Overview of Human Physiology, Homeostasis and Control System

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STUDY OBJECTIVES

By the end of the lecture the student will able

- To have an overview of human physiology.
- To appreciate the role of physiology in understanding the principles of medical practice.
- To understand how the different body systems contribute towards achieving homeostasis.
- To give the examples of homeostatic regulations.
- To describe the body control mechanisms.
- To explain the differences between negative and positive feedback and discuss their relationship to homeostasis.

Body Systems

Circulatory system
heart, blood vessels, blood

Digestive system
mouth, pharynx, esophagus, stomach, small intestine, large intestine, salivary glands, exocrine pancreas, liver, gallbladder

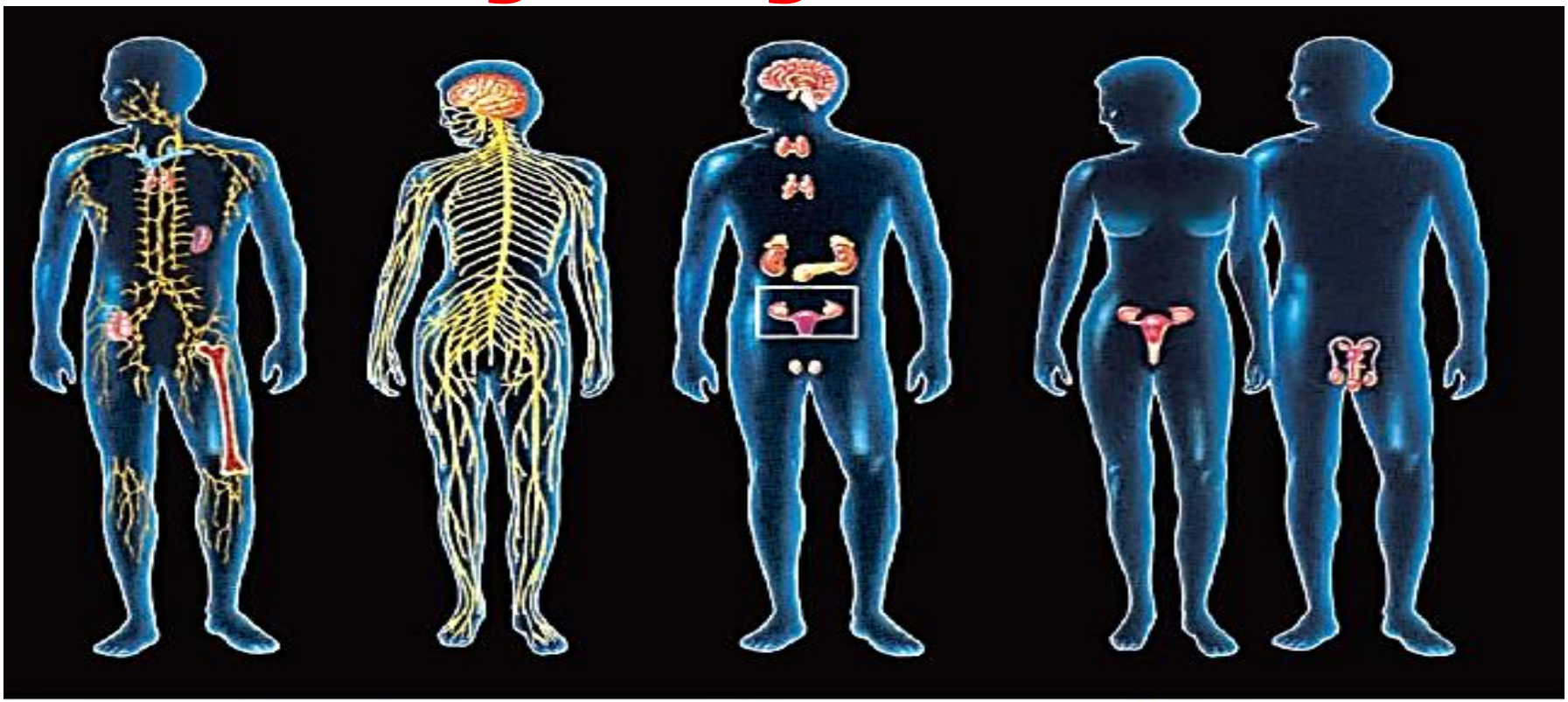
Respiratory system
nose, pharynx, larynx, trachea, bronchi, lungs

Urinary system
kidneys, ureters, urinary bladder, urethra

Skeletal system
bones, cartilage, joints

Muscular system
skeletal muscles

Body Systems



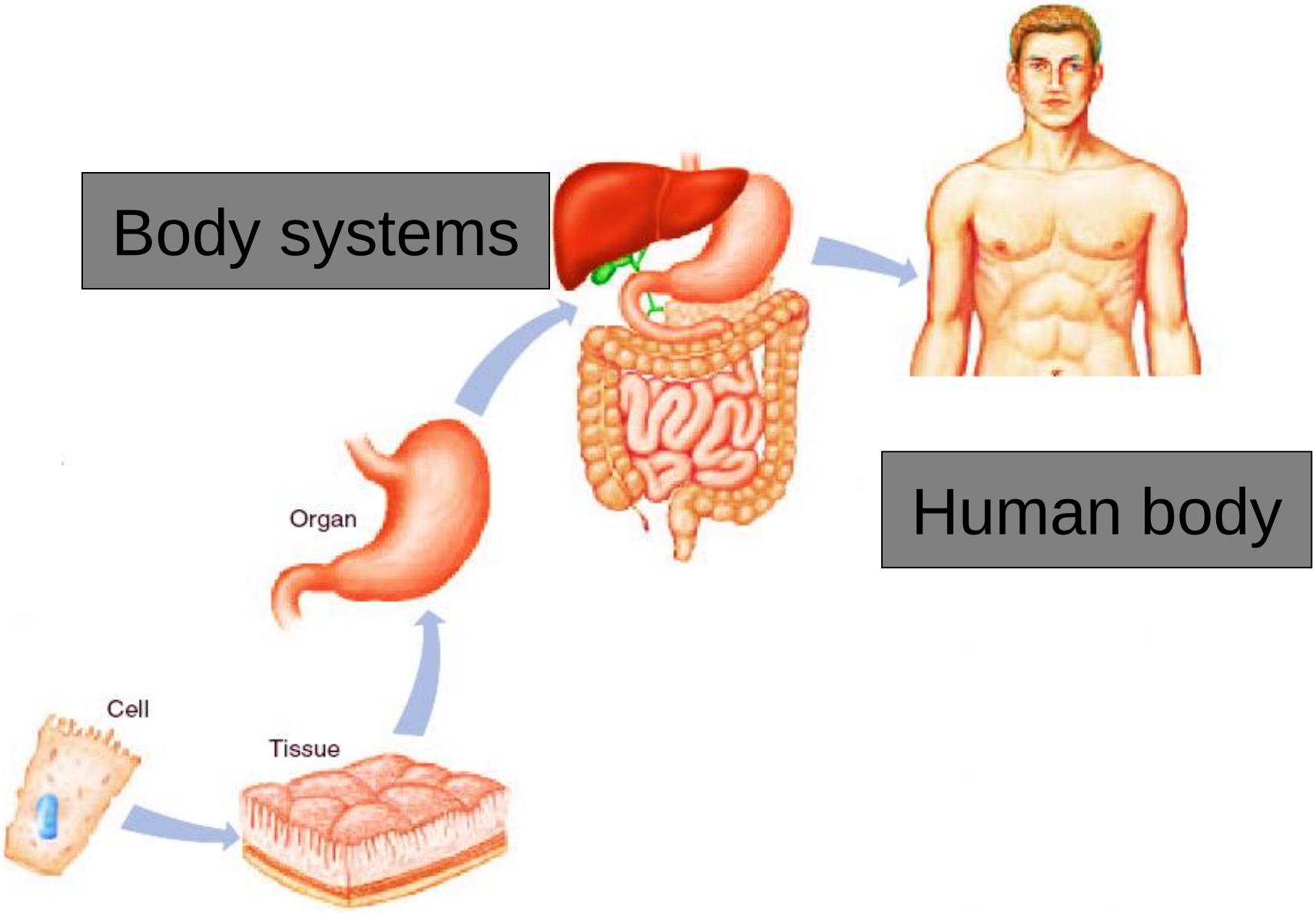
Immune system
lymph nodes, thymus, bone marrow, tonsils, adenoids, spleen, appendix, white blood cells (not shown), and mucosa-associated lymphoid tissue

Nervous system
brain, spinal cord, peripheral nerves, special sense organs (not shown)

Endocrine system
all hormone-secreting tissues, including hypothalamus, pituitary, thyroid, adrenals, endocrine pancreas, gonads, kidneys, pineal, thymus, and, not shown, parathyroids, intestine, heart, skin, and adipose tissue

Reproductive system
Male: testes, penis, prostate gland, seminal vesicles, bulbourethral glands, and associated ducts

Female: ovaries, oviducts, uterus, vagina, breasts



Cell is the structural and functional unit of the body.

Homeostasis

Keeping Everthing in Balance

Homeostasis

A Greek term meaning same state

Definition: It is the keeping of internal environment of the body constant despite large changes in the external environment.

Examples: water content, blood pressure, body temperature, some of hormones, pH and blood glucose levels.

Fill-in-the-Blank Questions:

The _____ is an example of a homeostatic regulation that involves maintaining the balance of water, electrolytes and pH in the body.

Answer: kidneys

Homeostasis

A Greek term meaning same state

Importance:

It is important because the cells and tissues will survive and function efficiently only when these internal conditions are properly maintained.

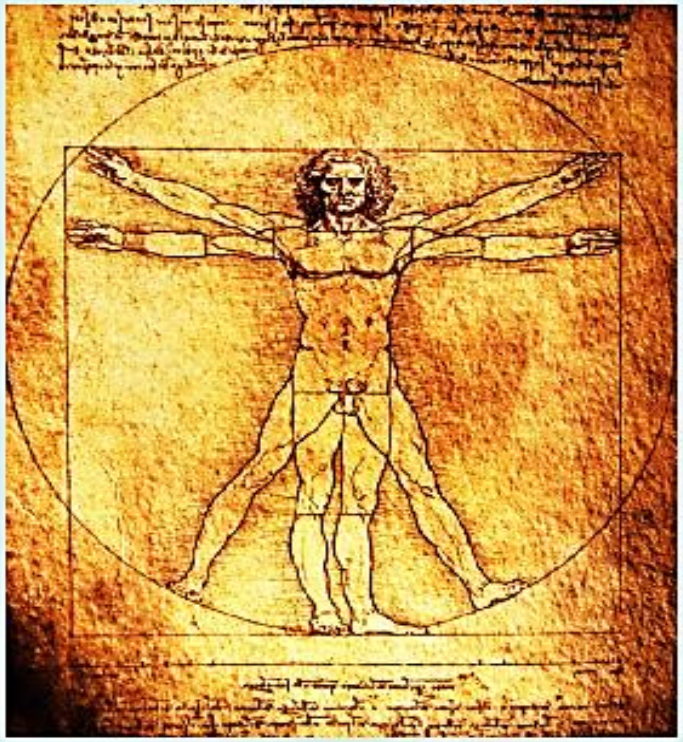
Fill-in-the-Blank Question:

Homeostasis is essential for the survival of _____.

Answer: cells

Homeostasis

Body systems maintain homeostasis



Homeostasis

Homeostasis is the maintenance by the highly coordinated, regulated actions of the body systems of relatively stable chemical and physical conditions in the internal fluid environment that bathes the body's cells.

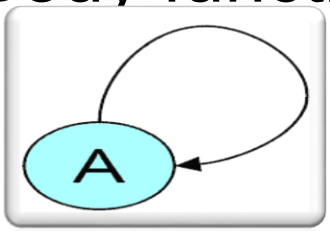
Homeostasis is essential for survival of cells

Animal cell cut-away

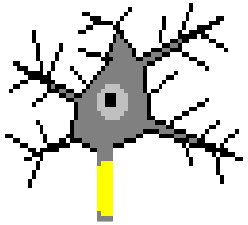
Cells make up body systems

Control of the Body Functions

- Body functions are regulated by **3 systems**:

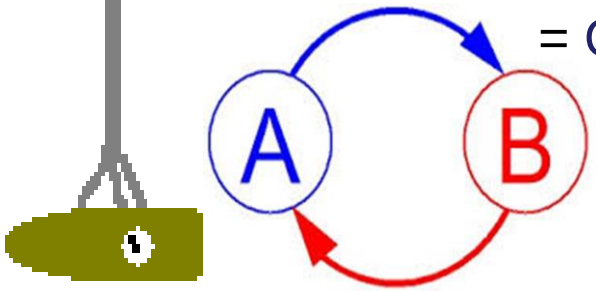


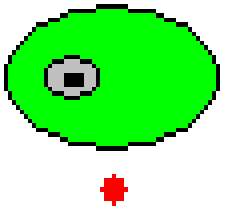
Auto-Regulation



Nervous system

- **Rapid** onset
- **Short** duration

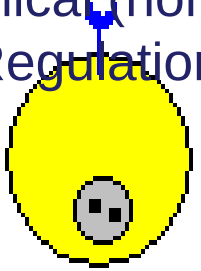




Endocrine system

- **Slow** onset
- **Long** duration

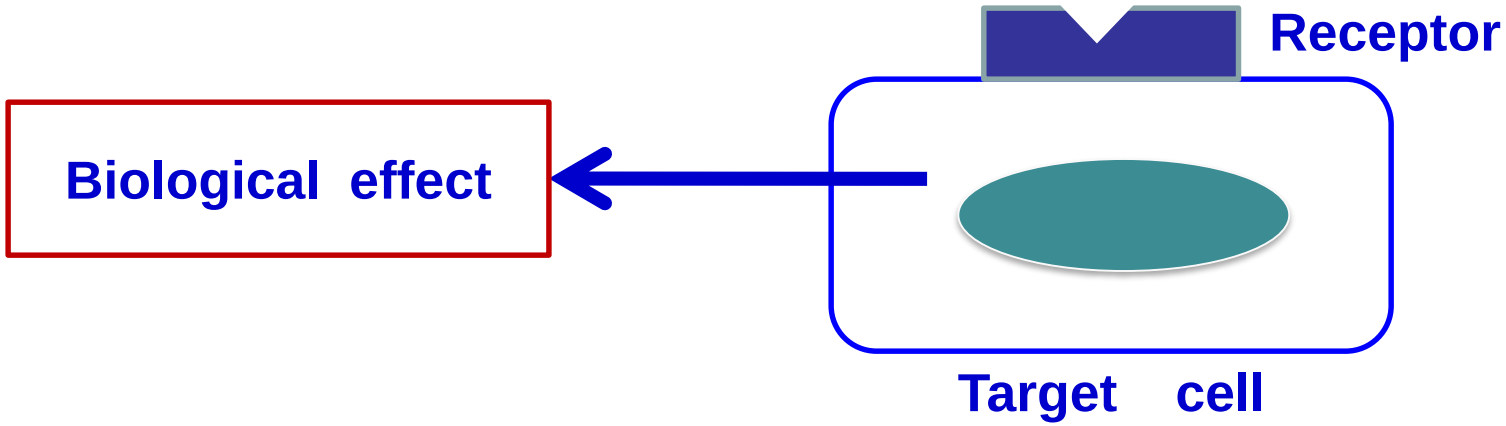
= Chemical (hormonal) Regulation



The _____ system is responsible for rapid, short-term responses to changes in the internal or external environment, while the _____ system is responsible for slower, long-term regulation

Answer: nervous, hormonal

Endocrine system



Control of the Body Functions

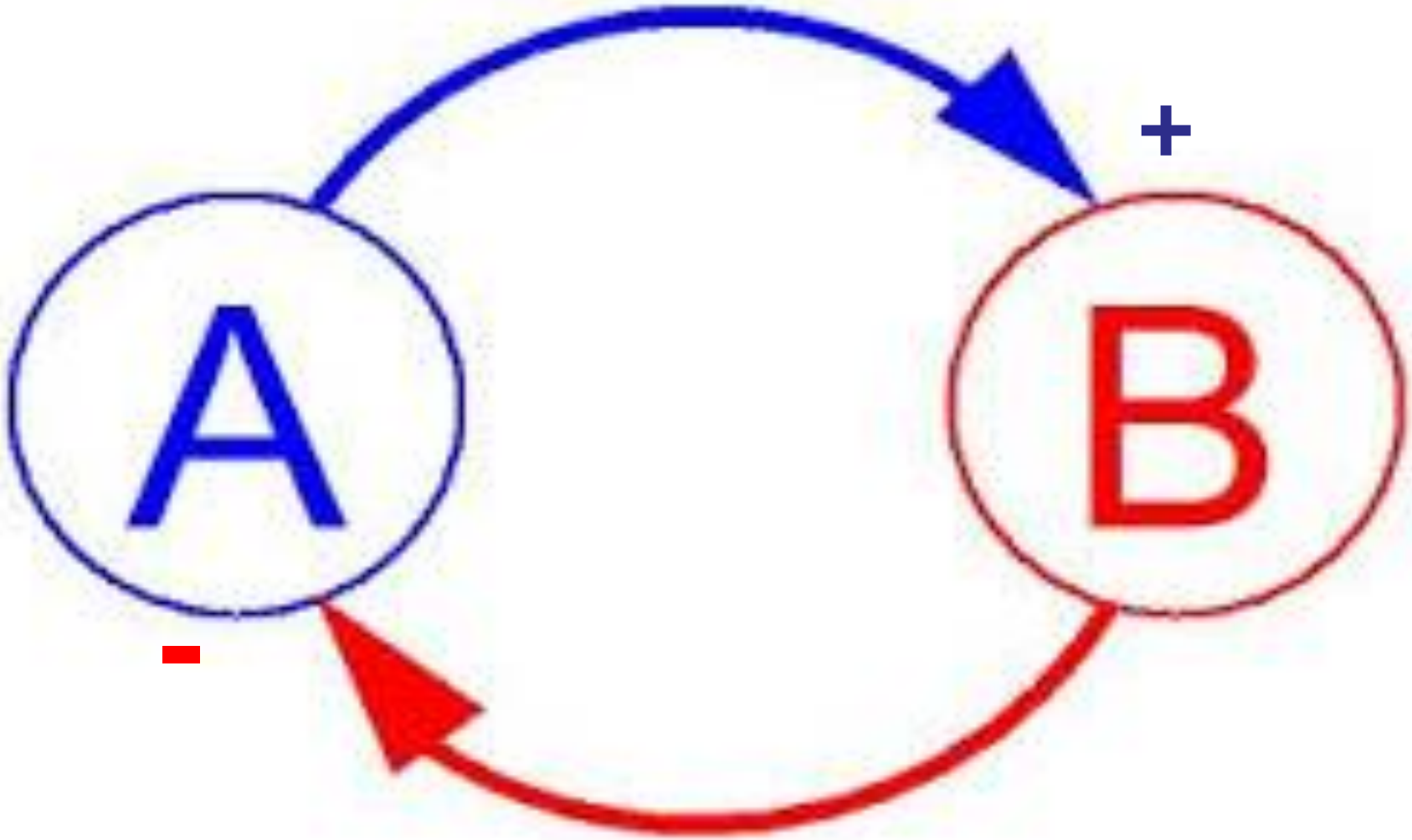
- The three regulations have coordinated and acts as one system, “feedback control system”. It consists of two forms:
  - **Negative** feedback mechanism.
  - **Positive** feedback mechanism.

Fill-in-the-Blank Questions

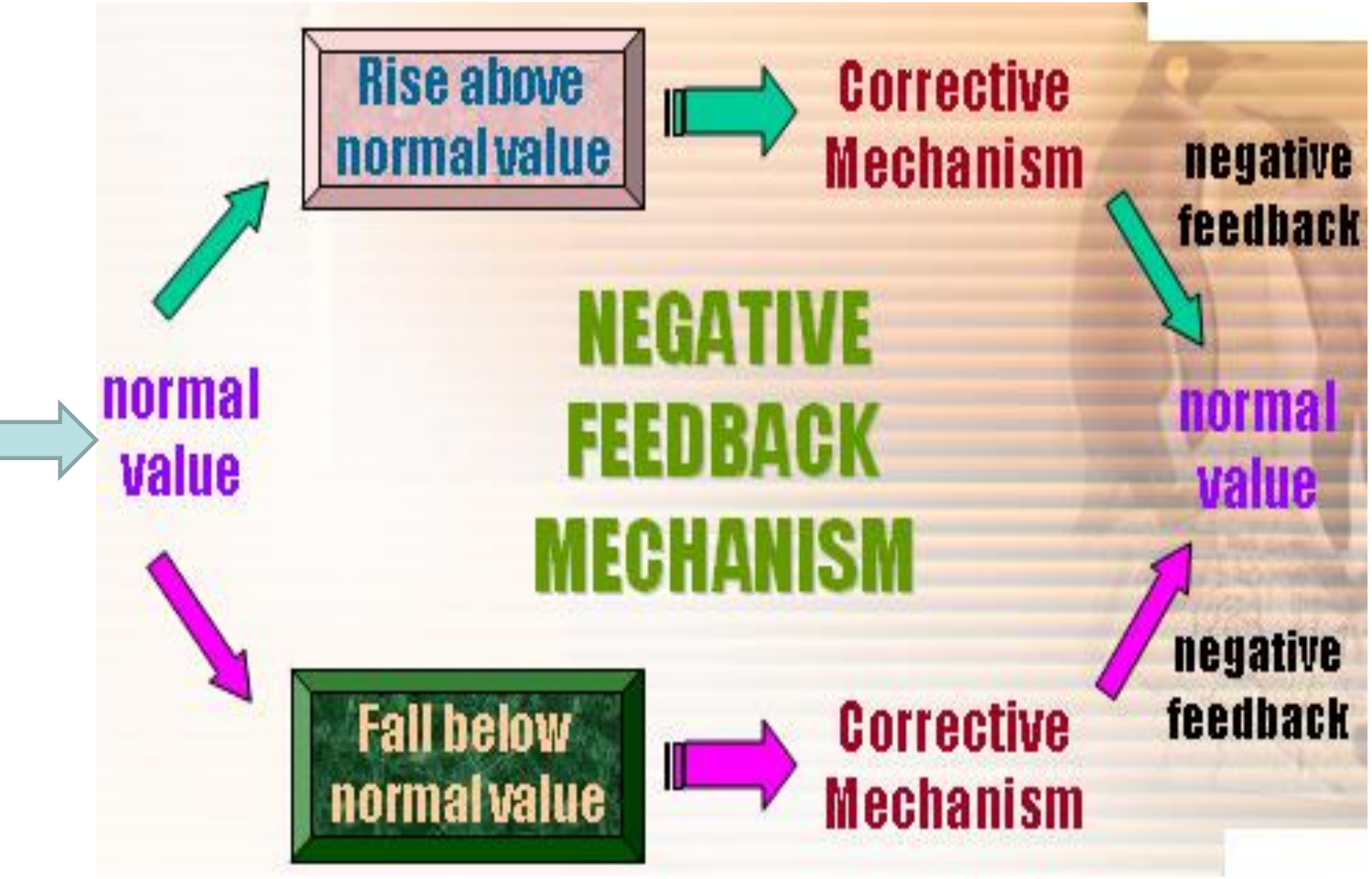
The coordinated and regulated actions of the body systems to maintain relatively stable internal conditions is described as a _____ control system.

Answer: feedback

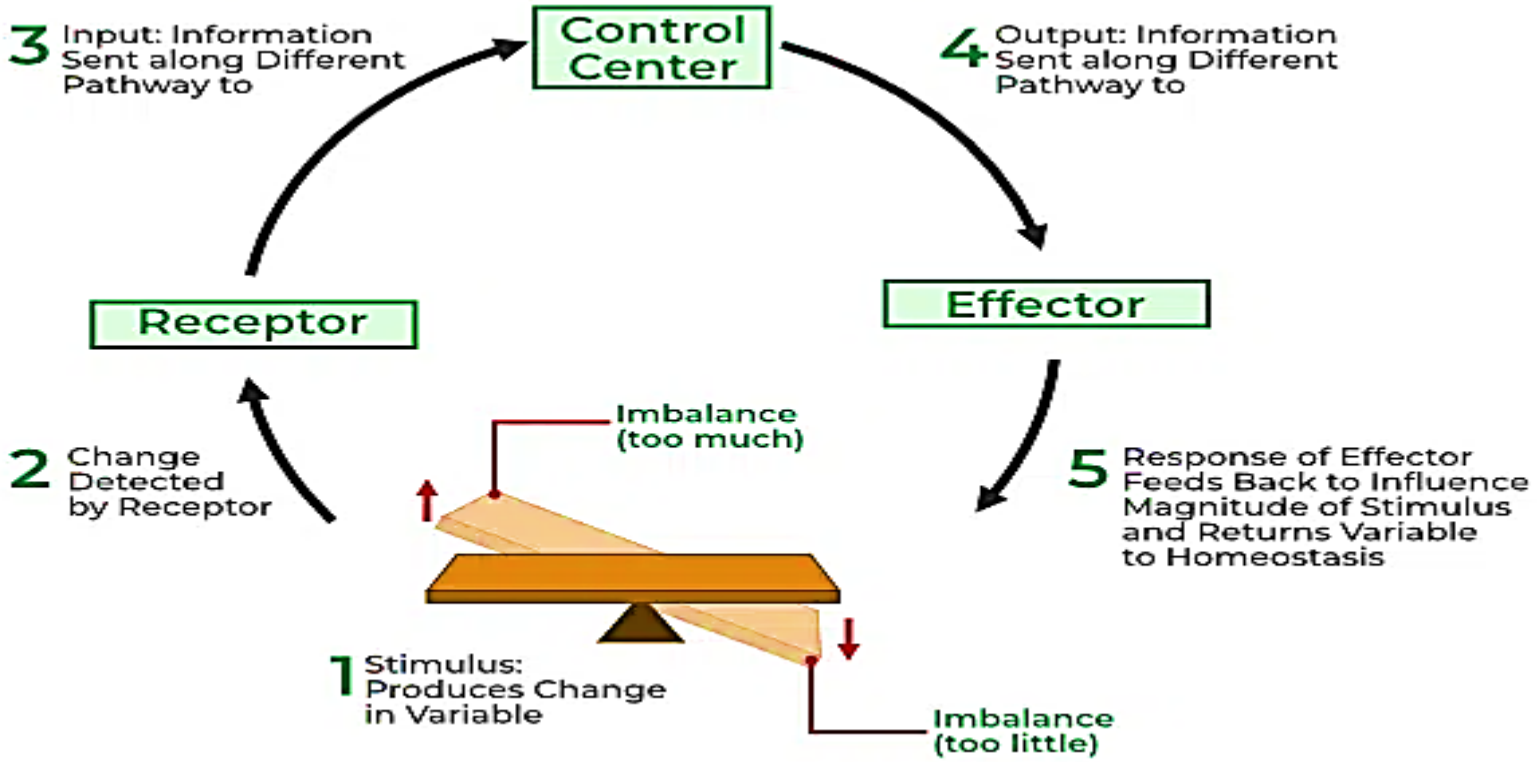
Negative Feedback



Negative Feedback Mechanism



Negative feedback loop

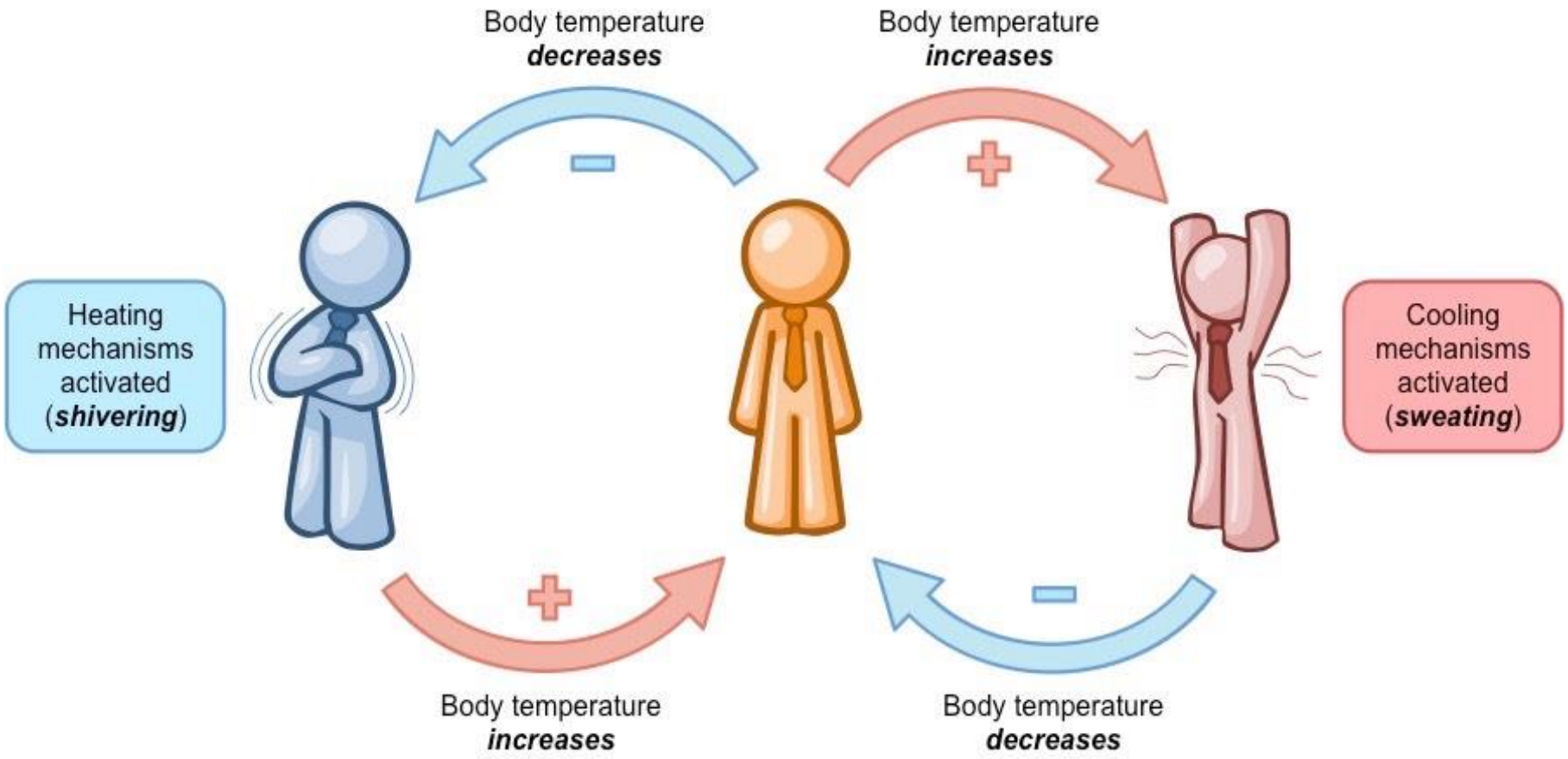


Fill-in-the-Blank Questions:

In a negative feedback loop, the _____ detects changes in the internal environment and sends signals to the _____, which then activates the _____ to counteract the change.

Answer: receptor, control center, effector

Example of Negative Feedback Mechanism



Fill-in-the-Blank Questions:

If the _____ were damaged, the body would lose its ability to regulate temperature, leading to potential _____ or _____ depending on the environment.

Answer: hypothalamus, hyperthermia, hypothermia

Match Question

Regarding to regulation of temperature, Indicate the roles served by each component of this control system using the following answer code:

a. Controlled variable

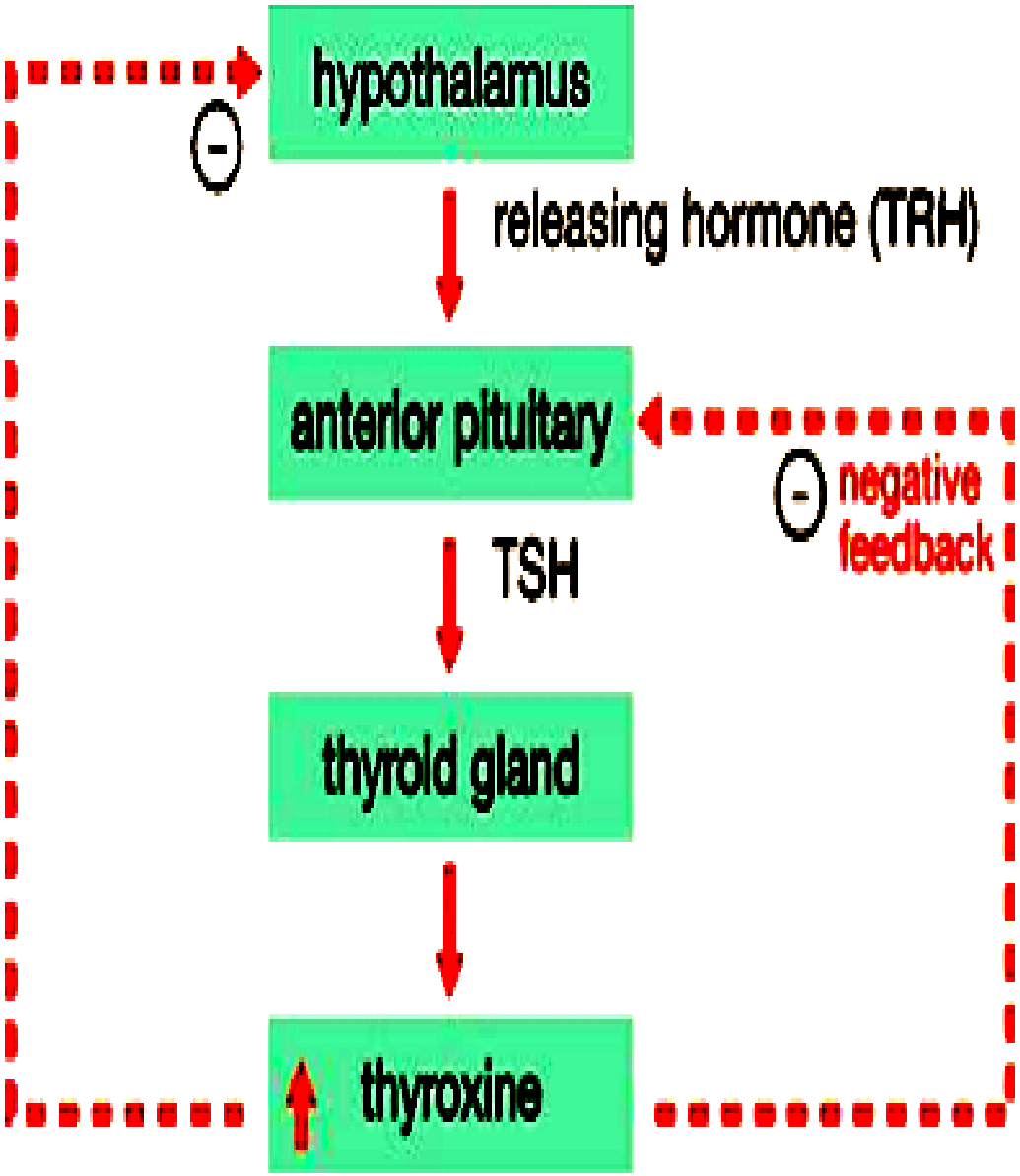
b. Control center c. Sensor d. Effector

1. Sweat gland and skeletal muscles

2.Thermoreceptors 3. Hypothalamus

Answer: 1-D, 2-C, 3-B

Example of Negative Feedback Mechanism



MCQ

- **If the amount of glucose in the blood decreases, then a negative feedback control mechanism would be expected to:**

a. Decrease the amount of glucose in the blood.
b. Increase the amount of glucose in the blood.
c. Increase the amount of insulin in the blood.
d. Leave the amount of glucose unchanged.
e. Decrease the amount of insulin in the blood.

Answer: B

Positive Feedback

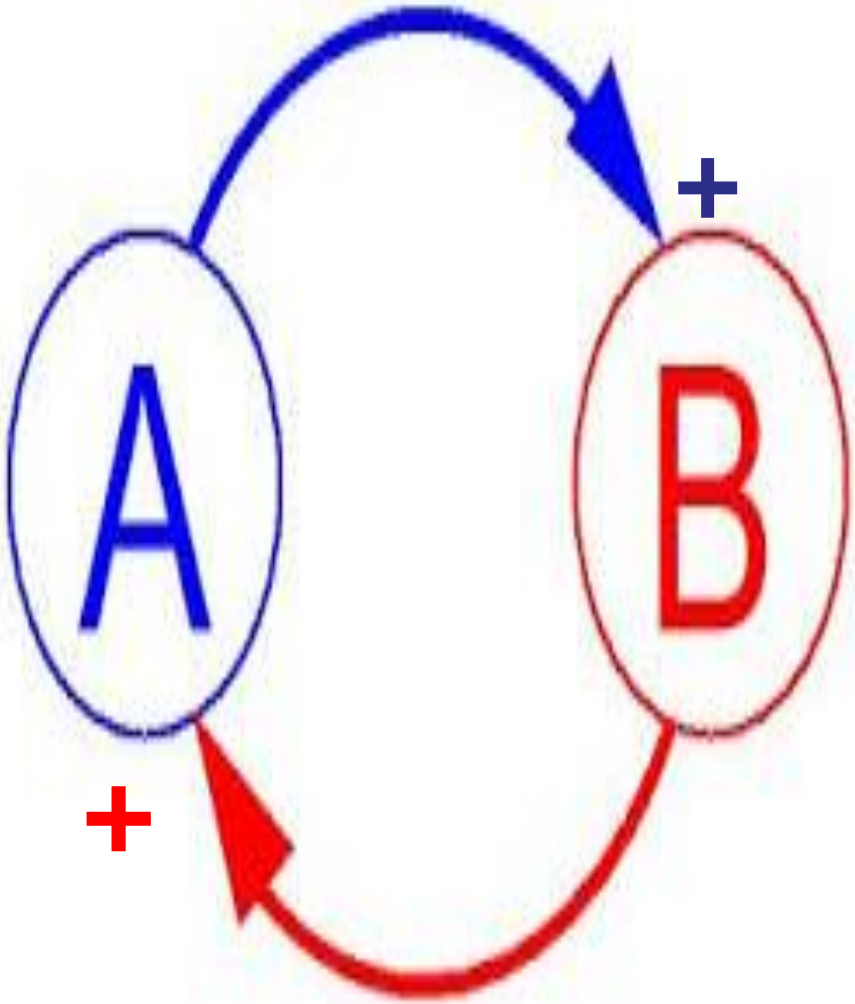
-The action of the effector amplifies the change. The positive feedback mechanisms are designed to push levels out of normal ranges.

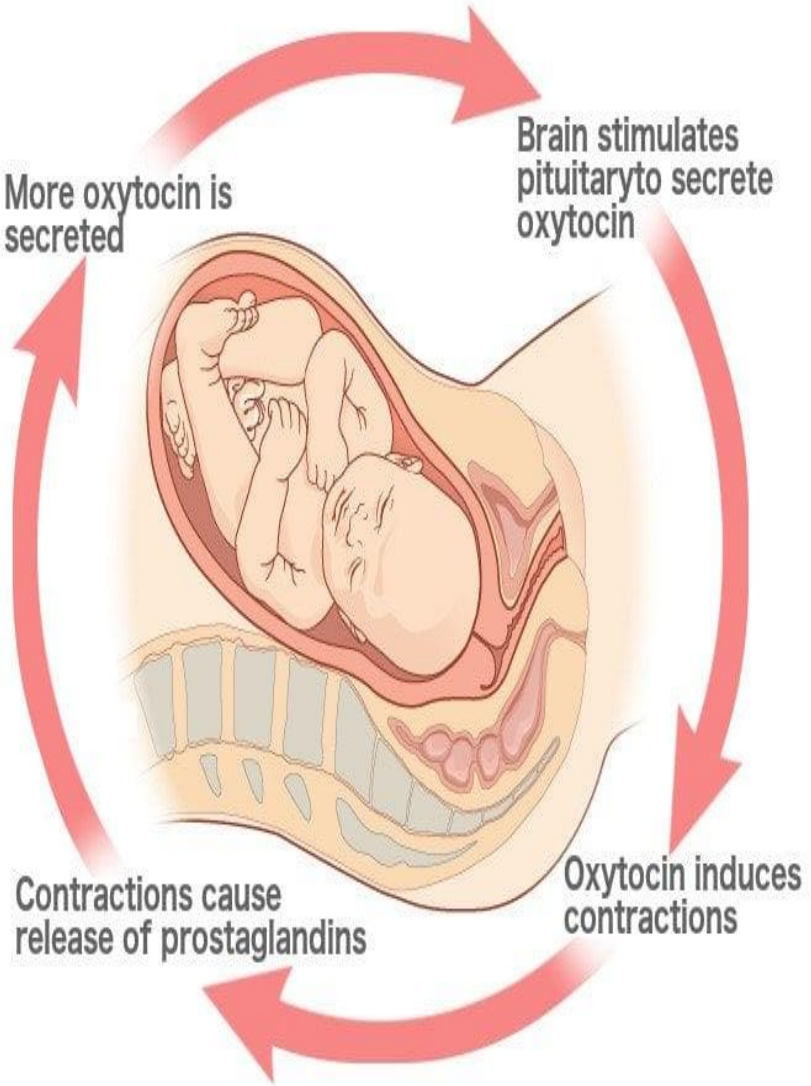
-It, if unchecked, can lead to a vicious cycle and dangerous situations and may be death.

The _____ feedback mechanism is more common in the body because it helps maintain stability, while the _____ feedback mechanism is less common and often associated with processes that need to be completed quickly, such as blood clotting or childbirth.

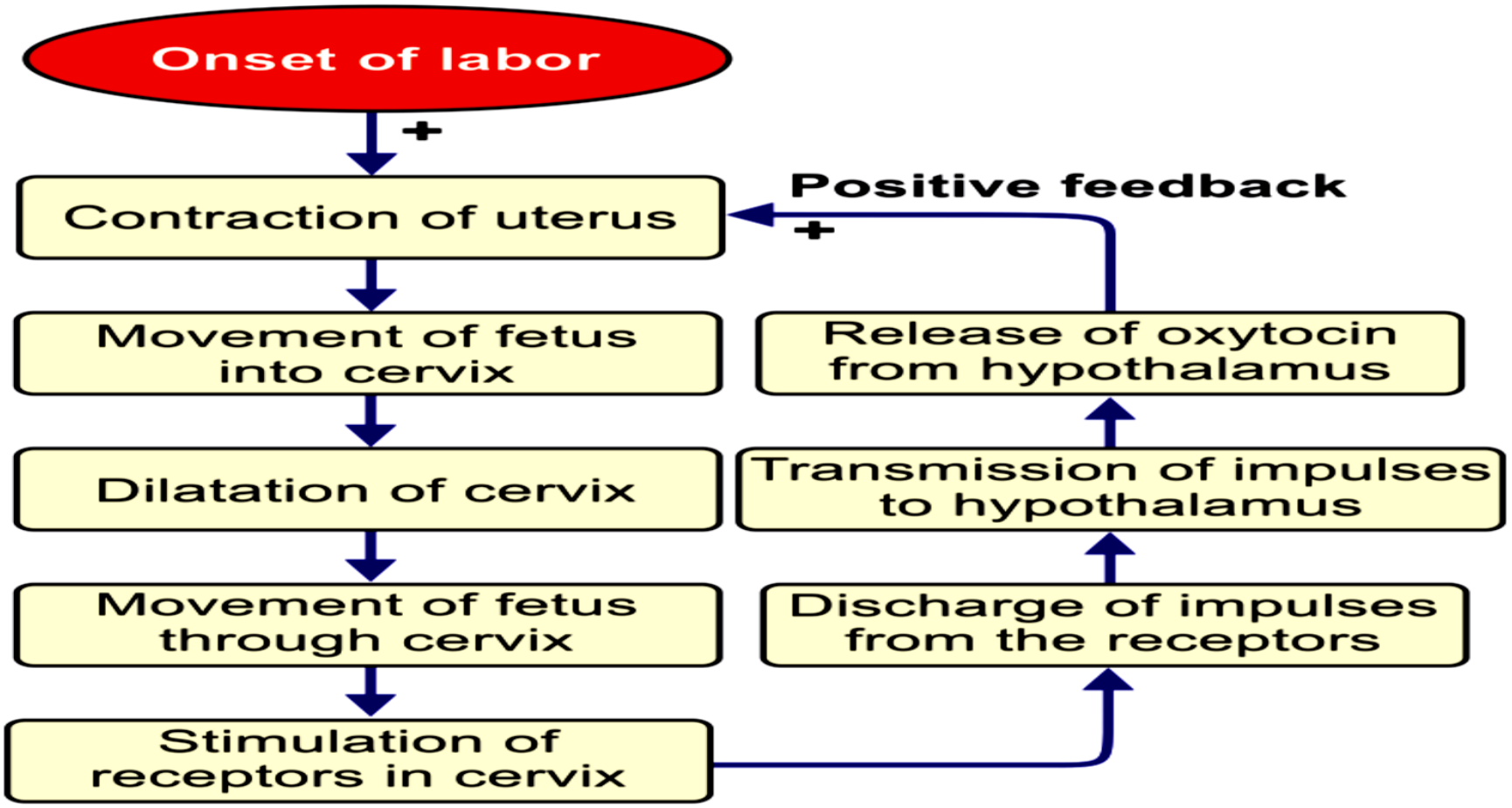
Answer: negative, positive

Positive Feedback





Example of Positive Feedback Mechanism



Fill-in-the-Blank Question:
During childbirth, the release of _____ is an example of a _____ feedback mechanism.
Answer: oxytocin, positive

MCQ

Which of the following statements about positive feedback mechanism is correct?

a. They are regulation mechanisms that control most fluctuations in the internal environment of the body.
b. The response to the stimulus serves to exaggerate the feedback effect.
c. This type of feedback response only involves an effector not a specific stimulus receptor site.
d. This feedback mechanism involves adjustments at the organ level but not at the cellular level.
e. Positive feedback is the most common feedback mechanism in the body.

Answer: B