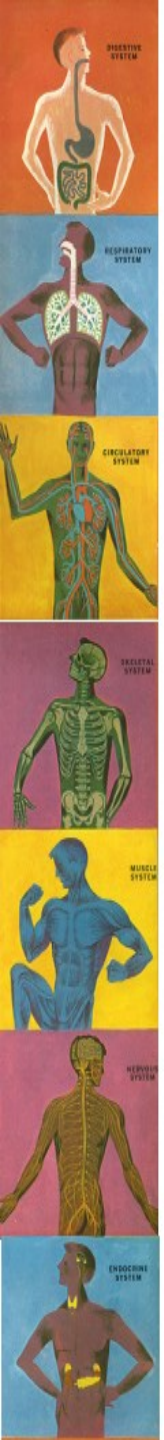

# Homeostasis

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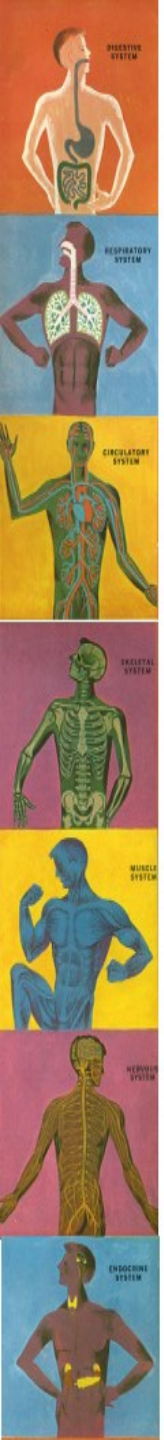
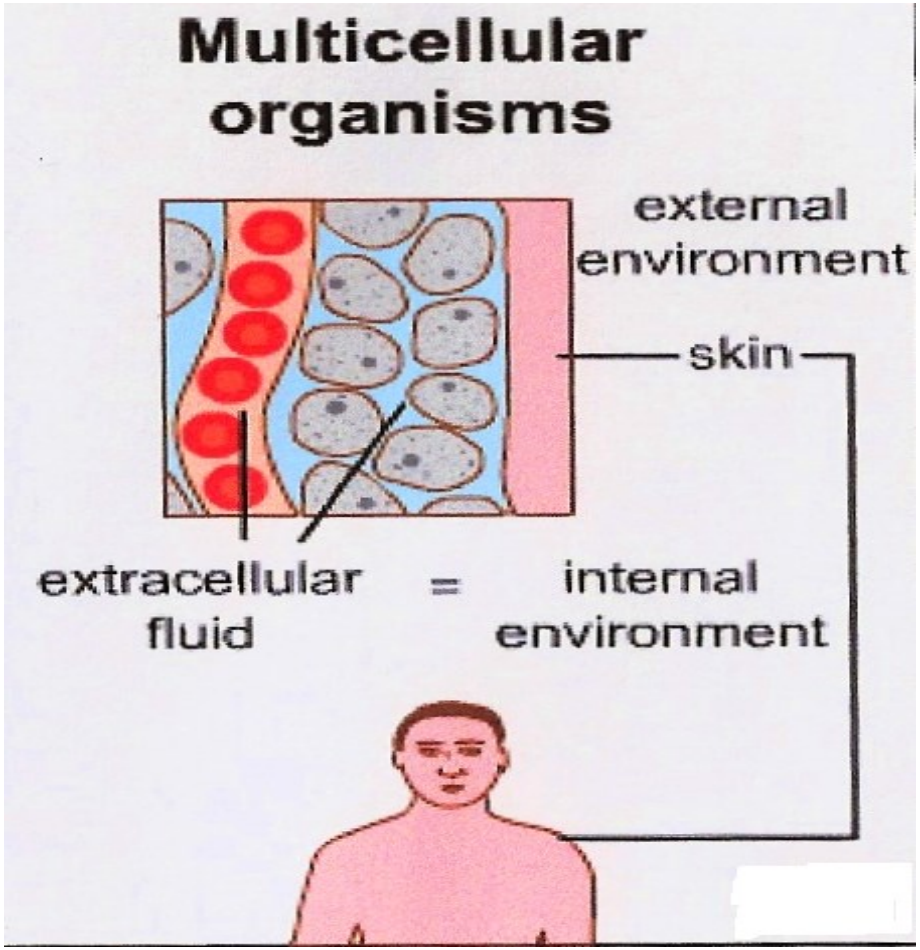


# Objectives

- Define and discuss the concept of homeostasis and its importance to the living organism.
- Discuss the physiologic control mechanisms that enable maintenance of the normal steady state of the body.
- Define a feedback mechanism and describe its components.
- Differentiate between positive and negative feedback mechanisms and give examples for each in the body.
- Apply the knowledge gained in feedback mechanisms to disturbances in the disturbances in ECF volume and osmolarity.

# The Internal environment

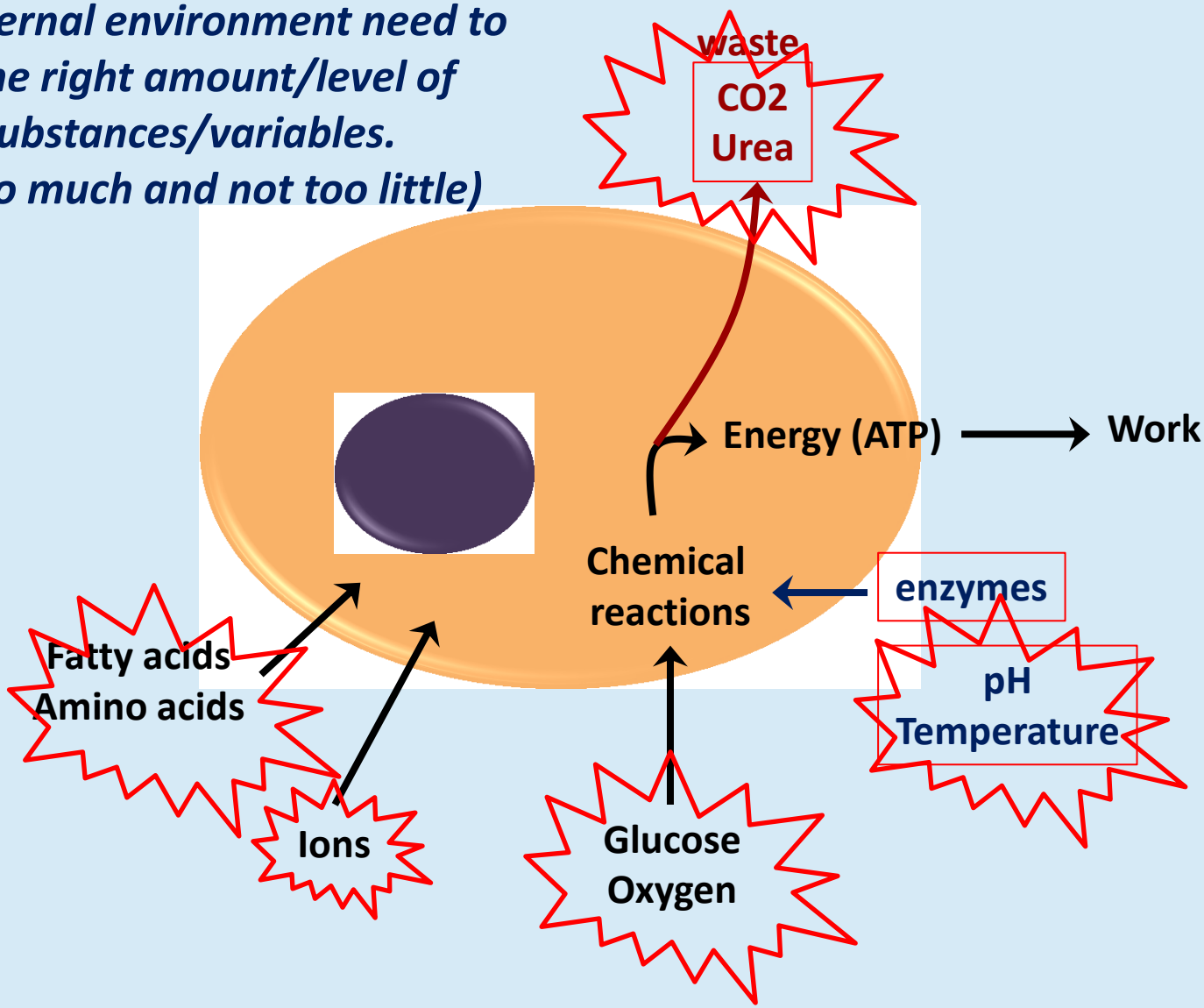
- All body cells live in the same environment →ECF.
- The skin separates this environment from the outside world (external environment).



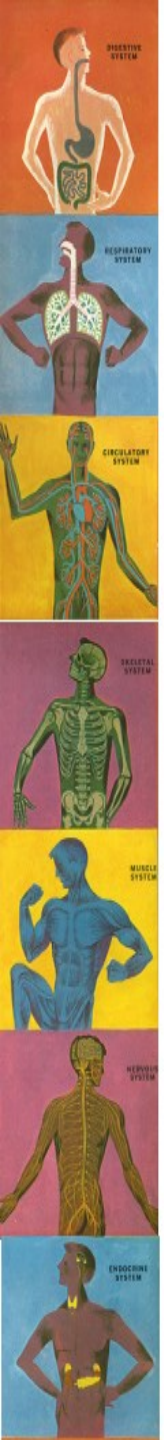

**ECF = Internal environment.**

# *In order for the cell to function properly,*

***The internal environment need to have the right amount/level of these substances/variables. (not too much and not too little)***



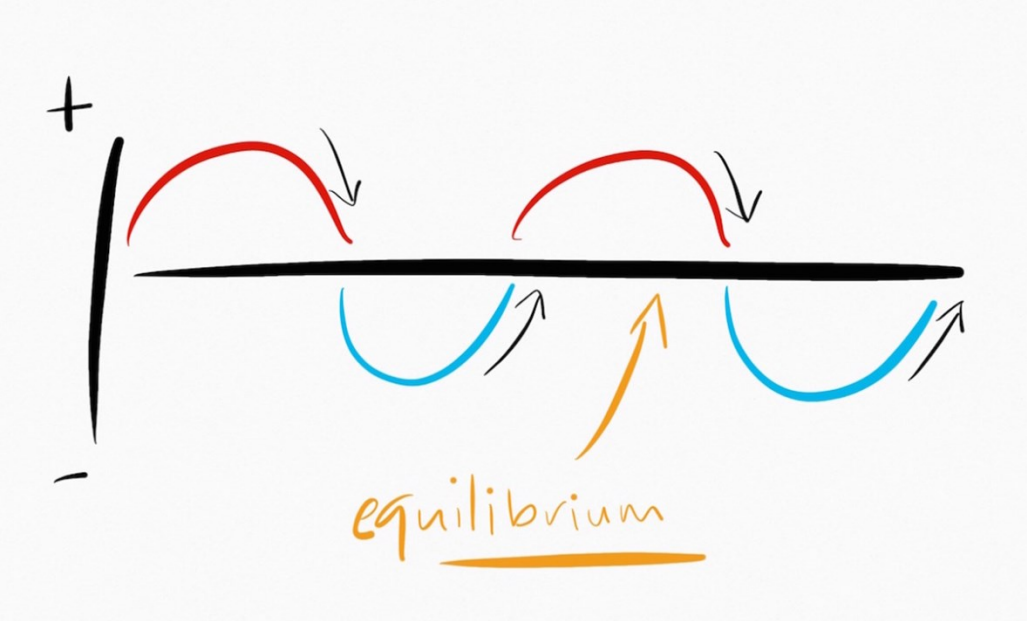

(Mr. Ford's class-Introduction to anatomy and physiology-youtube)



# The Internal environment

- The internal environment must be kept ***constant*** in the face of an ever changing external environment.

- The internal environment of the body (ECF)is in a ***dynamic state of equilibrium***



# “Homeostasis”

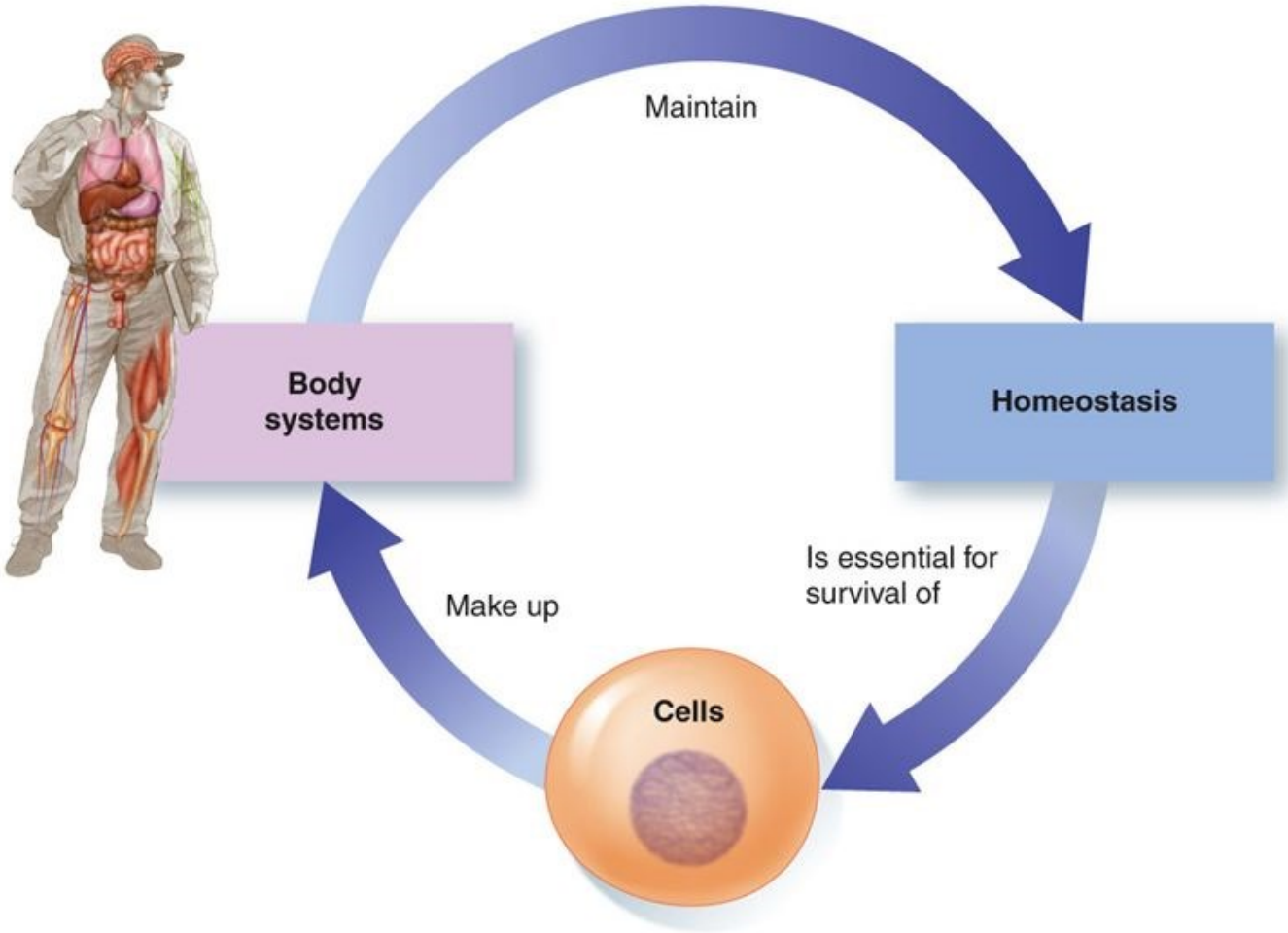
- **The process by which the body keeps the internal environment constant despite changes in the external environment is known as *“Homeostasis”.***

- ***Homeostasis*** means:
  - ***Homeo-*** : sameness, similarity
  - ***-stasis***: standing

- Essentially all the functions of the body organs and tissues aim at keeping the internal environment at a nearly constant state.

(Guyton and Hall Textbook of Medical Physiology. 13th ed. Ch-1)

# Homeostasis



Control systems

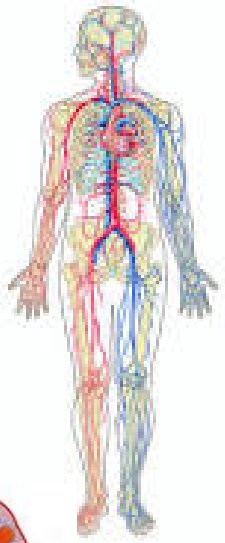
Nervous system

Endocrine systems

**Protection**

Skin

Immune system



$O_2$

$CO_2$

*Internal environment*

End metabolic products

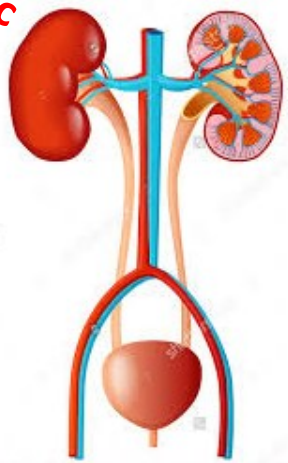
Detoxify

Feces

Nutrients

Ions

$H_2O$



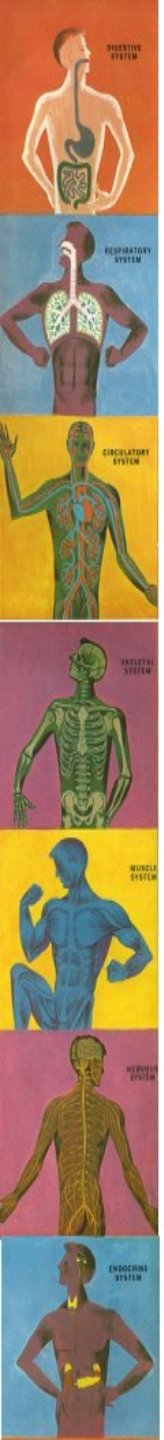
***Body constituents are normally regulated within a range rather than a fixed value;***

## Concentrations of Extracellular and Intracellular Electrolytes in Adults

| Electrolyte | Extracellular Concentration* | Intracellular Concentration* |
|---|---|---|
| Sodium | 135–148 mEq/L | 10–14 mEq/L |
| Potassium | 3.5–5.0 mEq/L | 140–150 mEq/L |
| Chloride | 98–106 mEq/L | 3–4 mEq/L |
| Bicarbonate | 24–31 mEq/L | 7–10 mEq/L |
| Calcium | 8.5–10.5 mg/dl | < 1 mEq/L |
| Phosphate/ phosphorus | 2.5–4.5 mg/dl | 4 mEq/kg† |
| Magnesium | 1.8–2.7 mg/dl | 40 mEq/kg† |

*Values may vary among laboratories, depending on the method of analysis used.

†Values vary among various tissues and with nutritional status.



# Control Mechanisms

- The body has thousands of control systems.
- They function to restore balance when it is lost.
- Control systems operate;
  - ***Within the organ*** itself
  - Throughout the body → to control ***interrelations between organs***.

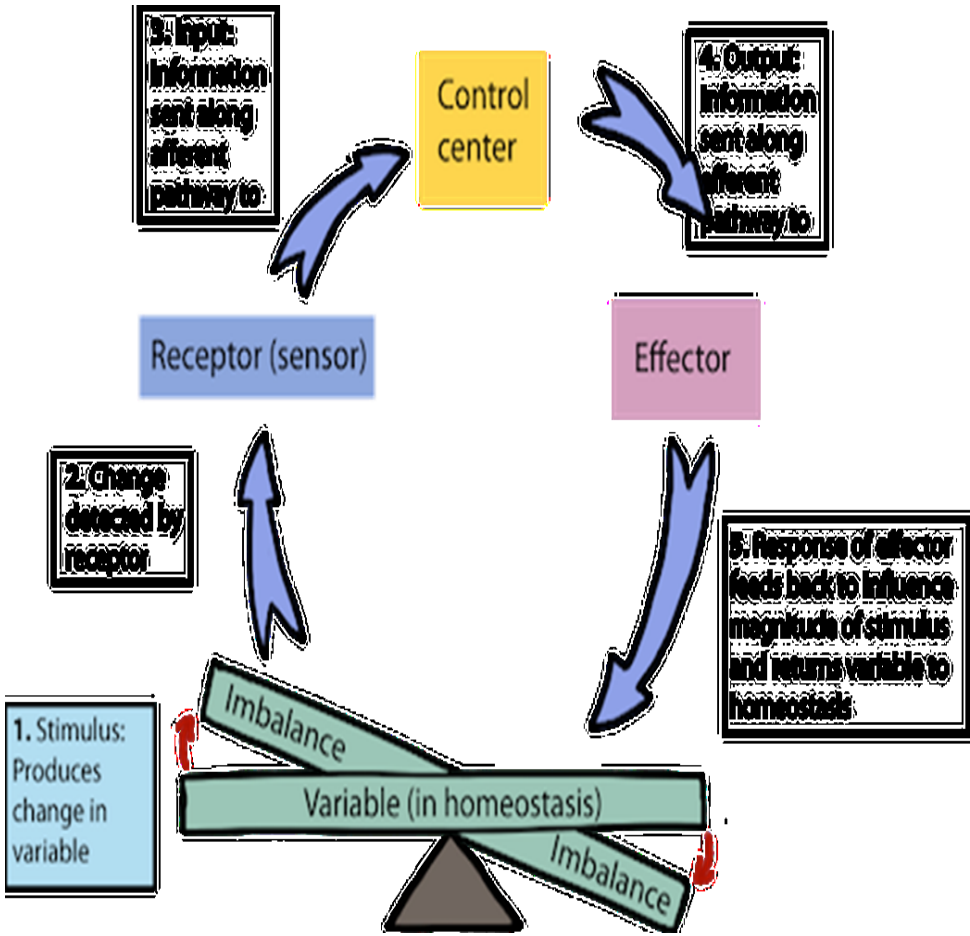
## How is this achieved?

## By feedback mechanisms

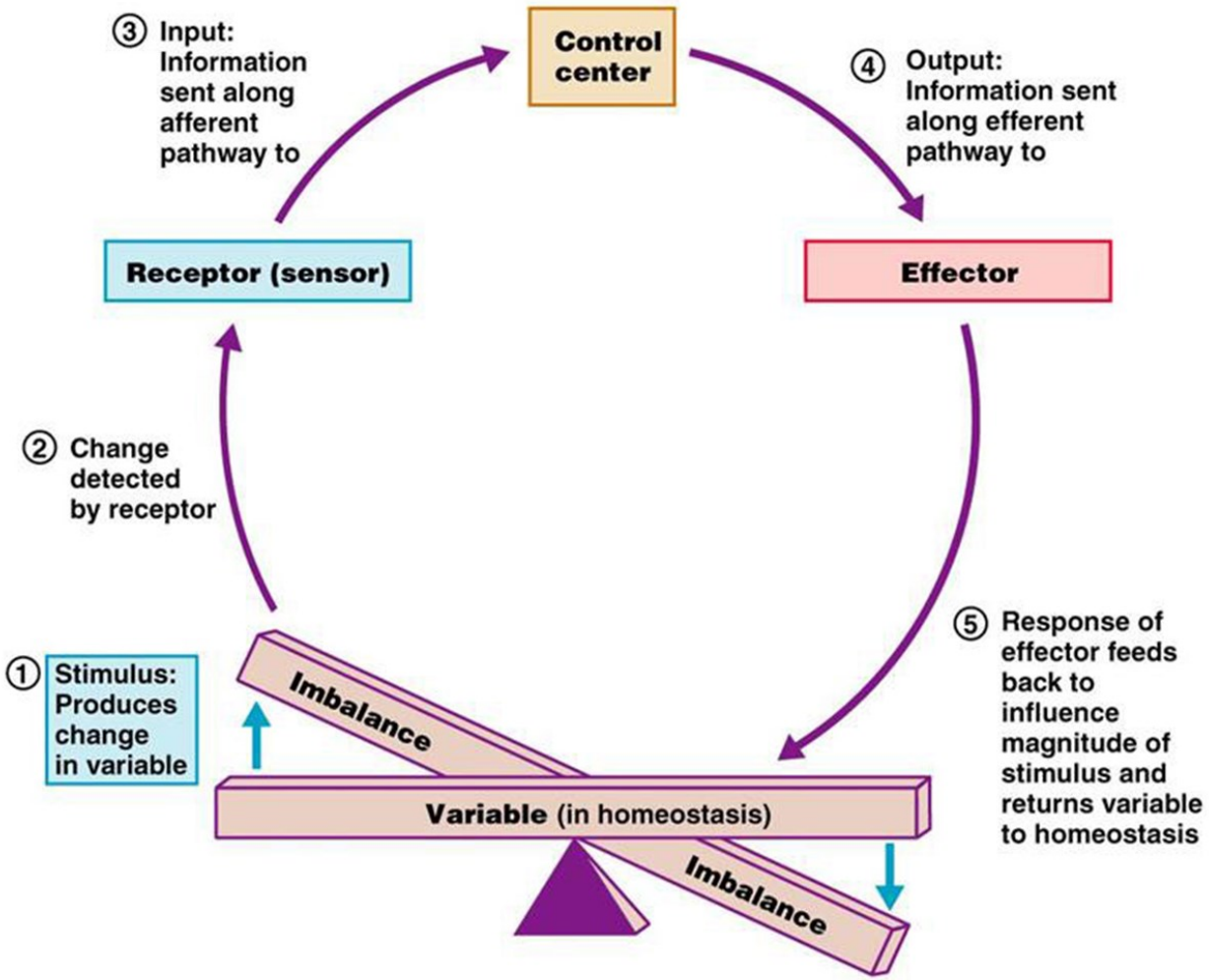
# Feedback Mechanisms

***What is meant by feedback?***

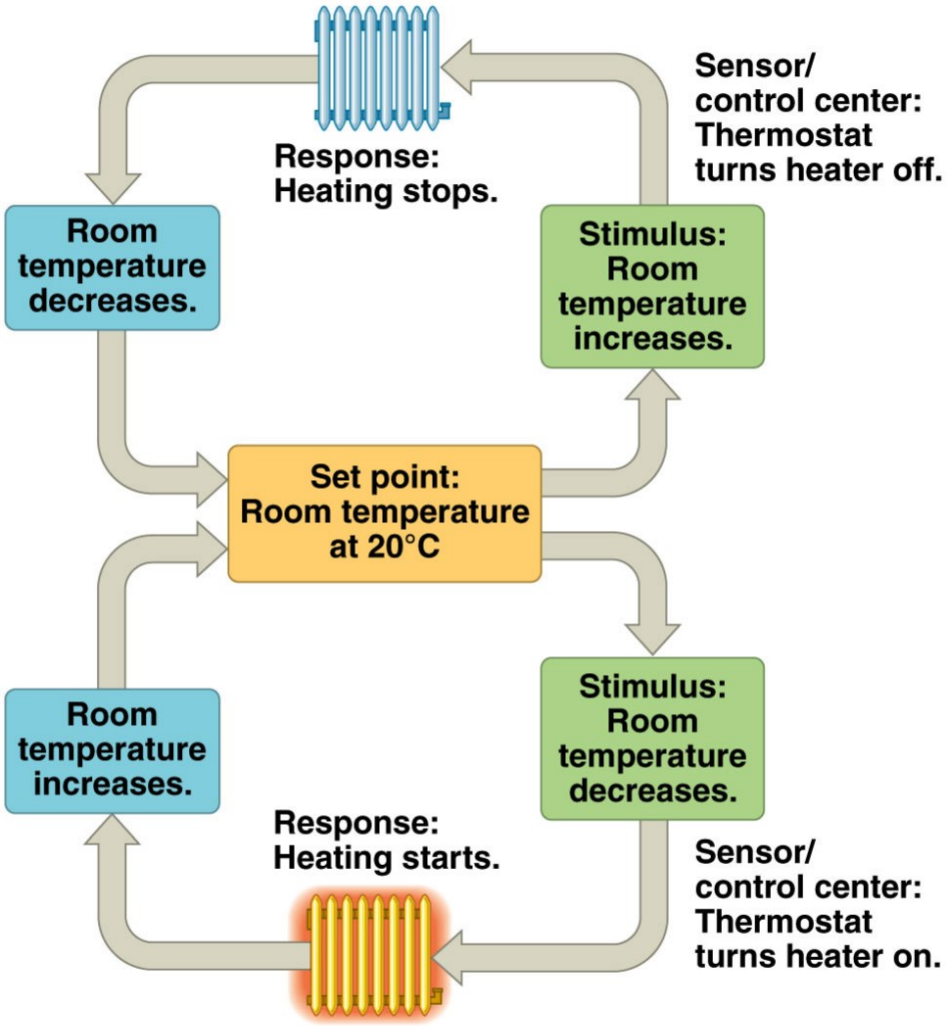
- A loop system in which the system responds to perturbation either in the **same direction** (***positive feedback***) or in the **opposite direction** (***negative feedback***).



# What are the components of a feedback mechanism?



# The Thermostat Analogy



# Types of Feedback Mechanisms

## Negative feedback

The effector response of the system is in the ***opposite direction*** to the stimulus that initiated the response.

E.g;

- A ***high level of in $CO_2$*** in the ECF will increase pulmonary ventilation, increasing the amount of $CO_2$ expired which will ***bring the level of $CO_2$ in ECF down***.

- Most of the control systems of the body act by negative feedback.

## Positive feedback

The effector response is in the same direction of the stimulus that initiated the response.

E.g;

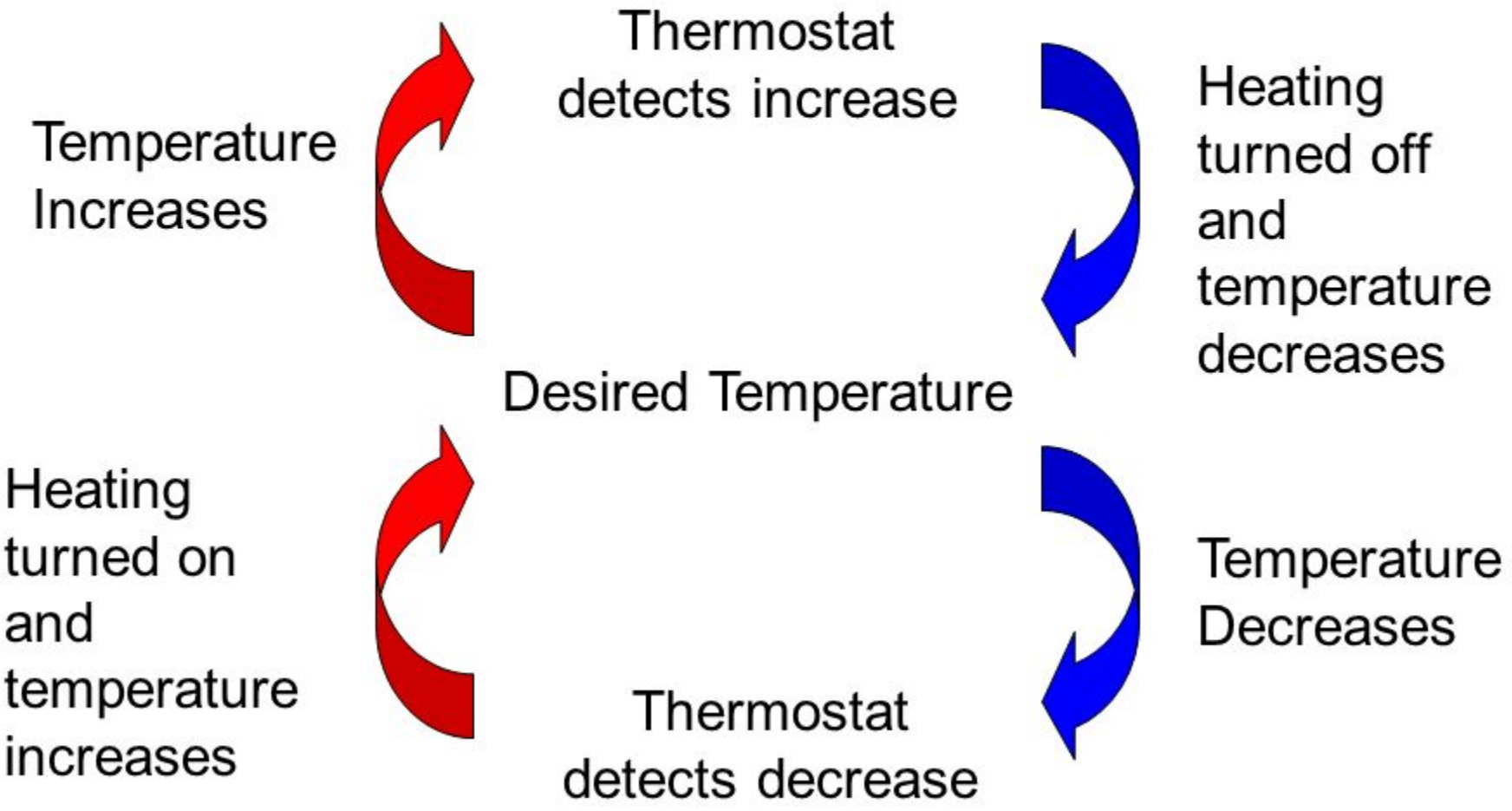
- In nerve signaling, ***entry of a small amount of Na+*** into the cell will open more Na+ channels ***causing more Na+ to enter the cell***.

- Only few systems display positive feedback mechanisms.. ***WHY?***

(Guyton and Hall Textbook of Medical Physiology. 13th ed. Ch-1)

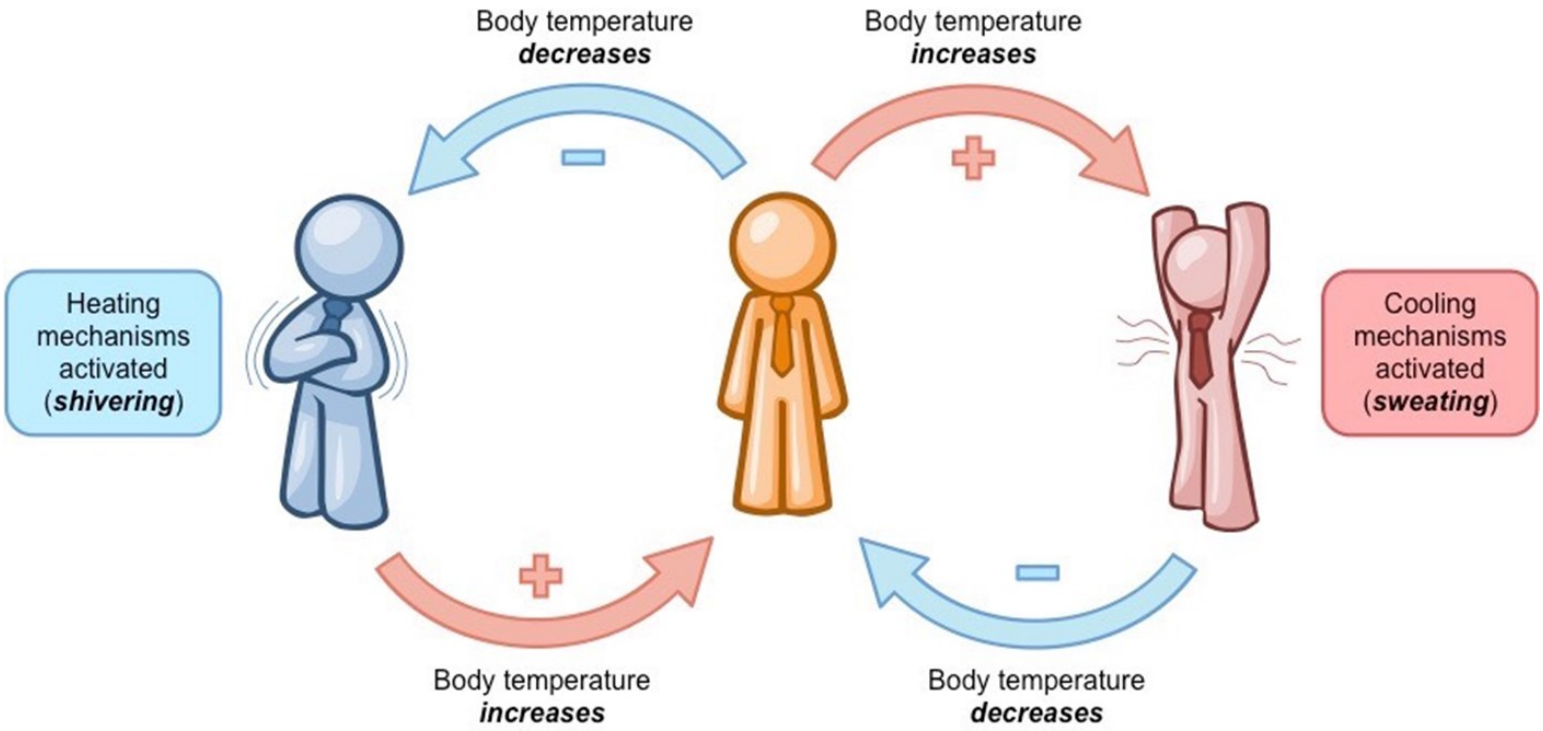
# Negative Feedback

(thermostat analogy)

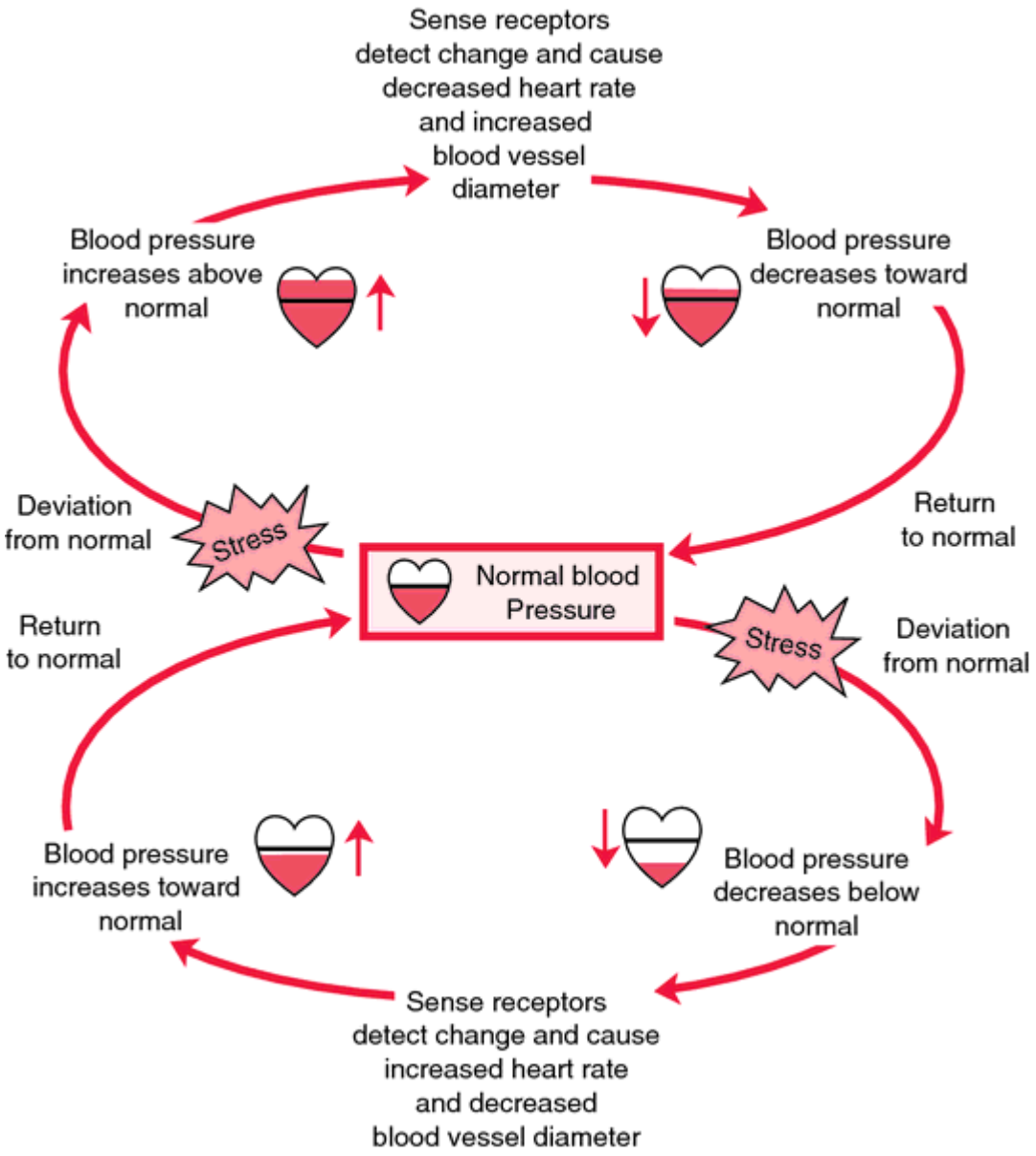


# Examples of Negative Feedback Mechanisms

**Body temperature control**

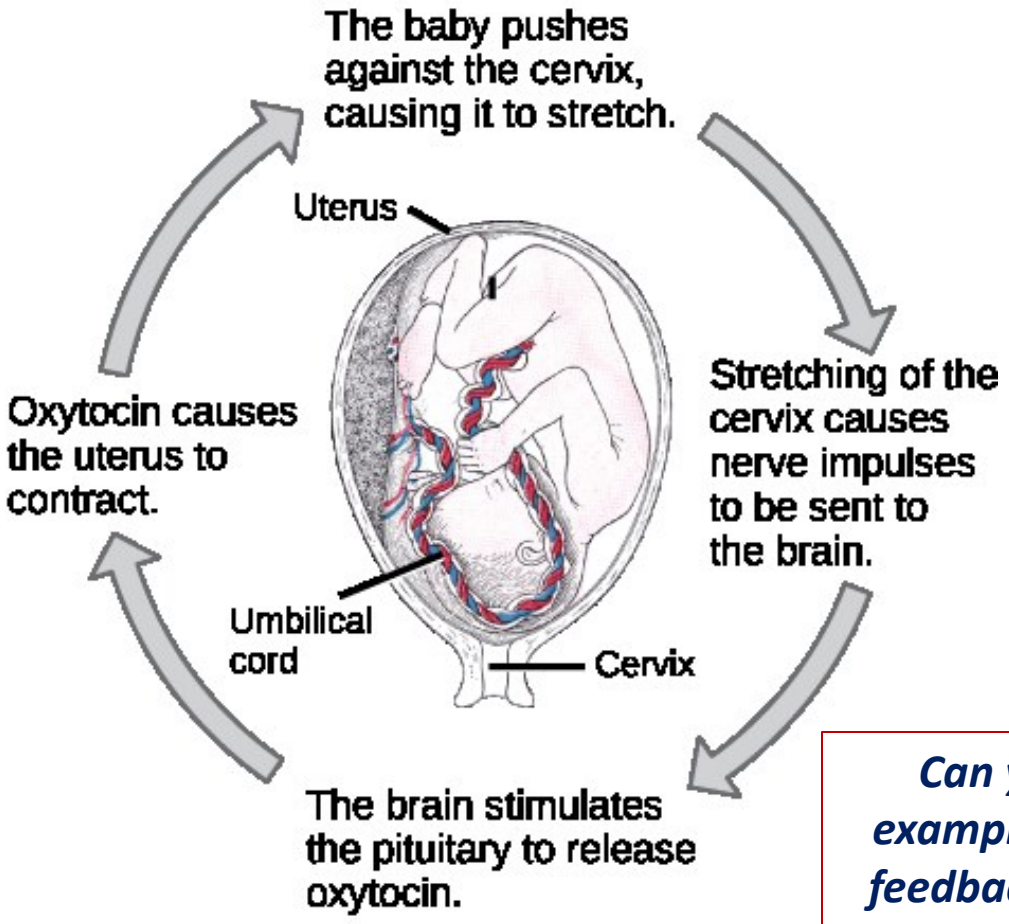


# Blood pressure control



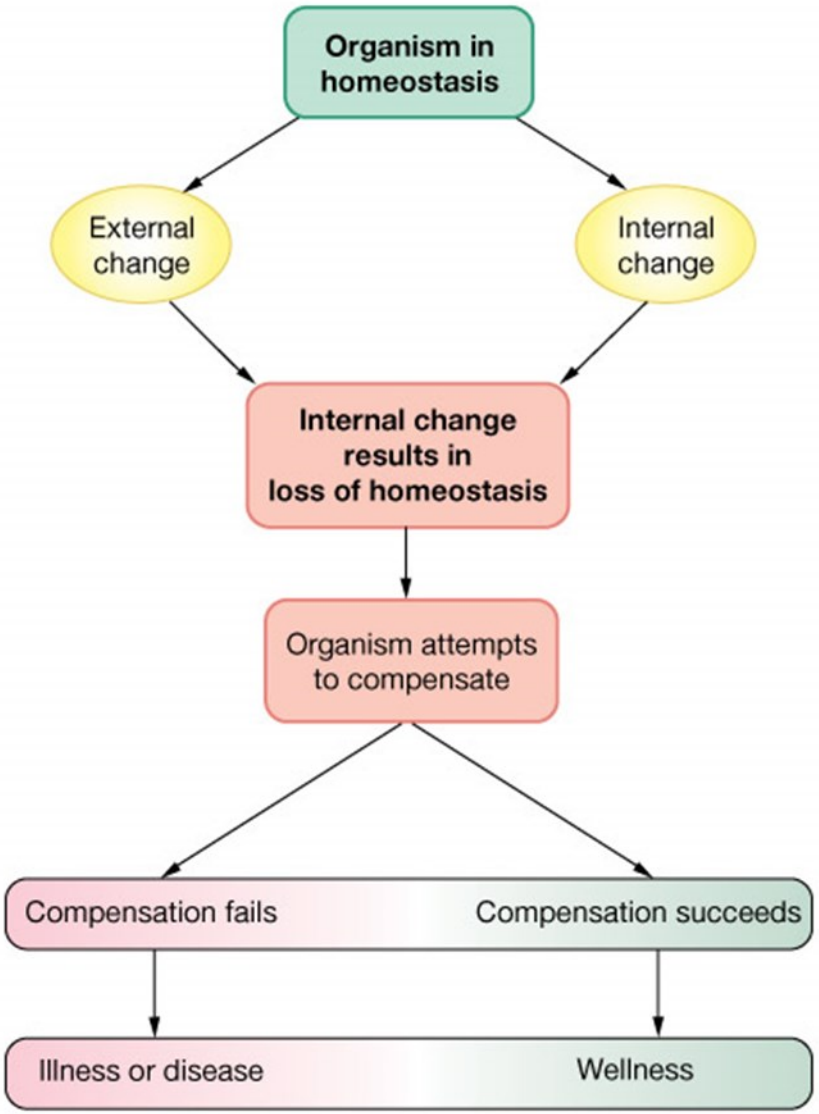
# Examples of Positive Feedback Mechanisms

## Childbirth




*Can you find other examples for a positive feedback mechanism in the body?*

# *Disease* is a state od disturbed homeostasis

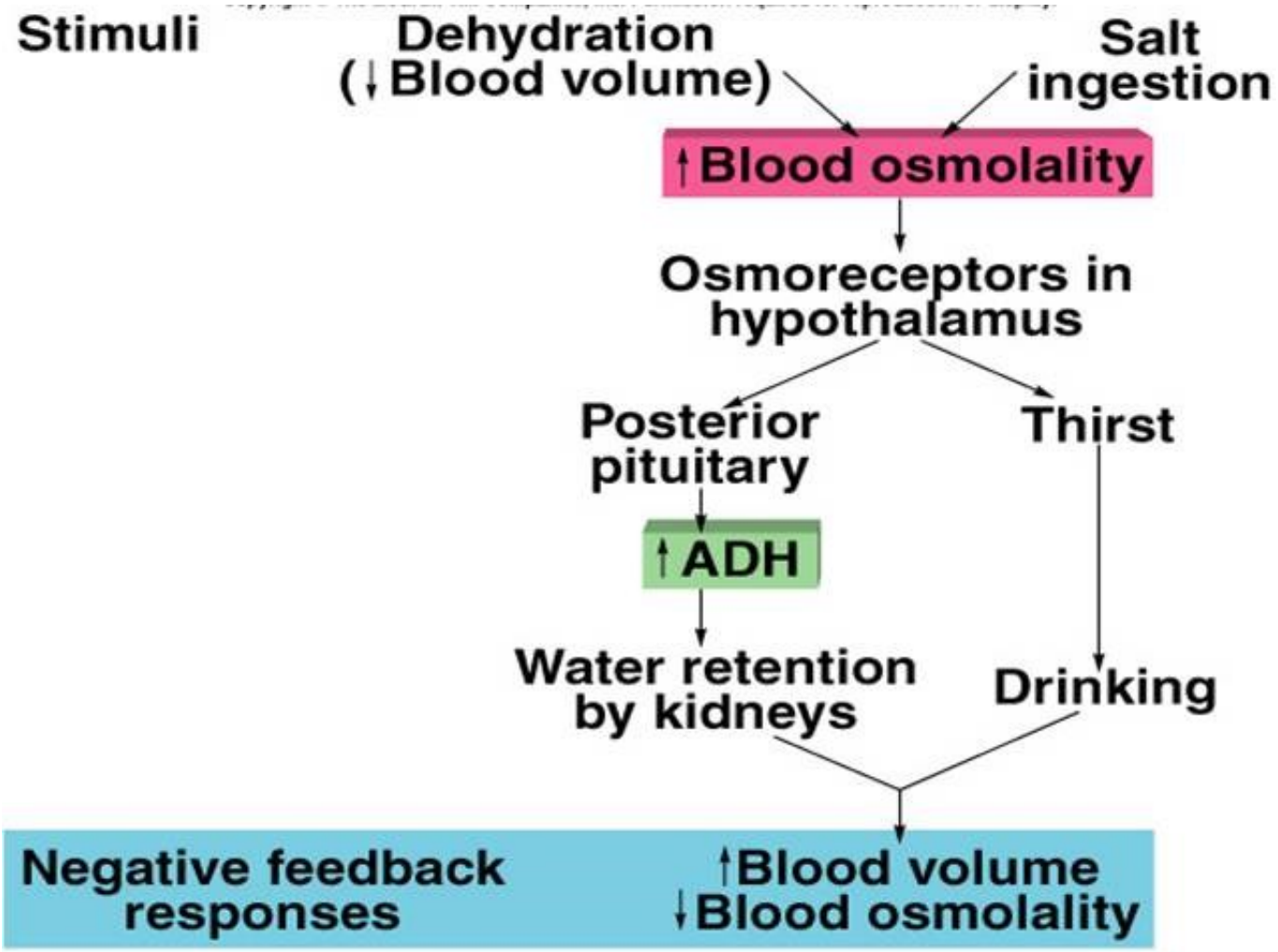


# Body Fluid Imbalance

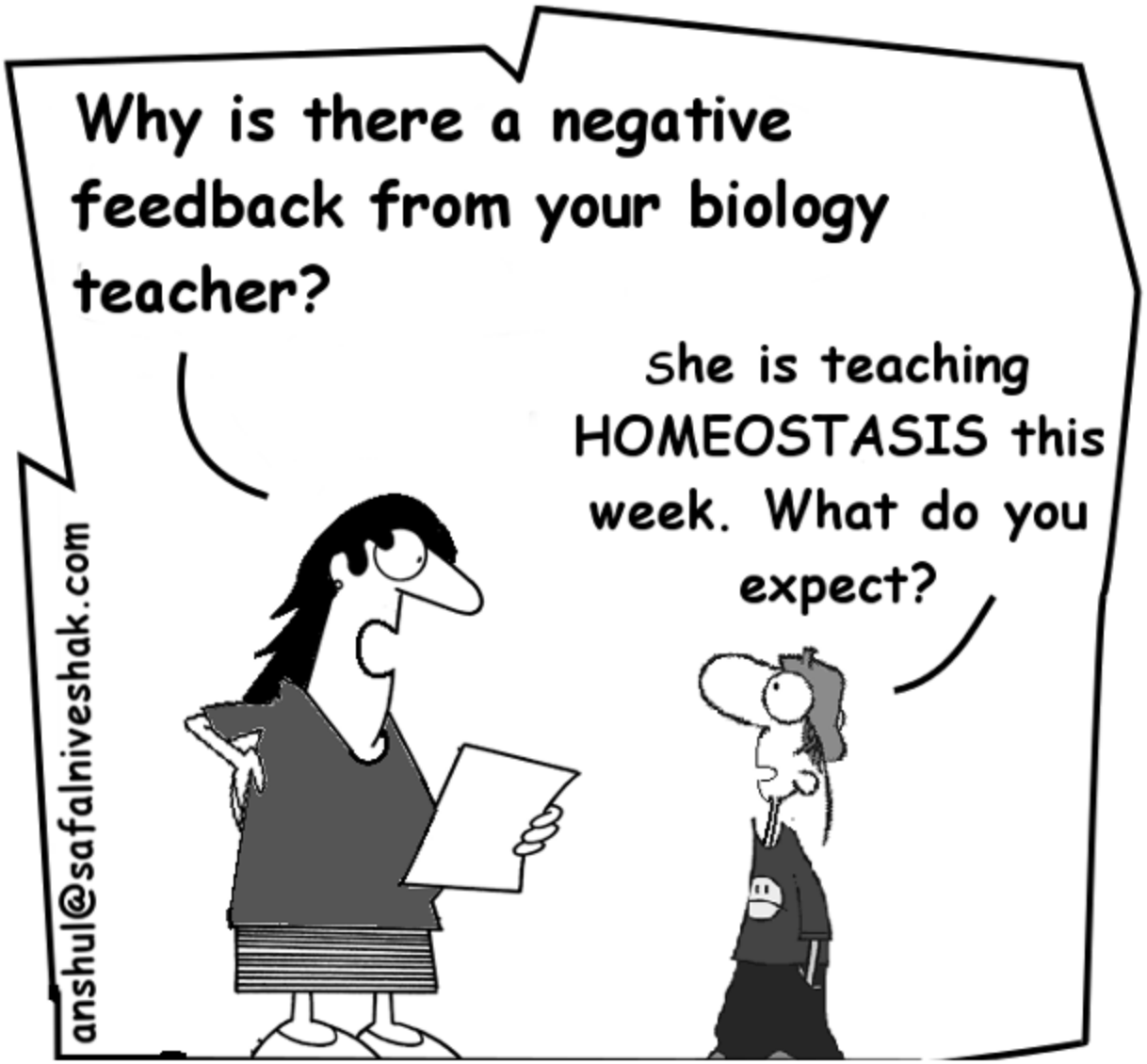
**Body Fluid Imbalance**

- **Volume change**
  - **Volume expansion**
    - Decrease output (kidney failure, SIADH)
    - Increase input (Infusion of excessive IV fluids)
  - **Volume contraction**
    - Increase output (diarrhea, vomiting, diuretics)
    - Decrease input (low intake)
- ***Commonly both occur together***
- **Osmolarity change**
  - **Hyper-osmolarity**
    - Excessive salt intake
    - Loss of water more than solutes
  - **Hypo-osmolarity**
    - Loss of salts (diuretics)
    - Gain of water more than solutes (SIADH)

# What are the feedback mechanisms operating in Fluid balance control?




DIGESTIVE SYSTEM
RESPIRATORY SYSTEM
CIRCULATORY SYSTEM
SKELETAL SYSTEM
MUSCLE SYSTEM
NERVOUS SYSTEM
ENDOCRINE SYSTEM
REPRODUCTIVE SYSTEM


Why is there a negative feedback from your biology teacher?
She is teaching HOMEOSTASIS this week. What do you expect?
anshul@safalniveshak.com


DIGESTIVE SYSTEM
RESPIRATORY SYSTEM
CIRCULATORY SYSTEM
SKELETAL SYSTEM
MUSCLE SYSTEM
NERVOUS SYSTEM
ENDOCRINE SYSTEM
REPRODUCTIVE SYSTEM

# Thank you