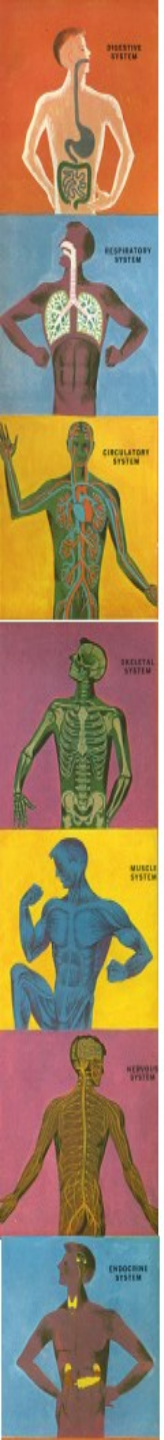
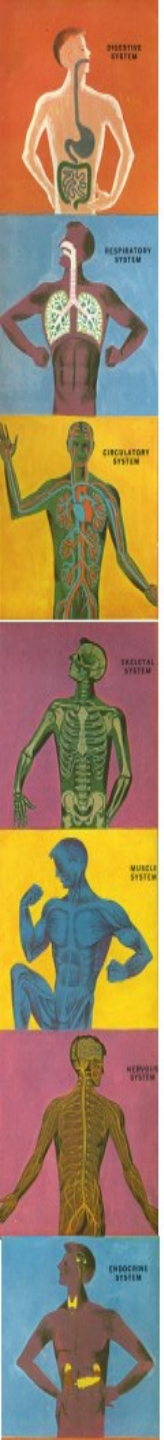


Homeostasis

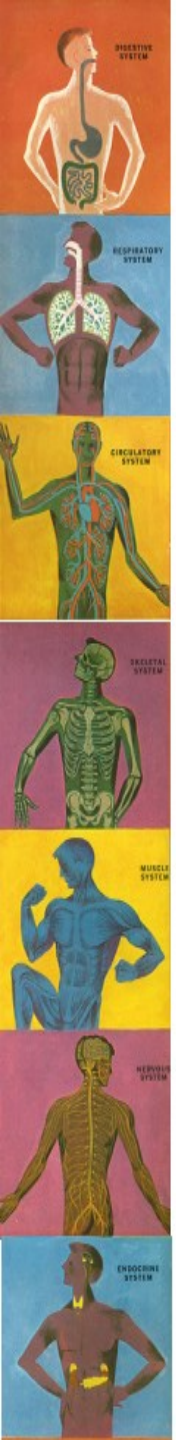
Dr. Maha Saja
Physiology department,
Level 2,
Office 89,
Email: msaja@ksu.edu.sa



Objectives

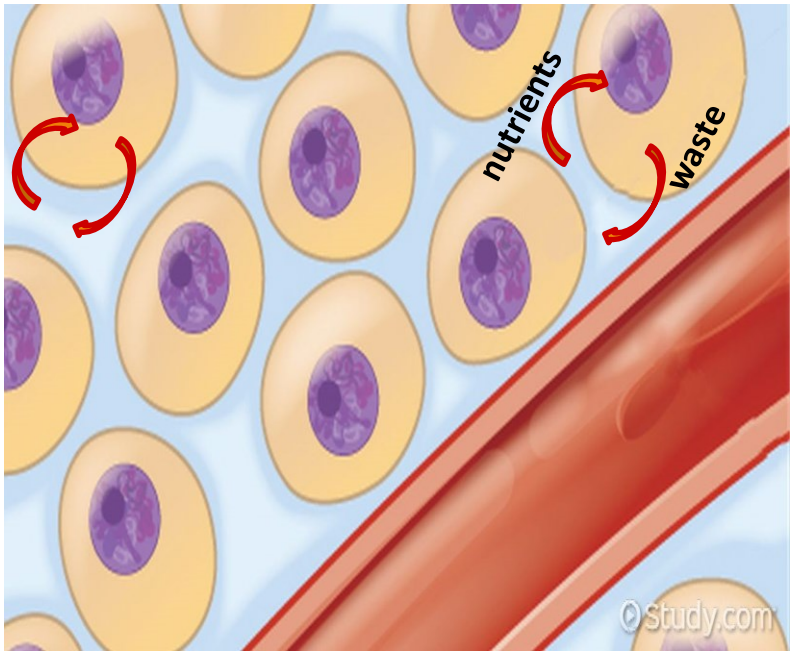
- Define the concept of the “internal environment” and state its physiologic importance.
- Differentiate between the external and internal environments.
- Define and discuss the concept of homeostasis and its importance to the living organism.
- Discuss the physiologic control mechanisms that enable 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.

Study source for this lecture:
(Guyton & Hall Textbook of Medical Physiology, 13th ed, Chapter 1)



The Internal Environment
"Milieu Intérieur"

- All the cells in the body are continuously bathing in fluid.
- Because this fluid is ***outside*** the cell, it is called **extracellular fluid** (***ECF***).
- It is from the ECF that cells get the ions and nutrients needed to maintain life.



Because,

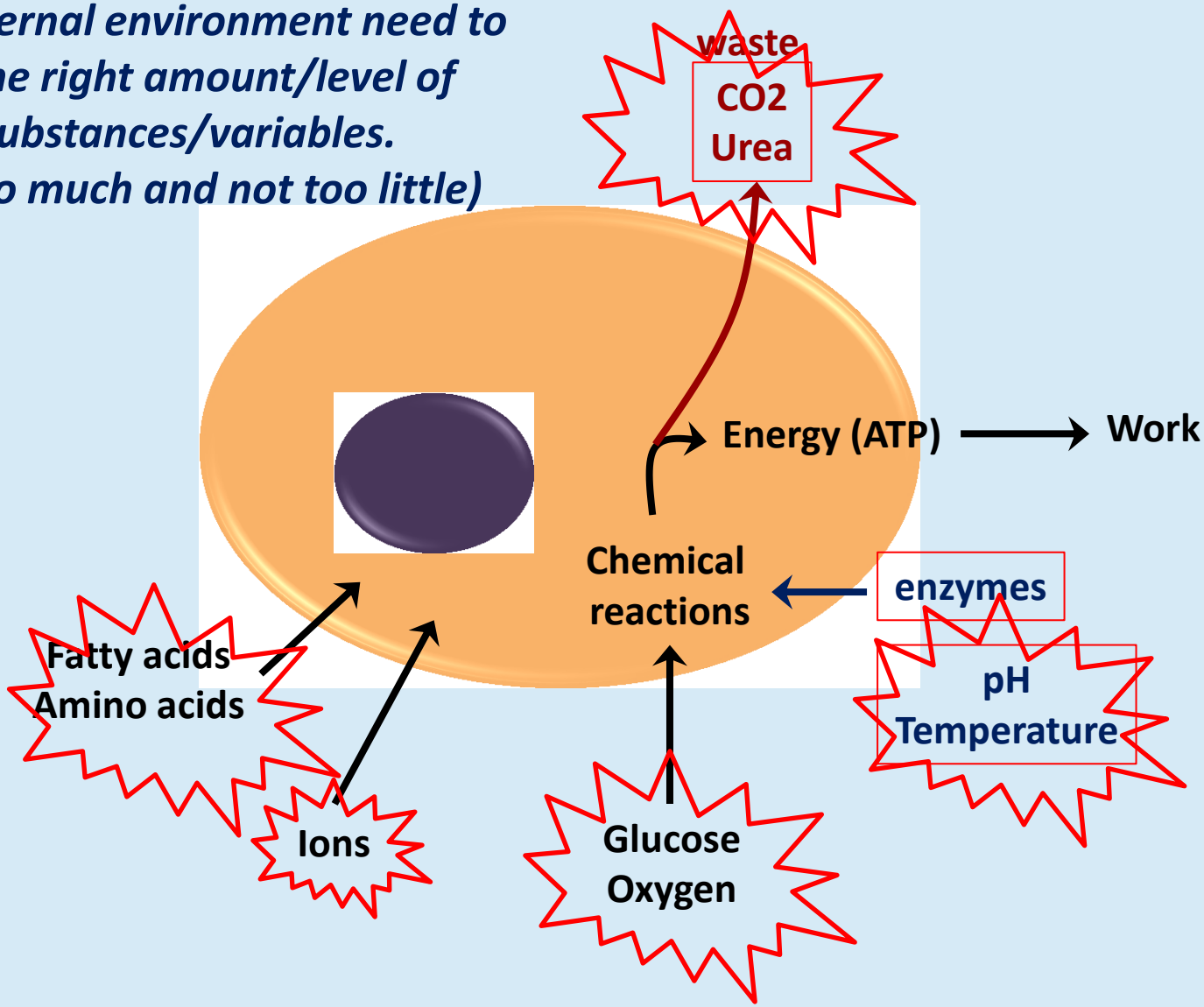
- ➢All body cells live in the same environment (i.e. ECF).
- ➢The composition of ECF is almost similar between the different species.

It was named the "***internal environment***" by the French physiologist Claude Bernard.

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

In order for the cell to function properly,

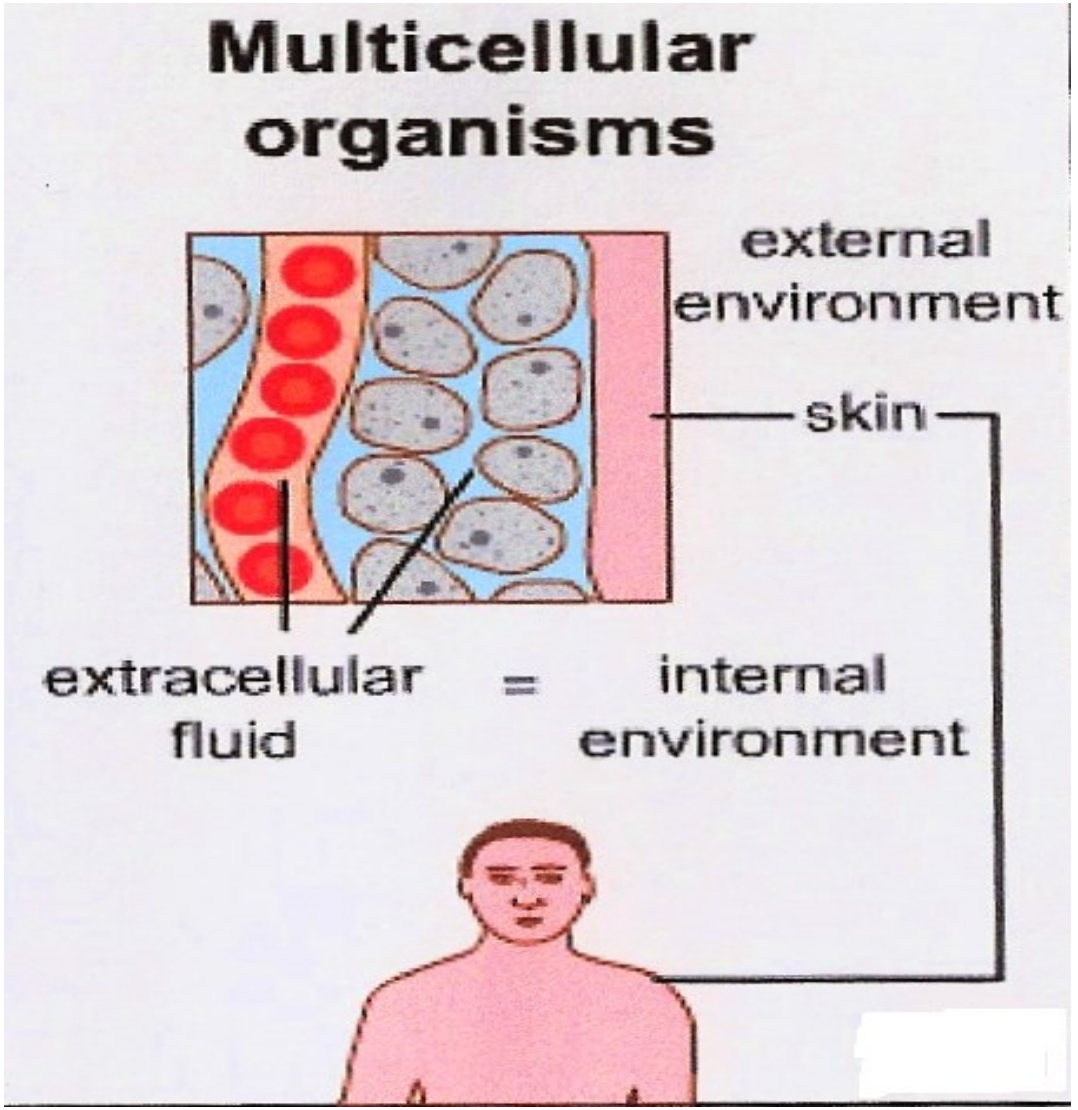
The internal environment need to have the right amount/level of these substances/variables. (not too much and not too little)

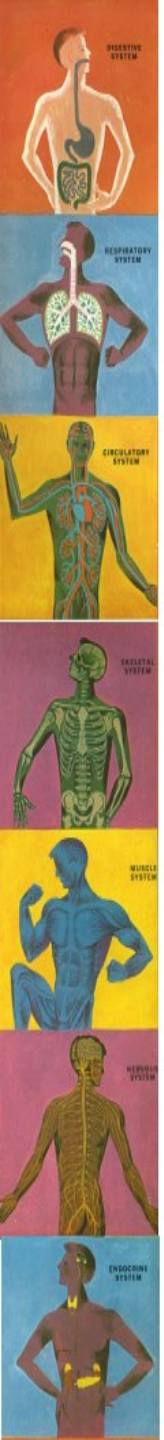


(Mr. Ford's class-Introduction to anatomy and physiology-youtube)

External vs Internal environment

- ***ECF = the internal environment***.
- The skin separates this environment from the outside world which known as the ***external environment***.

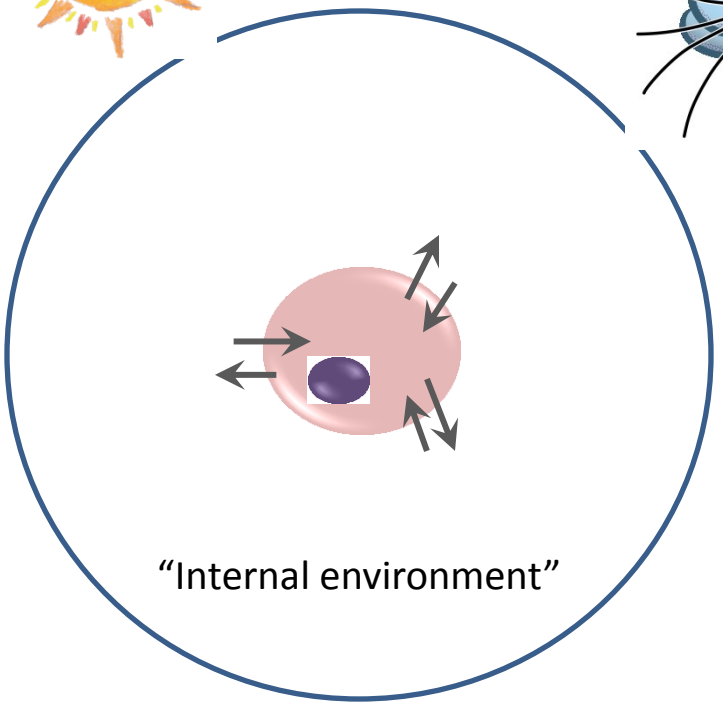




External vs Internal environment

In Multicellular organisms

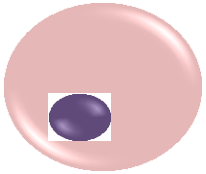
"External environment"



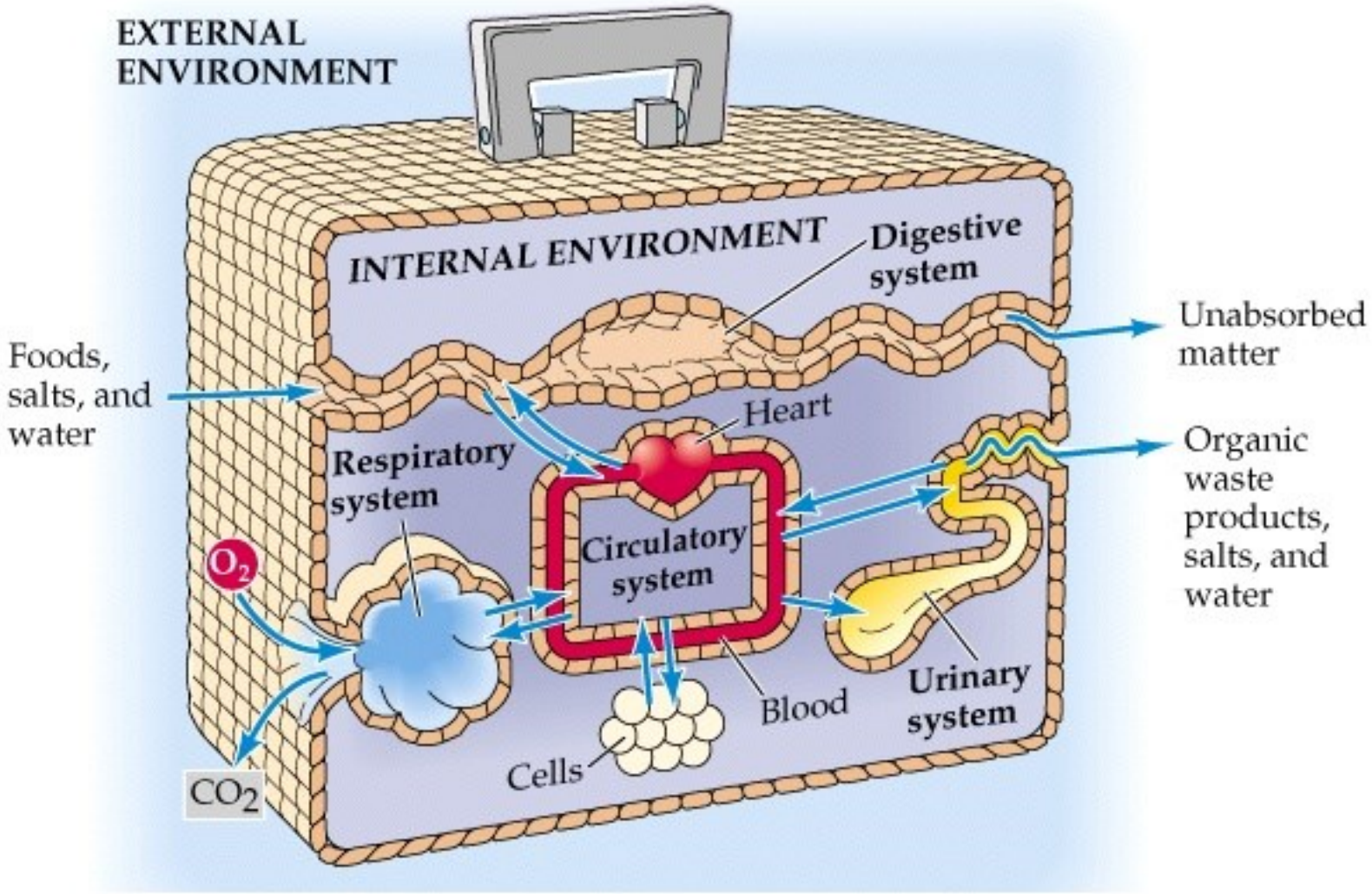
"Internal environment"

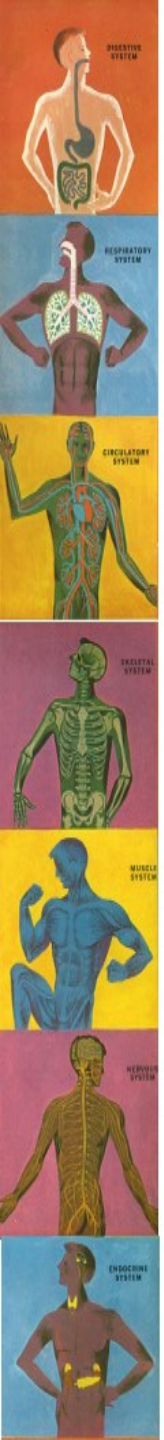
In Unicellular organisms

Internal environment = External environment



External vs Internal environment

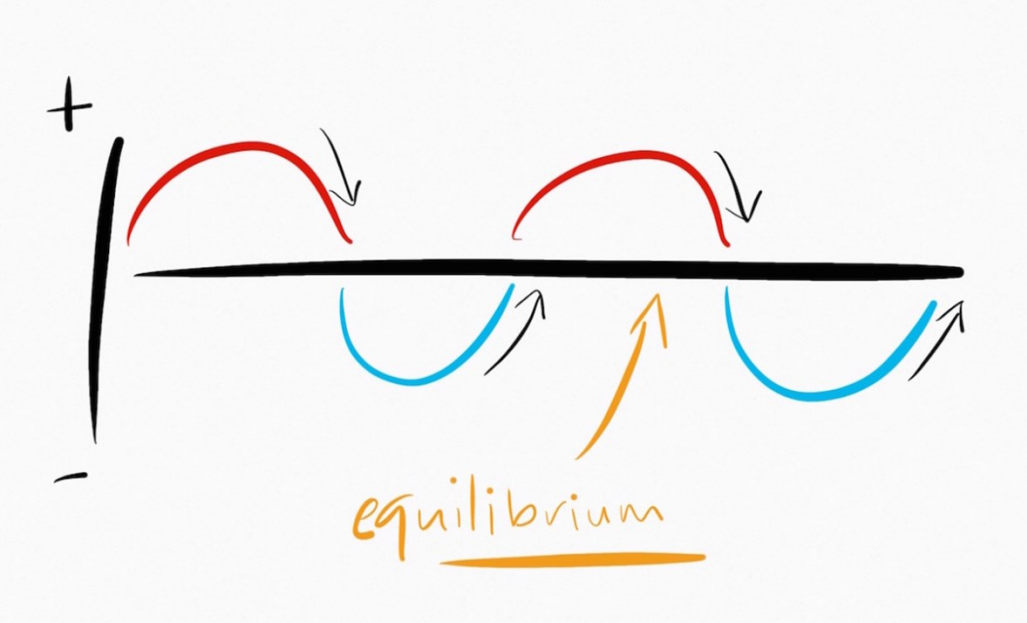




Homeostasis

- 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)

Control systems

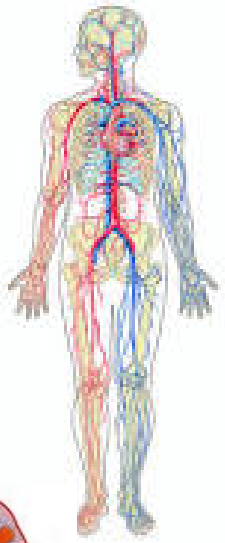
Nervous system

Endocrine systems

Protection

Skin

Immune system



O_2

CO_2

Internal environment

End metabolic products

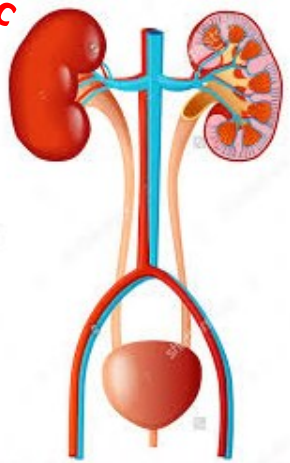
Detoxify

Feces

Nutrients

Ions

H_2O



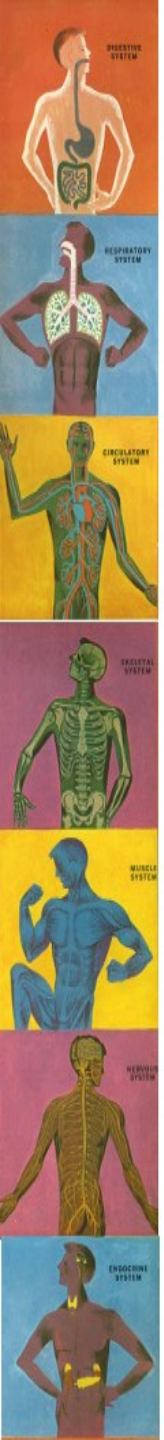
Body constituents are normally regulated within a range rather than a fixed value;

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***.

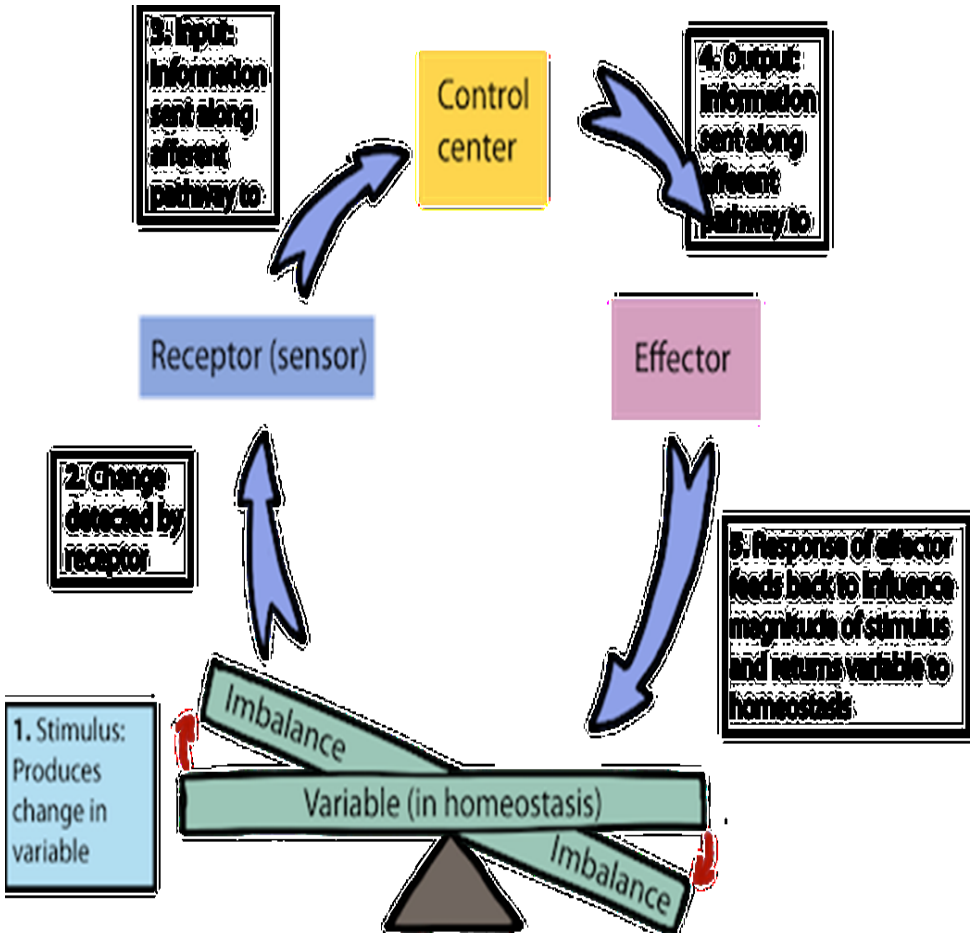
How is this achieved?

By feedback mechanisms

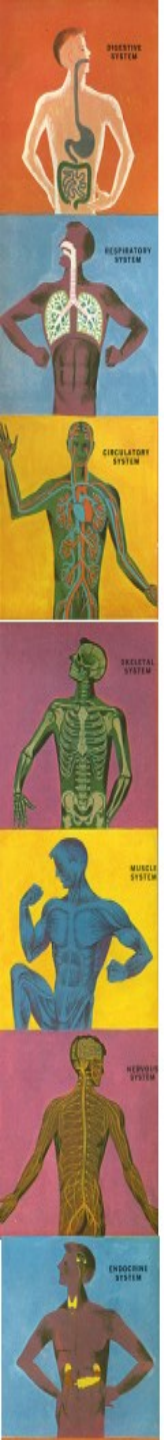
Feedback Mechanisms

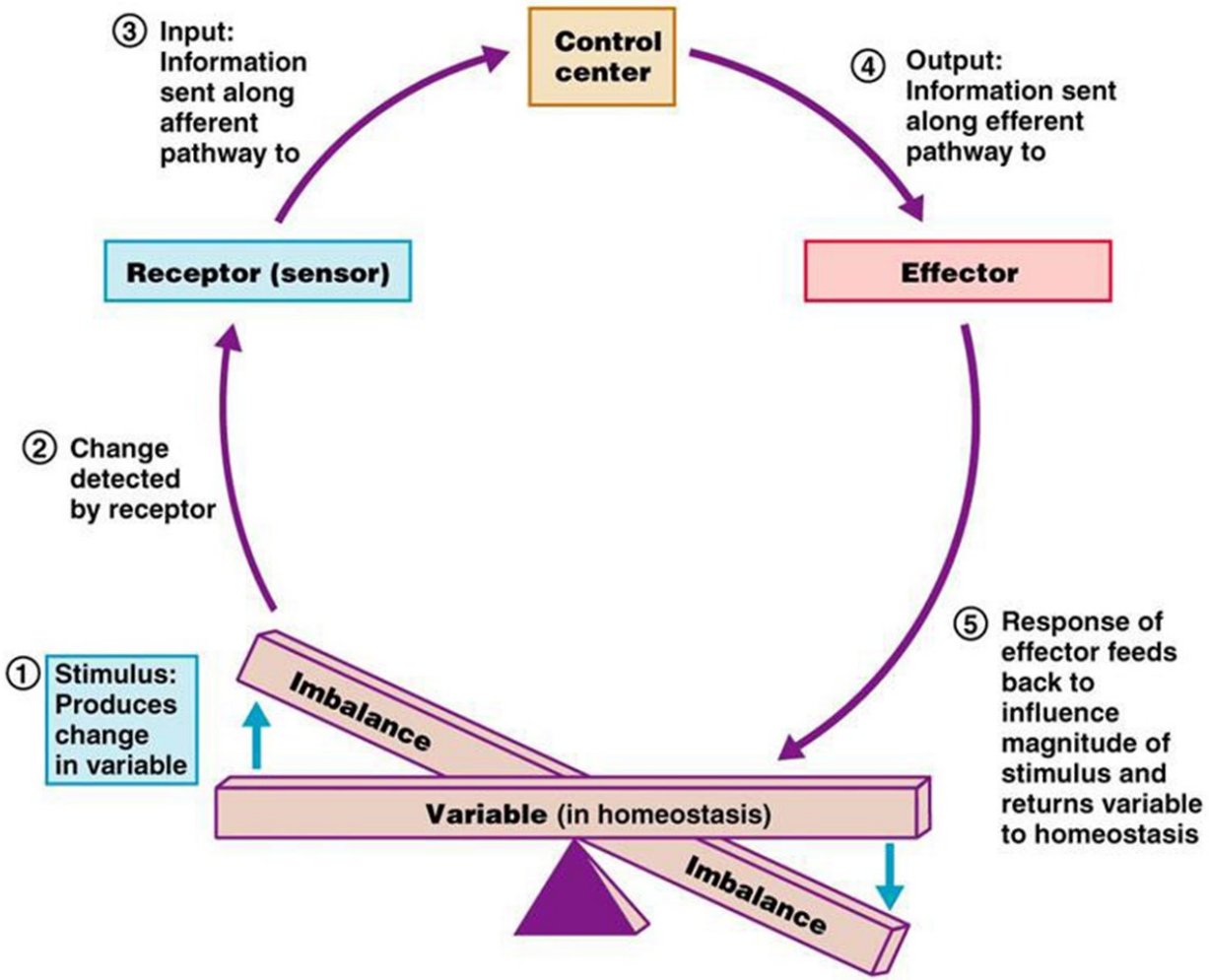
What is meant by feedback?

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

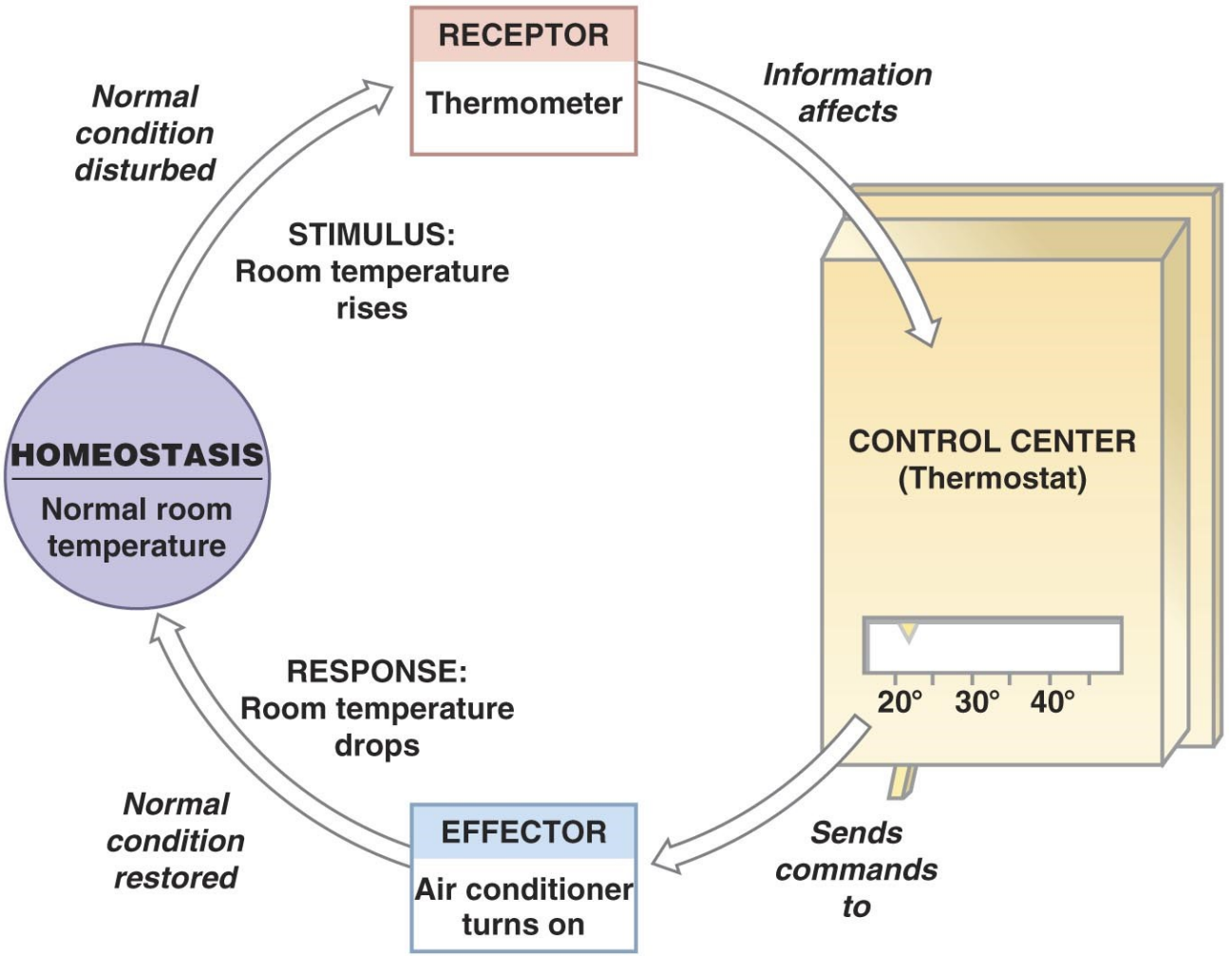


What are the components of a feedback mechanism?





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;

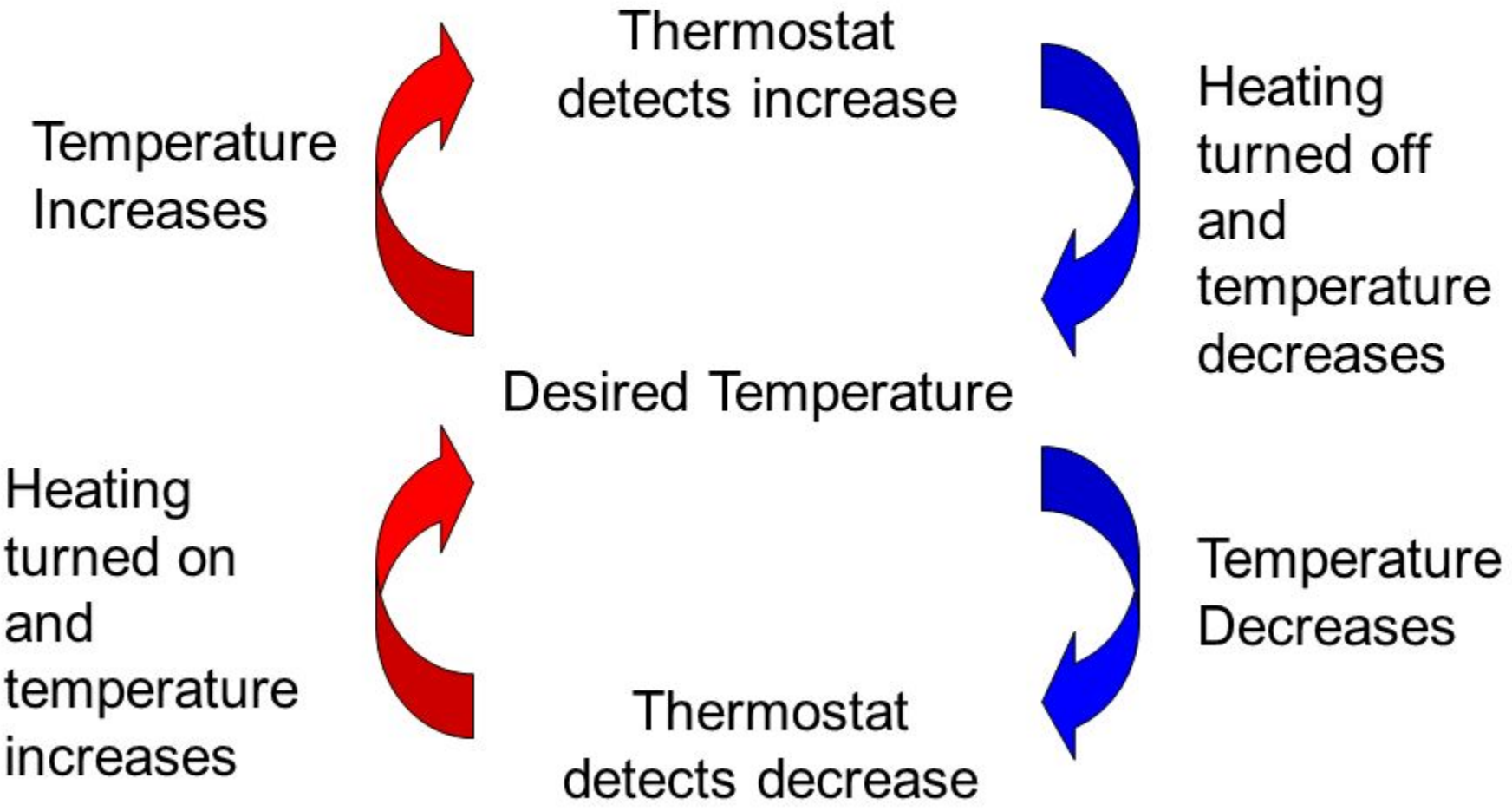
- In nerve signaling, ***entry of a small amount of Na+*** into the cell will open more Na+ channels ***causing more Na+ to enter the cell***.

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

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

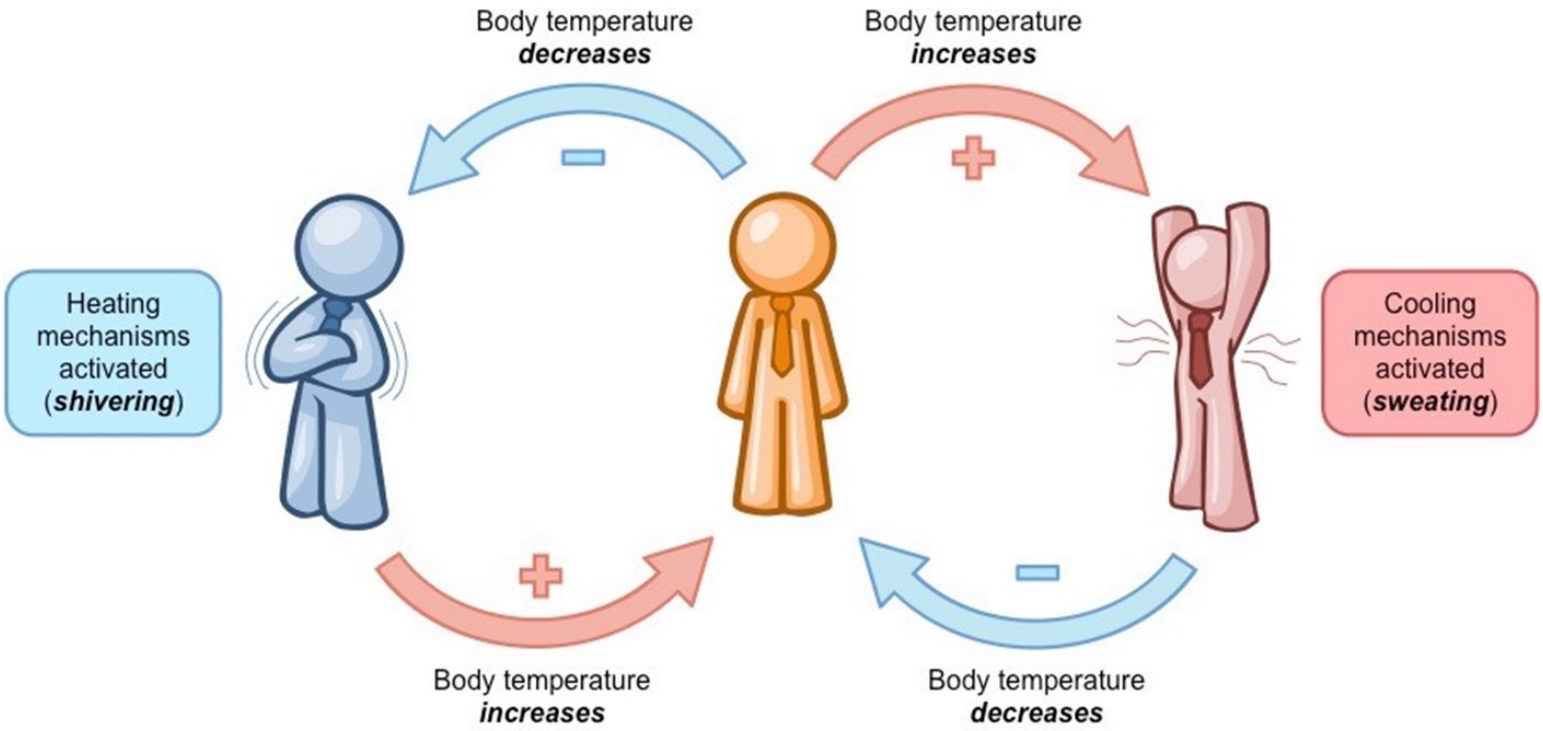
Negative Feedback

(thermostat analogy)

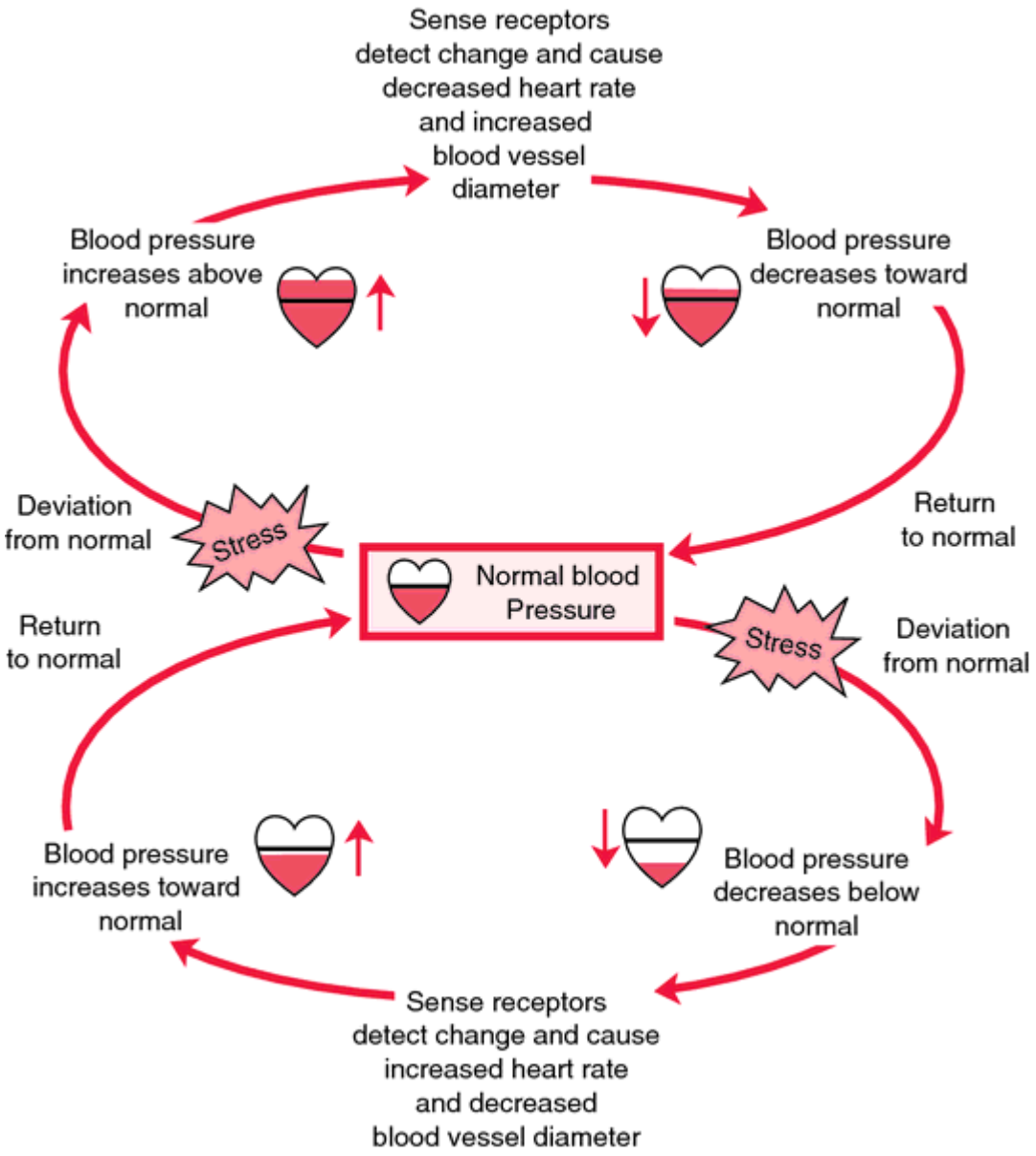


Examples of Negative Feedback Mechanisms

Body temperature control

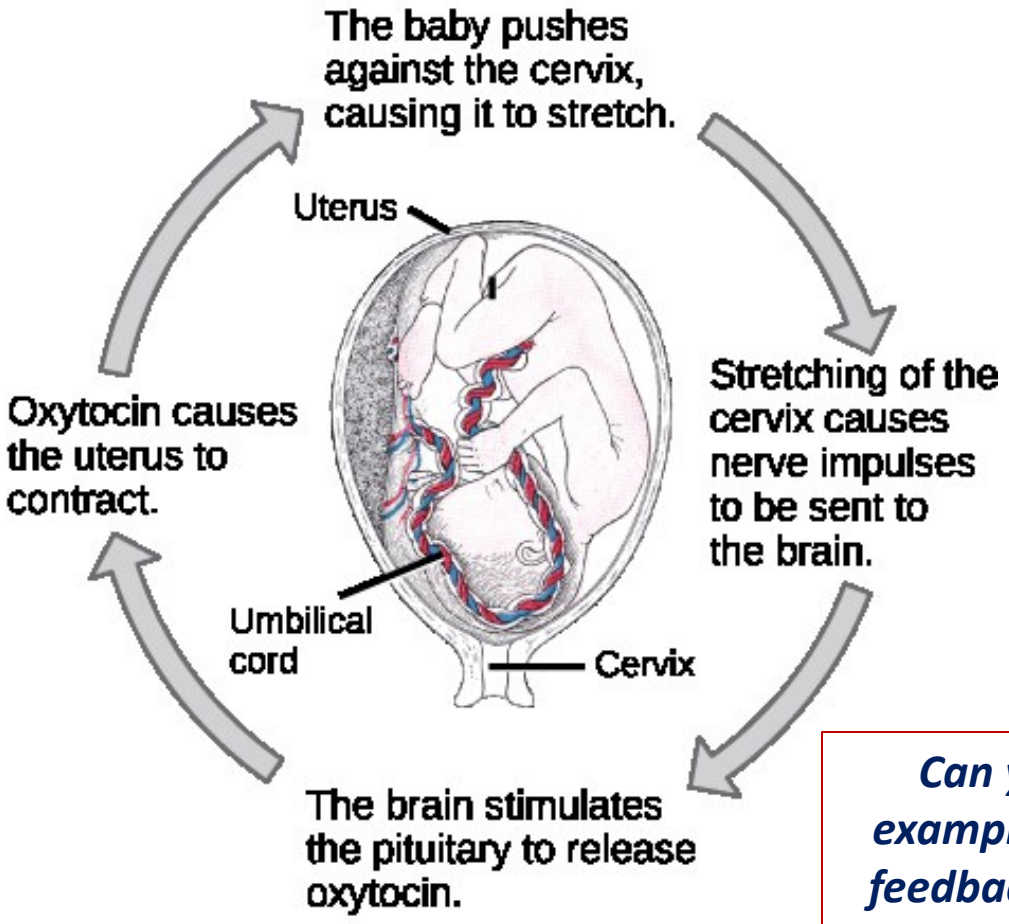


Blood pressure control



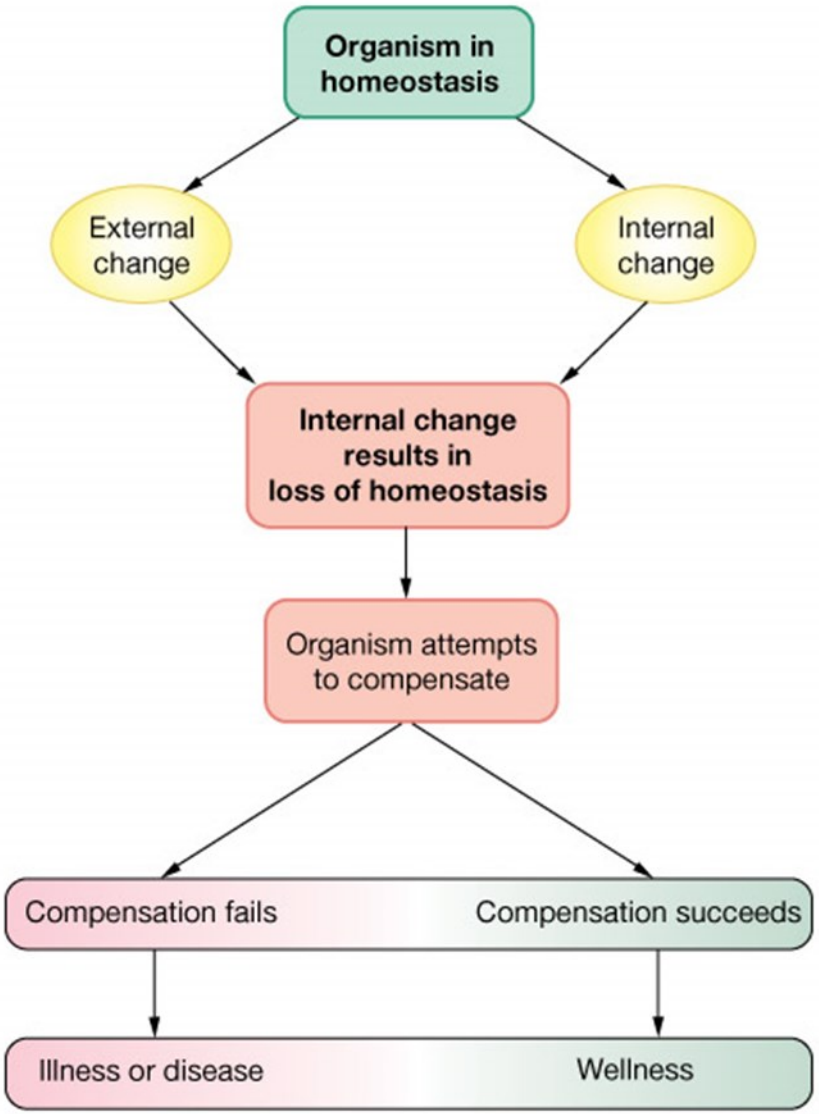
Examples of Positive Feedback Mechanisms

Childbirth

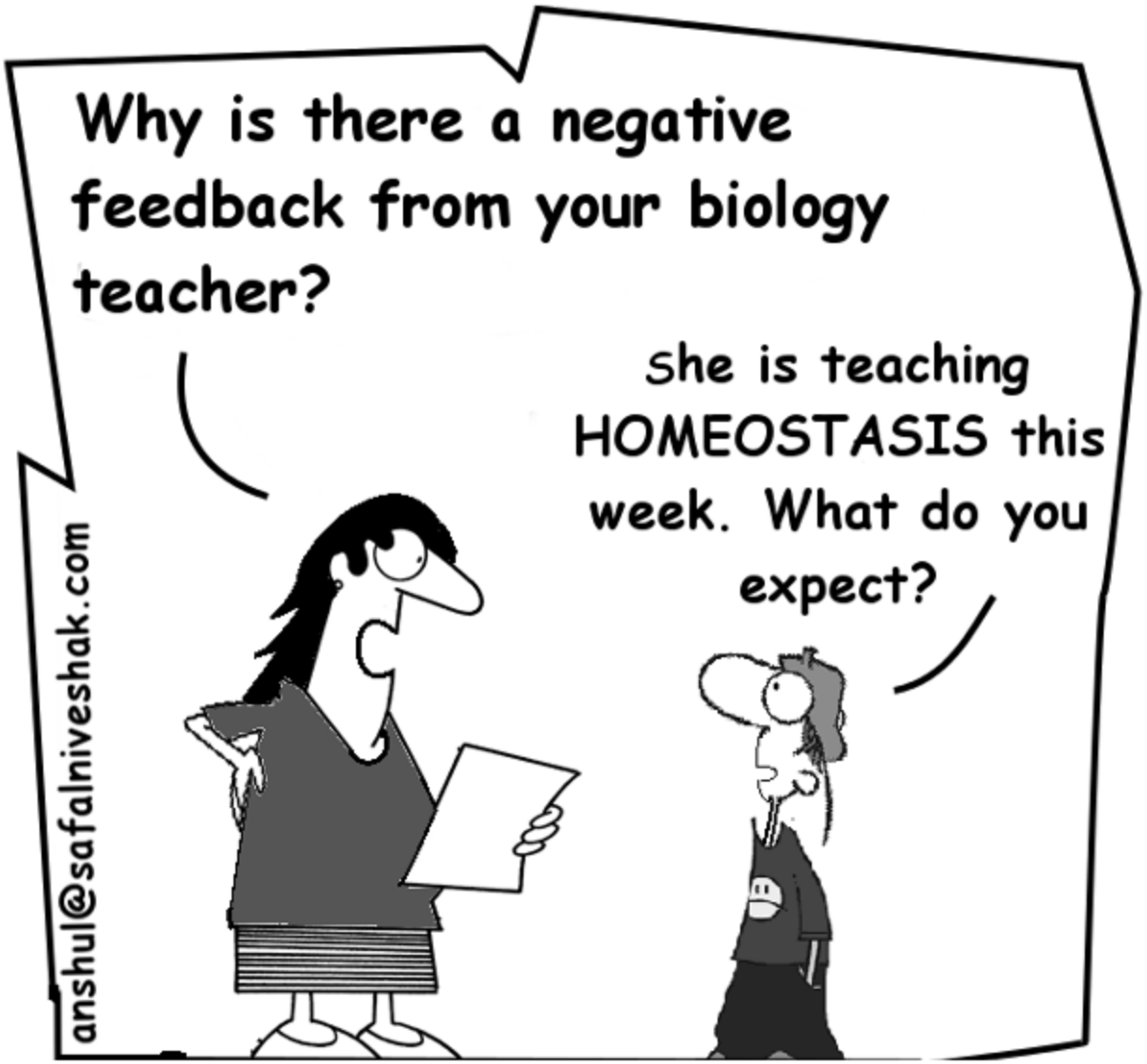


Can you find other examples for a positive feedback mechanism in the body?

Disease is a state of disturbed homeostasis




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