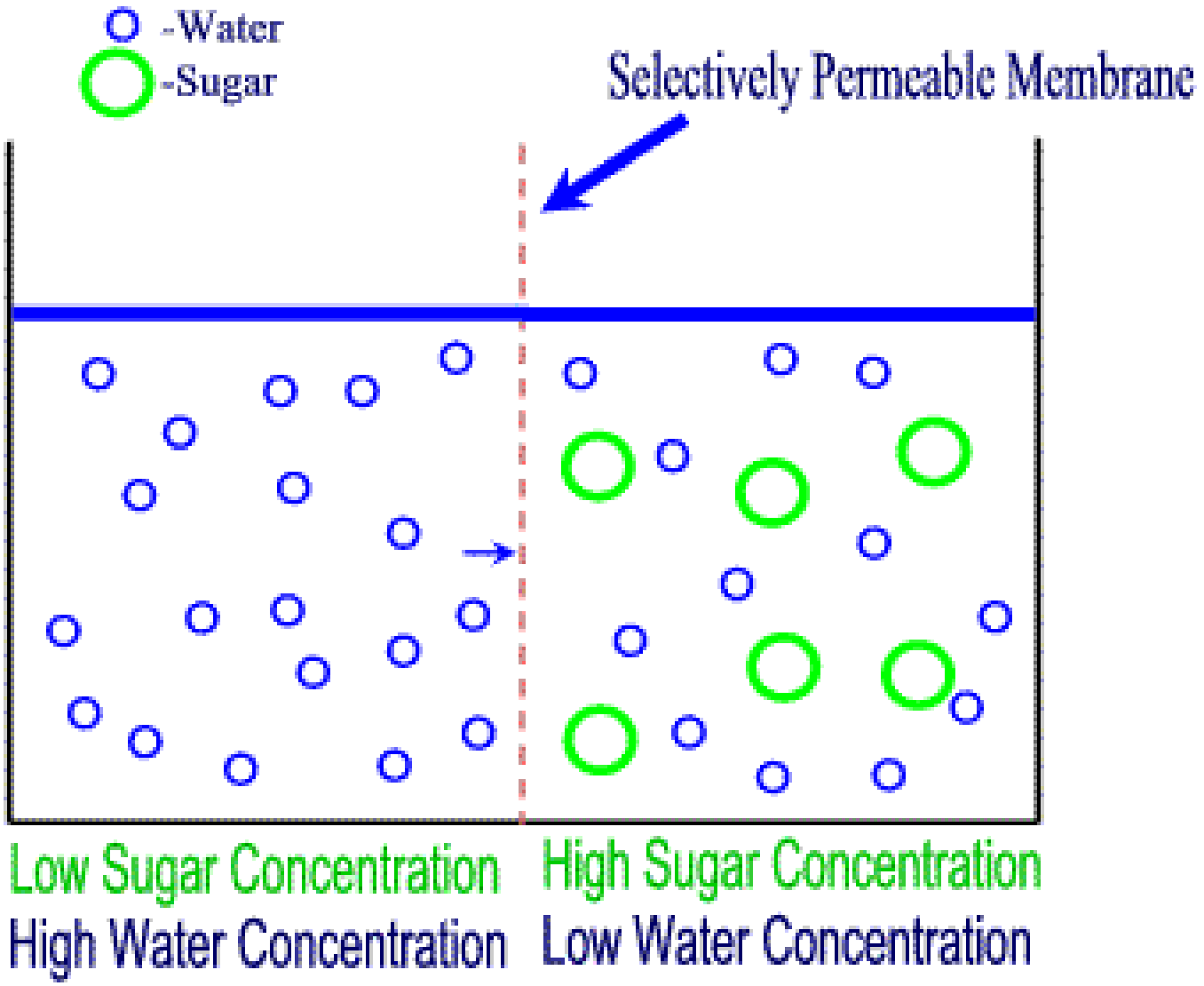
Transport across membranes

Passive transport…(cont.)

2. **Osmosis:** is the **diffusion of (fluid) water** through a selectively permeable membrane from an area of high concentration to an area of low concentration.

    a. **Isotonic**
    b. **Hypertonic**
    c. **Hypotonic**

Osmosis

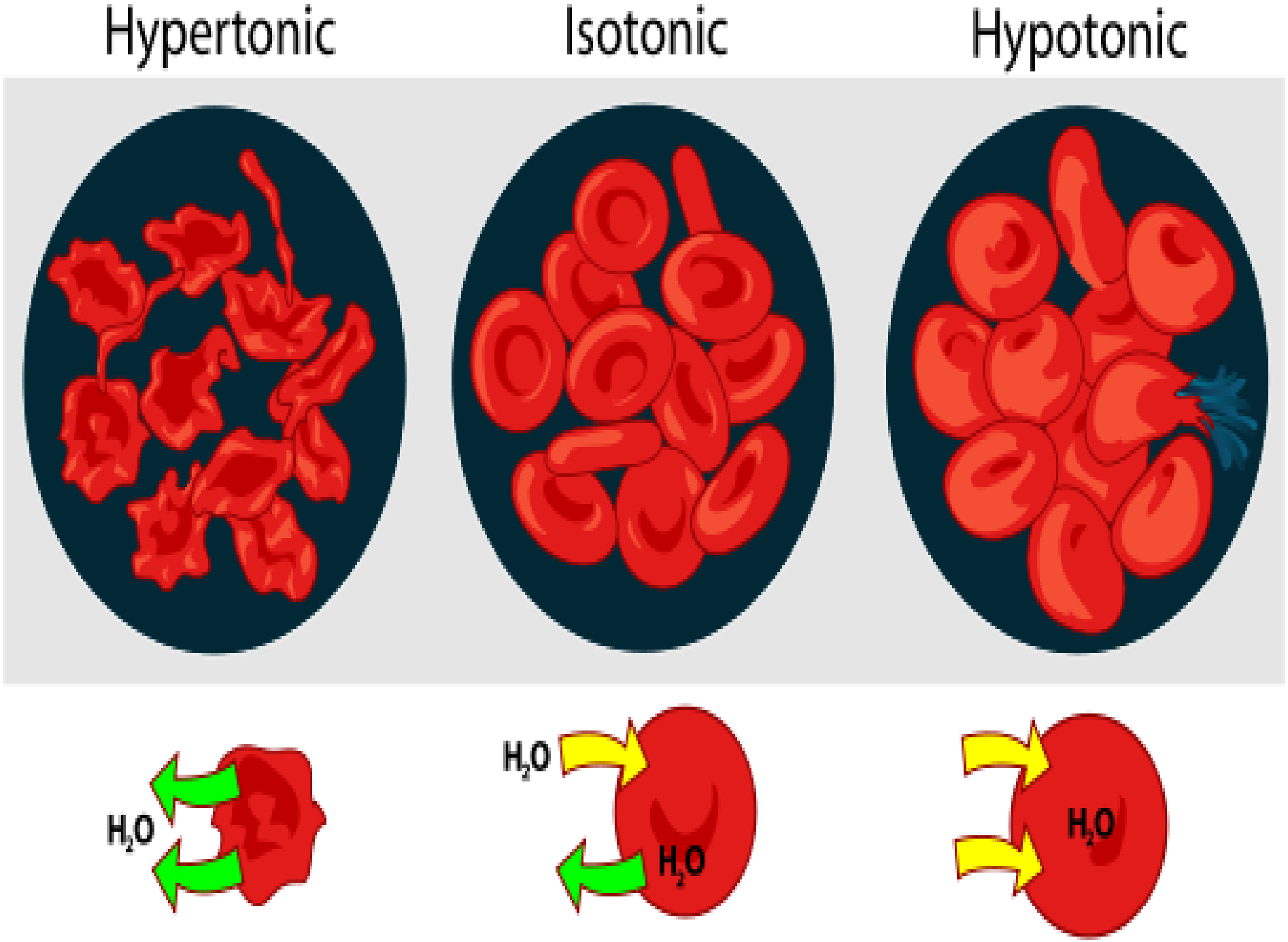

-Water
-Sugar
Selectively Permeable Membrane
Low Sugar Concentration
High Water Concentration
High Sugar Concentration
Low Water Concentration

Passive transport…(cont.) Osmosis

a) **Hypertonic Solutions:** contain **a high concentration** of solute relative to another solution .When a cell is placed in a hypertonic solution, the water diffuses **out** of the cell, causing the cell to **shrivel**.

b) **Hypotonic Solutions:** contain a **low concentration** of solute relative to another solution. When a cell is placed in a hypotonic solution, the water diffuses **into** the cell, causing the cell to **swell** and possibly **explode**.

c) **Isotonic Solutions:** contain the **same concentration** of solute as another solution. When a cell is placed in an isotonic solution, the water diffuses **into and out** of the cell **at the same rate**. The fluid that surrounds the body cells is isotonic.

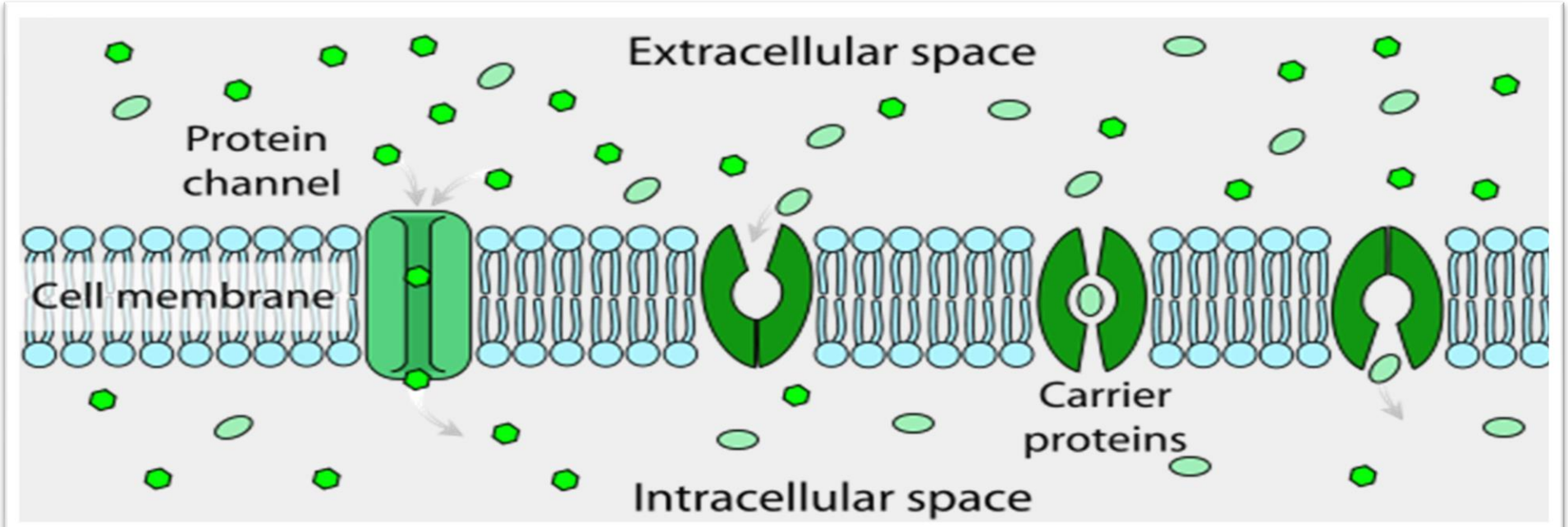

Hypertonic
Isotonic
Hypotonic
H2O
H2O
H2O
H2O

Transport across membranes

Passive transport…(cont.)

3. Facilitated diffusion: is the movement of larger molecules like glucose through the cell membrane – larger molecules must be "helped"

Proteins in the cell membrane form channels for large molecules to pass through. Proteins that form channels (pores) are called protein channels.



Transport across membranes

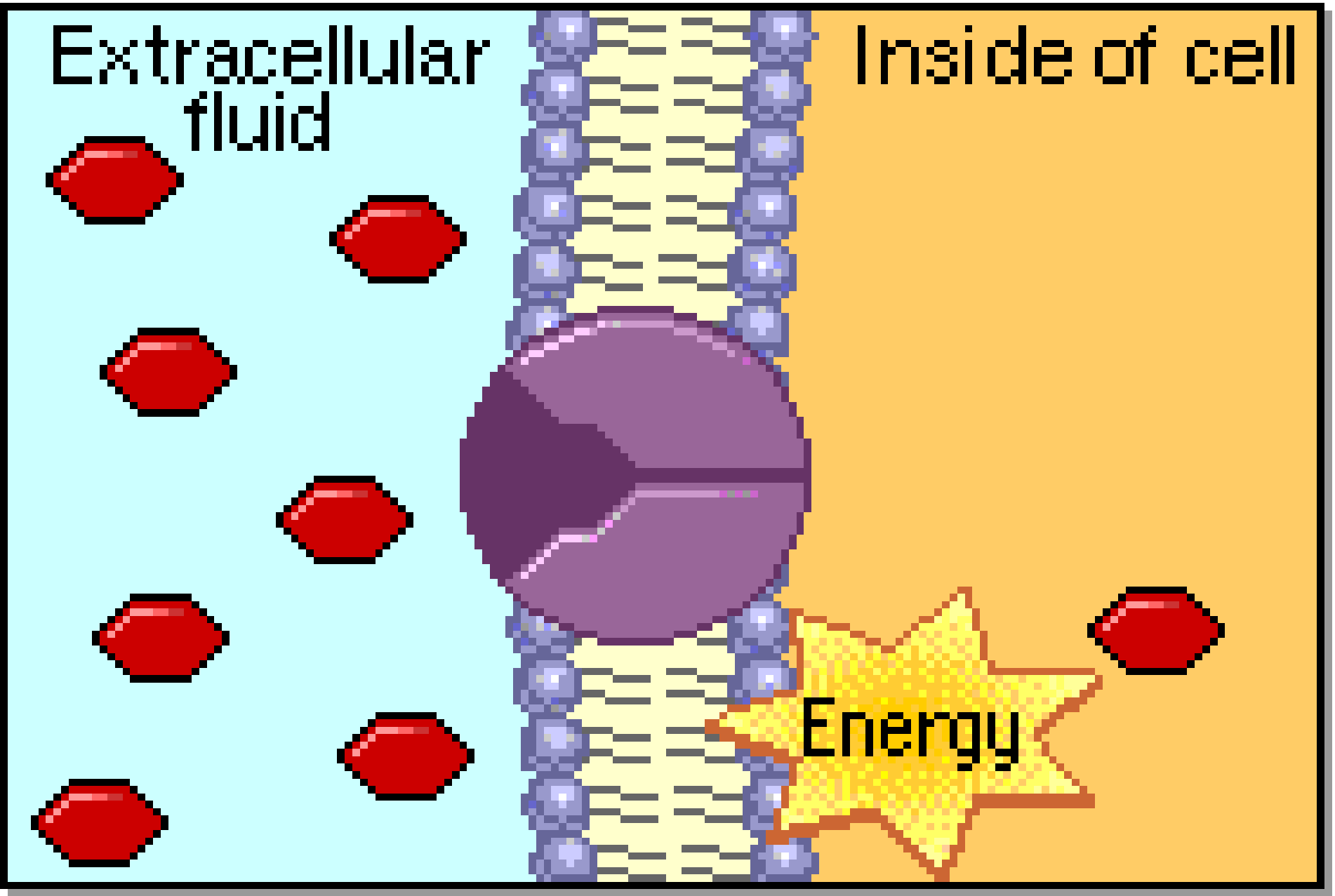
b).Active transport

- Active transport is the movement of molecules from **LOW to HIGH** concentration.
- **Energy is required (**Because active transport moves solutes against a concentration gradient to prevent an over accumulation of solutes in an area).

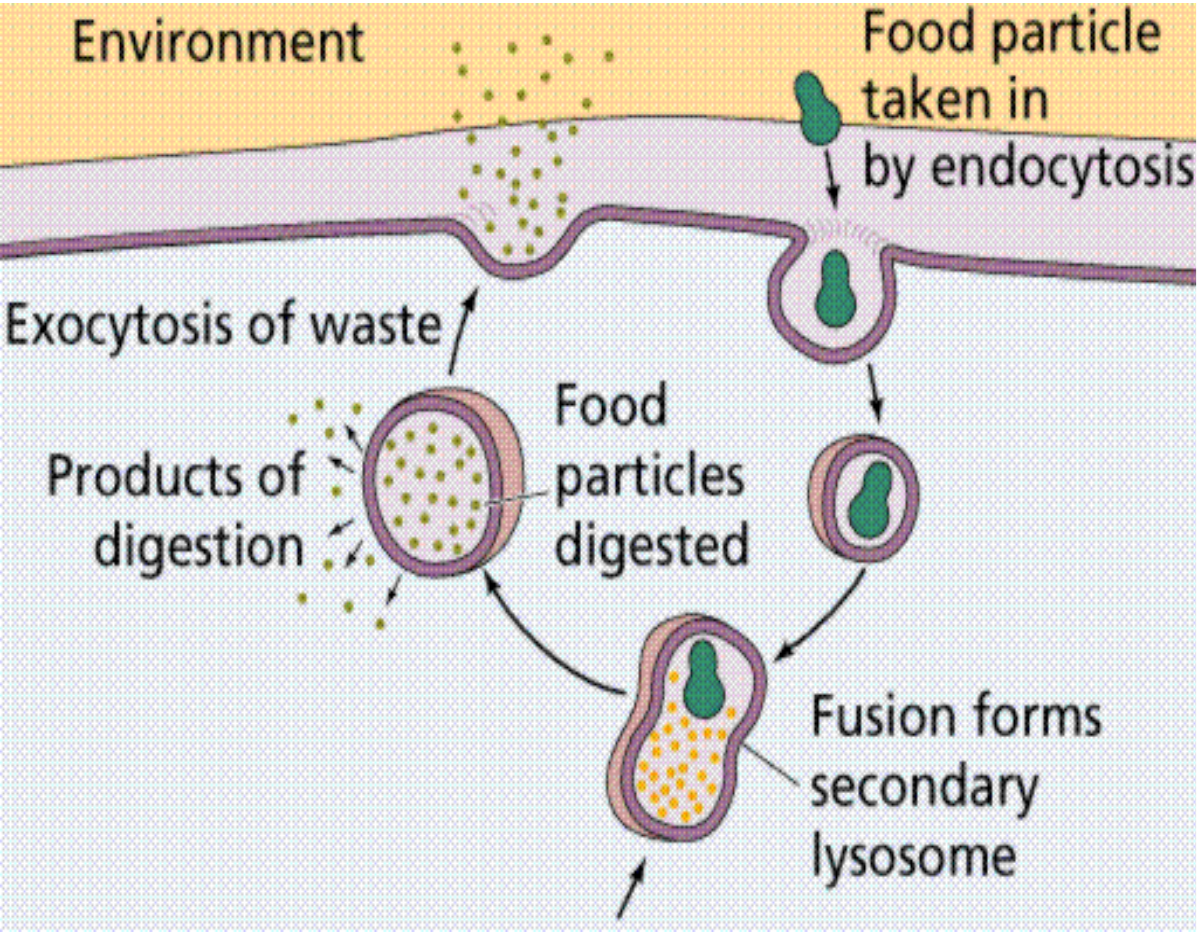
a).Endocytosis

b).Exocytosis

Active Transport

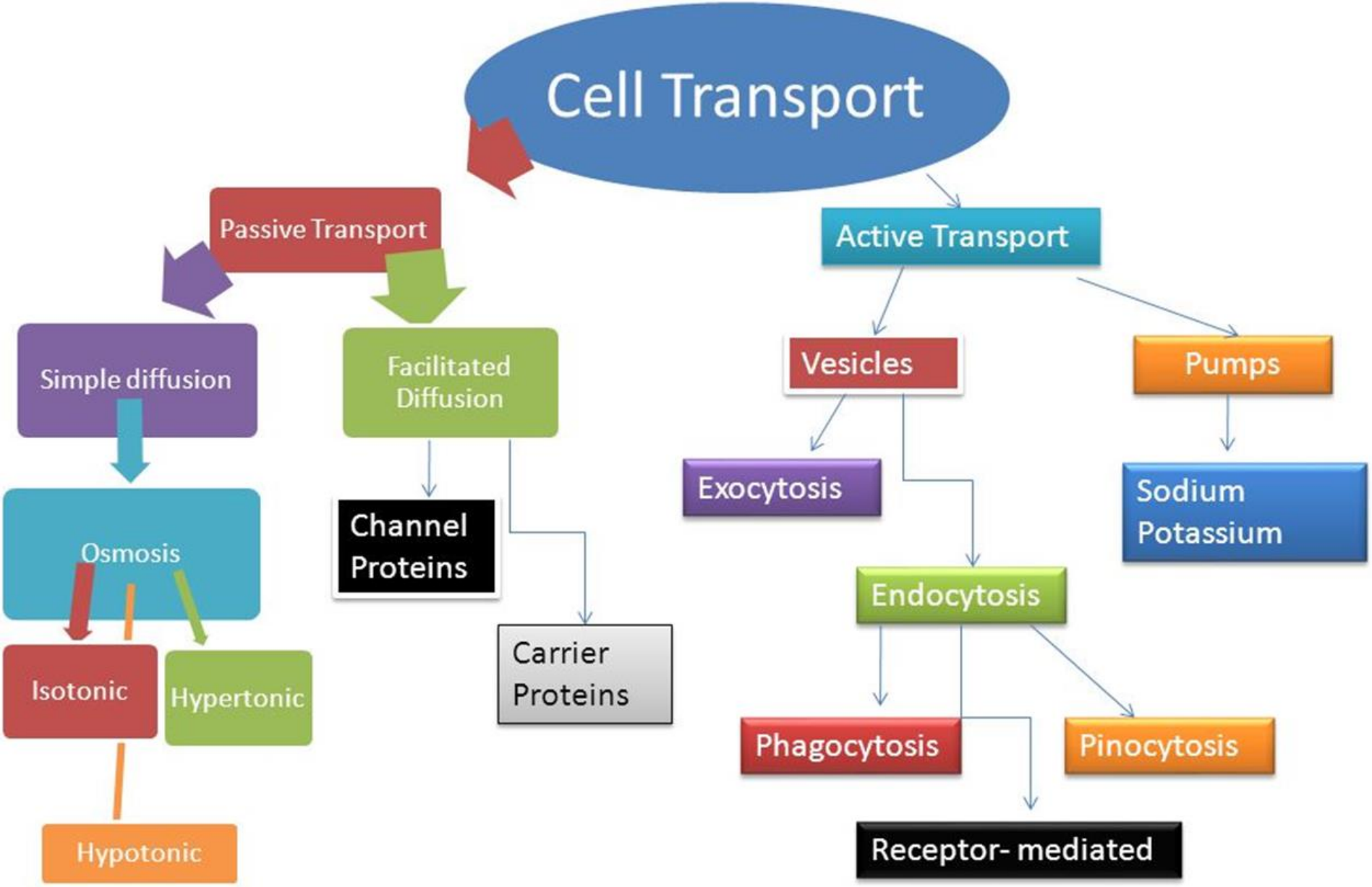


Endocytosis and Exocytosis is the mechanism by which **very large molecules** (such as food and wastes) get into and out of the cell..



Food is moved **into the cell** by **Endocytosis**

Wastes are moved **out of the cell** by **Exocytosis**


Cell Transport
Passive Transport
Active Transport
Simple diffusion
Facilitated Diffusion
Vesicles
Pumps
Osmosis
Channel Proteins
Exocytosis
Sodium Potassium
Endocytosis
Isotonic
Hypertonic
Carrier Proteins
Phagocytosis
Pinocytosis
Hypotonic
Receptor- mediated

Homeostasis

- **Homeostasis**: is the ability of the body or a cell to seek and maintain a condition of equilibrium within its internal environment when dealing with external changes.
- **It is a state of equilibrium for the body.**
- homeostasis involves keeping various cell conditions within normal limits.
- **Loss of homeostasis result in disease and death.**

Characteristics that are controlled include:

- Temperature – at 36.5°C.
- Blood glucose – 4–8mmol/l
- pH of the blood – at 7.4.
- Fluid and electrolyte balance.

Homeostatic control mechanisms

- Our body regulates the internal system through a multitude of feedback systems. There are **three basic parts to the feedback system**; **a receptor, a control center and an effector**.

1. Receptor

- The receptor is body structure that senses changes in the internal environment and relays information to the control center.

For example: certain nerve endings in the skin sense temperature change and detect changes such as a sudden rise or drop in body temperature.

Feedback part ……continue :

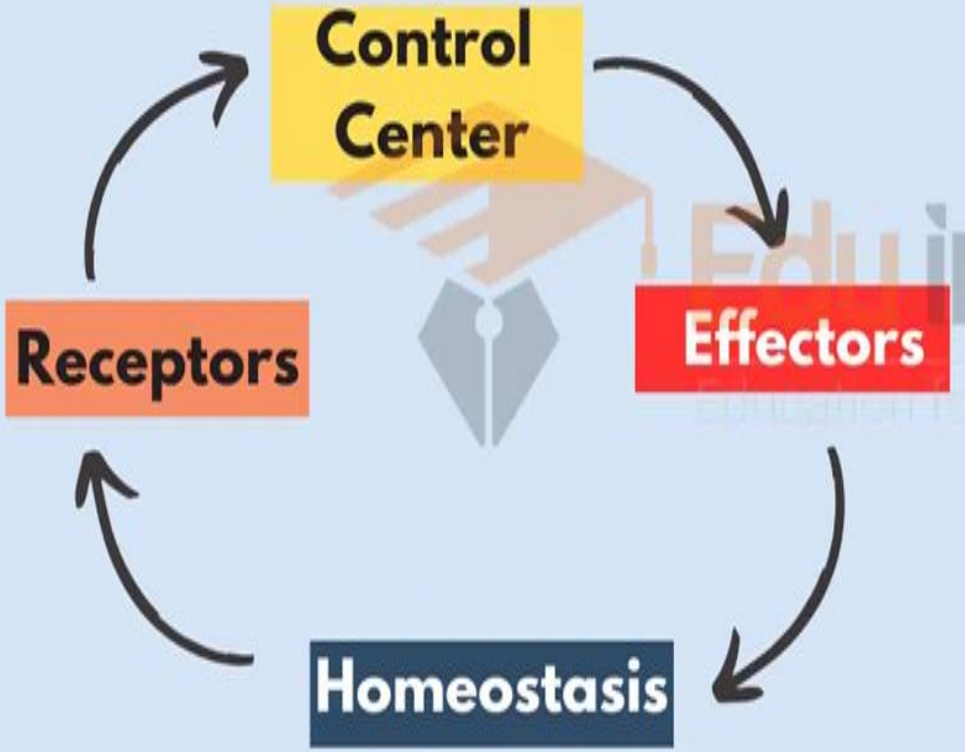
2. Control center

The brain is the control center. It receives the information from the receptor and interprets the information and sends information to the effector. The output could occur as nerve impulses or hormones or other chemical signals.

3. Effector

An effector is a body system such as the skin, blood vessels or the blood that receives the information from the control center and produces a response to the condition.

Homeostasis Feedback Mechanism



Response can be Positive (in same direction), or Negative (in opposite direction)

Feedback Control Loop:

- Classified as negative or positive; negative feedback loops are the most important and numerous control mechanisms. Both mechanisms are vital for physiological balance and response.

• Negative Feedback

Purpose: Counteracts deviations from a set point to maintain stability.

- Mechanism: Reduces the effect of a stimulus, promoting equilibrium.
- Negative feedback is the cornerstone of homeostasis, ensuring stability.

Examples:

Thermoregulation:

- Heat: Sweating cools the body.
- Cold: Shivering generates heat.

Positive Feedback

- Purpose: increases a stimulus to drive processes to completion.
- Mechanism: Reinforces changes, moving the system away from equilibrium temporarily.
- Positive feedback is specialized for rapid, self-limiting processes.

Examples

1. Childbirth:

- - Oxytocin enhances contractions, leading to more oxytocin until delivery.

2. Blood Clotting:

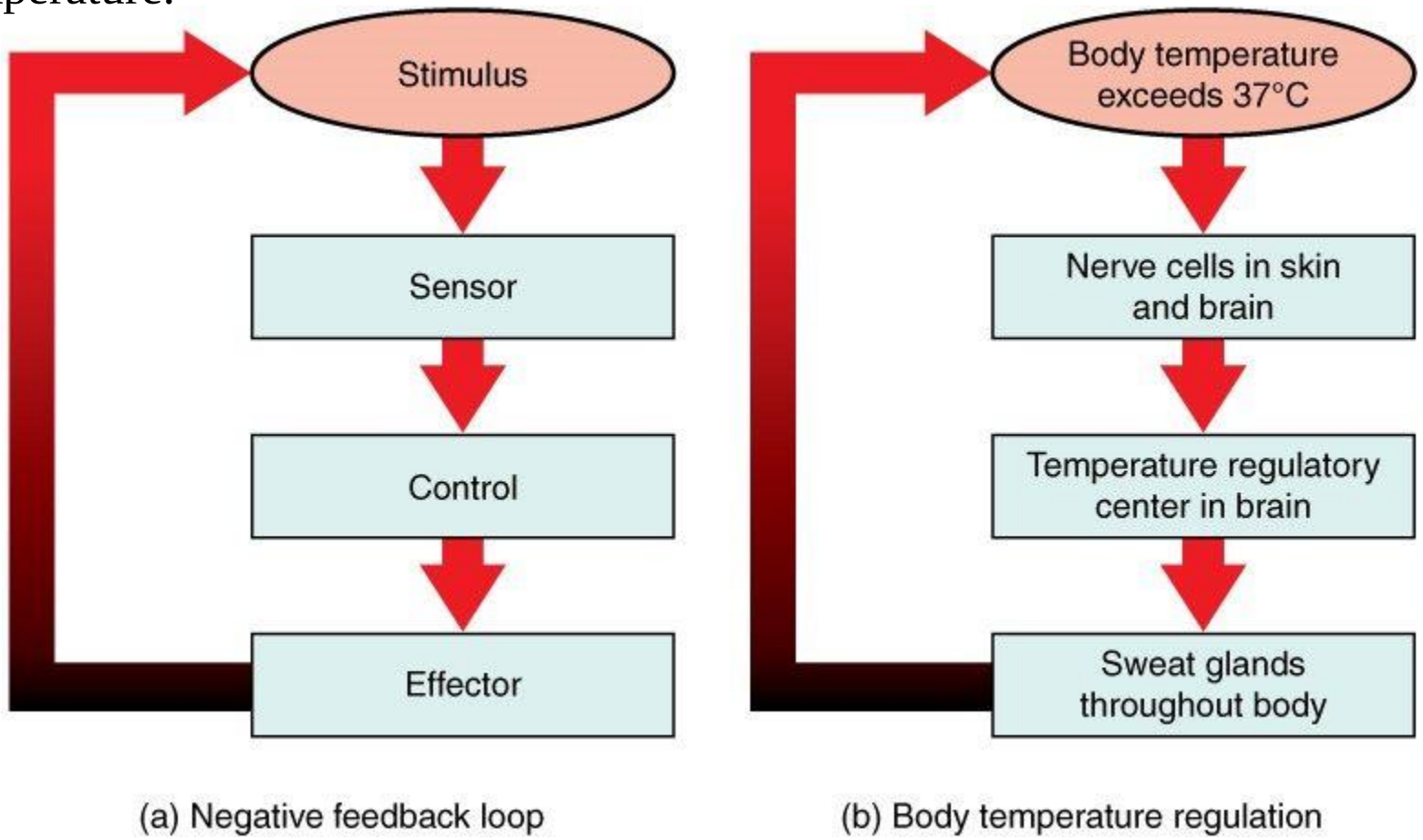
- - Platelets release chemicals attracting more platelets, forming a clot.

Differences between negative and positive feedback

Aspect	Negative Feedback	Positive Feedback
Outcome	Stabilizes internal conditions	Drives processes to an endpoint
Frequency	Common in homeostasis.	Rare, short-term.
Effect on Stimulus	Reduces/Reverses the stimulus.	Increases the stimulus.

For example, the regulation of body temperature by our skin:

Elevated above normal where the hypothalamus act as the control center, which receives input from the skin. The output from the control center goes to the skin(sweat gland) via nerves to initiate sweating thus decrease in body temperature.



(a) Negative feedback loop

(b) Body temperature regulation

The Role of Fluids in Homeostasis

Fluids are essential for maintaining homeostasis because they:

1**. Transport nutrients and waste products**: Blood plasma, a fluid, carries oxygen, glucose, and hormones to cells while removing carbon dioxide and other wastes.

2. **Maintain cellular function**: Intracellular fluid and extracellular fluid provide the medium for biochemical reactions.

3. **Regulate body temperature**: Sweat, a fluid, helps cool the body through evaporation.

How Does the Body Maintain Fluid Balance?

The body maintains fluid balance through several mechanisms:

1. Kidneys: Filter blood, reabsorb water and electrolytes, and excrete excess fluids and waste.

2**. Hormones:**

- Antidiuretic Hormone (ADH): Increases water reabsorption in the kidneys.

- Aldosterone: Promotes sodium and water retention.

3. Thirst Mechanism: Signals the brain to increase water intake when fluid levels are low.

Examples of Homeostasis in Action

1. Dehydration: When fluid levels drop, the body conserves water by reducing urine output and triggering thirst.

2. Overhydration: Excess fluids are excreted through increased urine production.

3. Electrolyte Imbalance: The body adjusts sodium, potassium, and calcium levels to ensure proper nerve and muscle function.

Thanks a lot