II. Internal environment & homeostasis

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Homeostasis

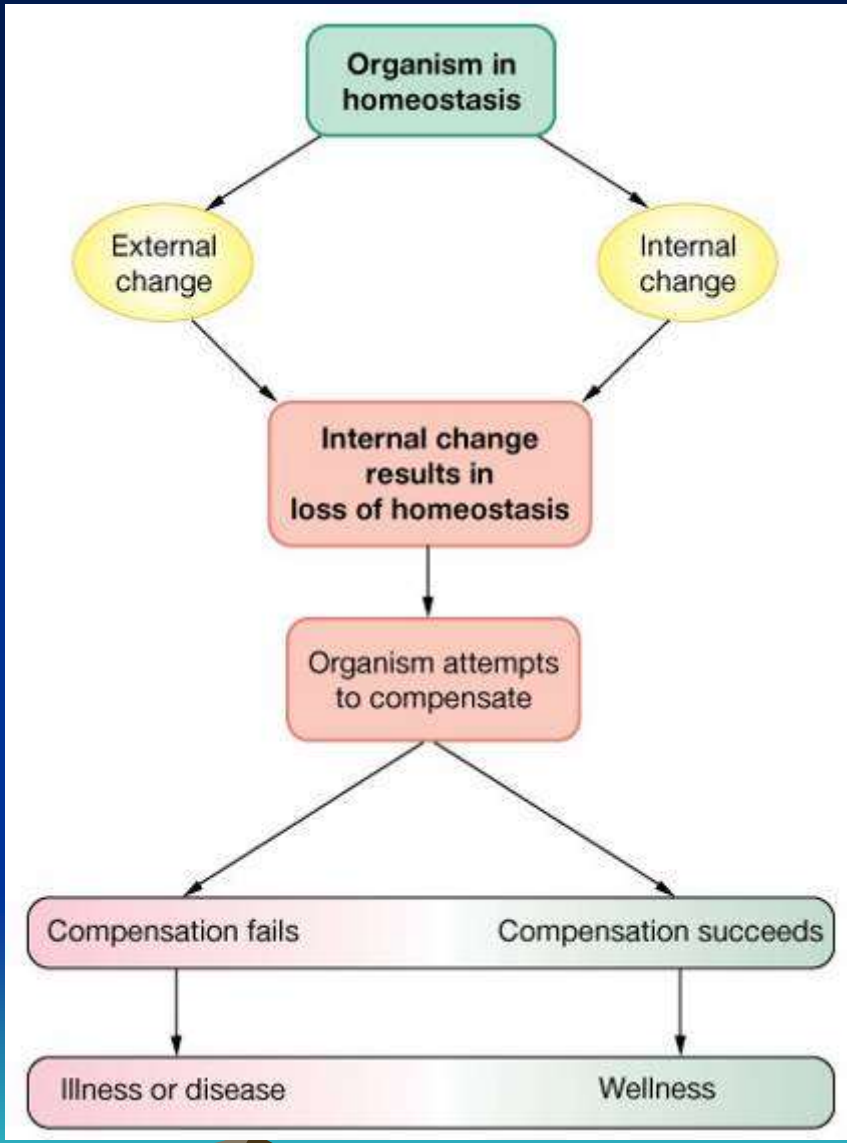
'Homeo,' Latinized from the Greek word 'homio,' means **'similar to**,' and when combined with the Greek word 'stasis,' meaning **'standing still'** gives us the term that is a cornerstone of physiology.

The body's many functions, beginning at the cellular level, operate as to not deviate from a narrow range of internal balance, a state known as **dynamic equilibrium**, despite changes in the external environment.

Homeostasis & Controls

-On the cellular level, homeostasis is observable in the biochemical reactions that take place. Regulation **of pH, temperature, oxygen, ion concentrations, and blood glucose** concentration is necessary for enzymes to function optimally in the environment of the cell, and the formation of waste products must be kept in control as not to disrupt the internal environment of the cells as well.

-Cells respond to changes in volume by activating the metabolic transport of molecules necessary to return to back to normal volume. In both, the cases of hyperosmolar or hypoosmolar external cellular states, the transfer of molecules must result in volume regulation as not to disturb the contents of the cell from their maximum function.



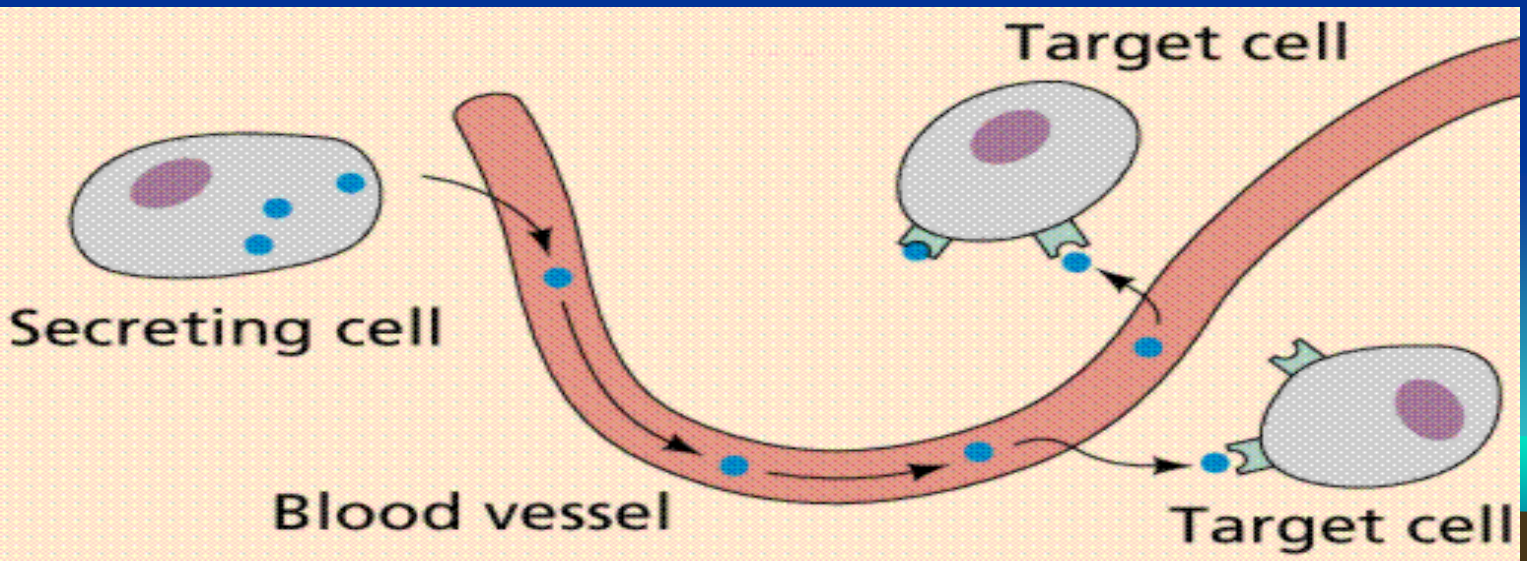
Regulation of the Body Functions

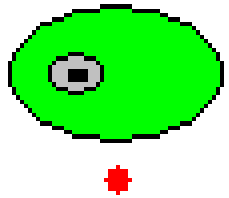
- Regulation- the ability of an organism to maintain a stable internal conditions in a constantly changing environment
  - Three types:
    - 1. Chemical (hormonal) Regulation
    - 2. Nervous Regulation
    - 3. Autoregulation

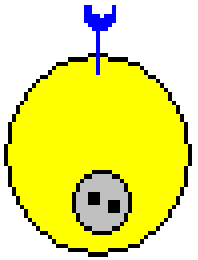
- A proposed mechanism for homeostasis is represented by a regulatory system in which five critical components must work together in a reflex loop: the **sensor, setpoint, error detector, controller, and effector**. A regulated (sensed) variable has a sensor within the system to measure the change in its value, an example of which is blood glucose concentration.
- On the other hand, a controlled (non-regulated) variable whose value becomes altered to maintain the regulated variable in the narrow range, an example of which would be the roles of gluconeogenesis, glycolysis, and glycogenolysis in blood glucose concentration.

I. Chemical (hormonal) Regulation

- A regulatory process performed by **hormone** or **active chemical substance** in blood or tissue.
  - response slowly
  - acts extensively
  - lasts for a long time.





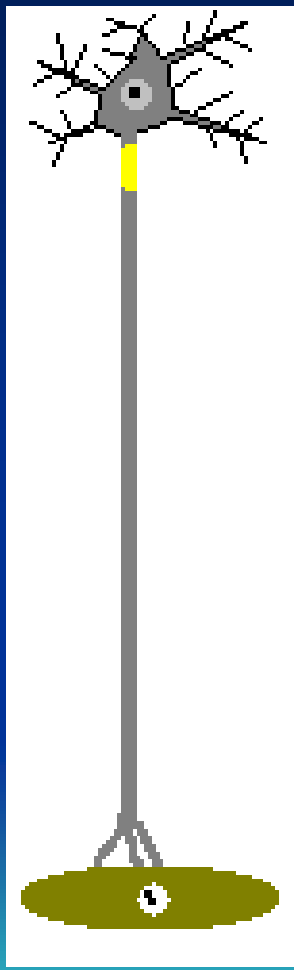


II. Nervous Regulation

- a process in which body functions are controlled by nerve system
  - Pathway: nerve reflex
  - Types: unconditioned reflex and conditioned reflex
  - Example: baroreceptor reflex of arterial blood pressure

– Characteristics:

- response fast
- acts exactly or locally
- last for a short time



III. Autoregulation

- A tissue or an organ can directly respond to environmental changes
  - independent of nervous and hormonal control
  - Characteristics：
    - Amplitude of the regulation is smaller than other two types.
    - Extension of the effects is smaller than other two types.

Regulation of the Body Functions

- The three regulations have coordinated and acts as one system, “feedback control system”.
- Feedback Control
  - **Feedback: Output** (feedback signal) from **controlled organ** returns to affect or modify the action of the **control system**.
  - Feedback control mechanism consists of two forms:
    - **Negative** feedback control.
    - **Positive** feedback control

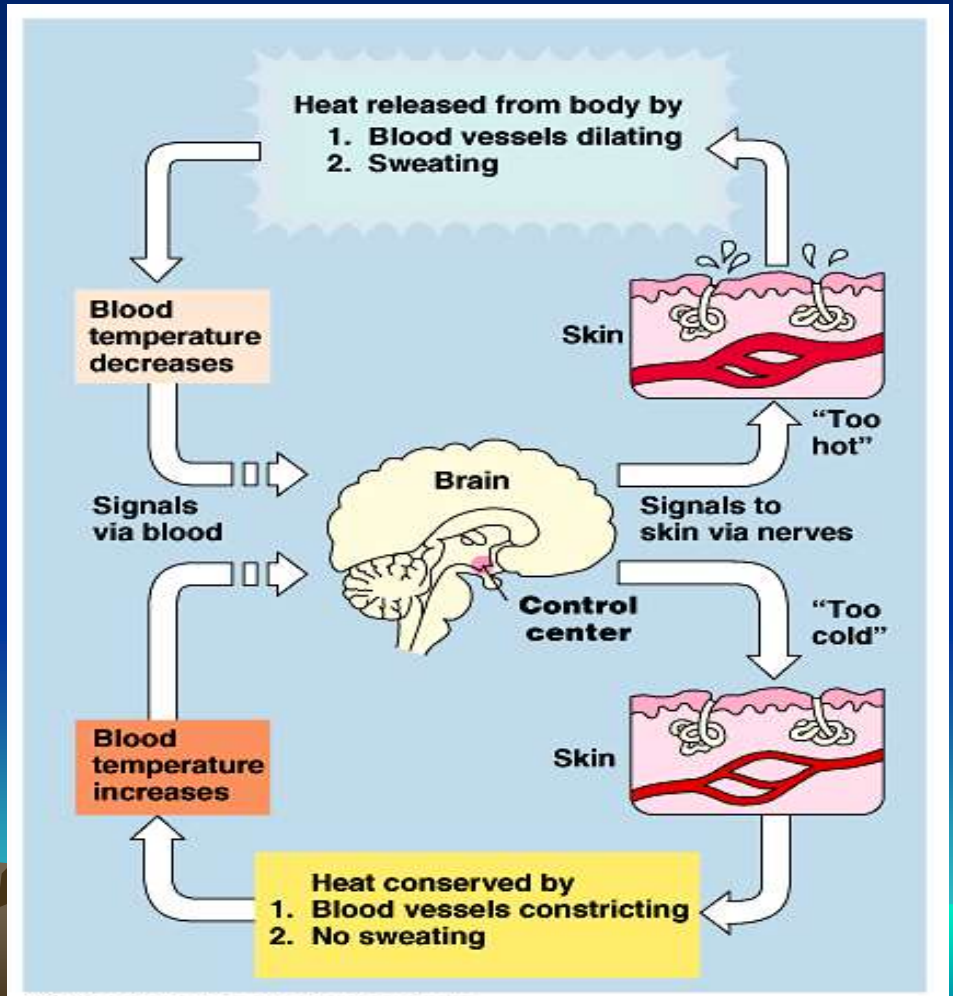
Negative feedback

- The feedback signals from controlled system produces effect **opposite** to the action of the control system.
- The opposite effect is mainly “inhibitory action”.

Negative Feedback: Inhibitory.

Stimulus triggers response to counteract further change in the same direction.

Negative-feedback mechanisms prevent small changes from becoming too large.



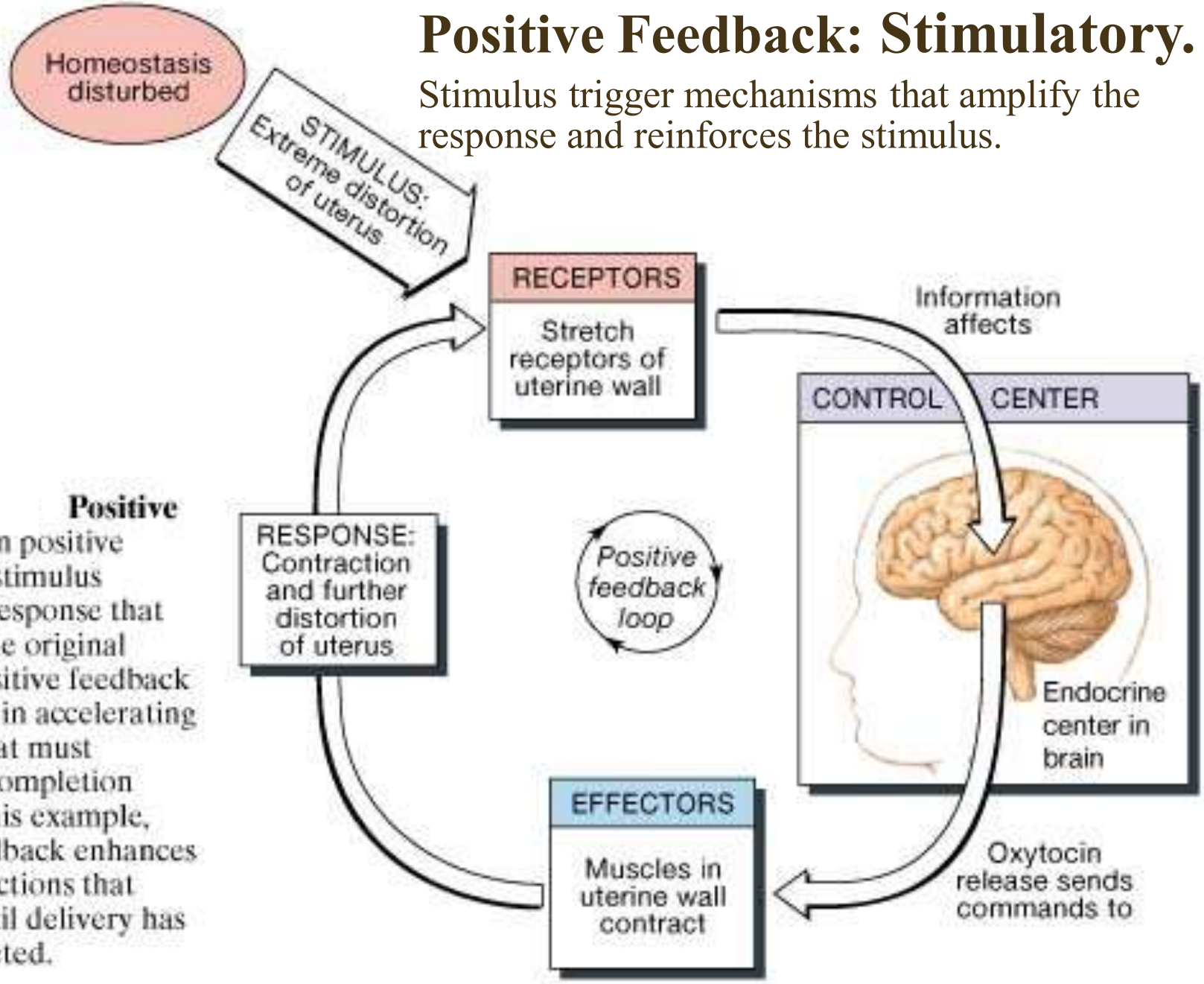
(b) Control of body temperature

Positive feedback

- The feedback signal or output from the controlled system increases the action of the control system
- Examples:
  - Blood clotting
  - Micturition
  - Defecation
  - Contraction of the uterus during childbirth (parturition)

Positive Feedback: Stimulatory.

Stimulus trigger mechanisms that amplify the response and reinforces the stimulus.



Positive feedback. In positive feedback, a stimulus produces a response that reinforces the original stimulus. Positive feedback is important in accelerating processes that must proceed to completion rapidly. In this example, positive feedback enhances labor contractions that continue until delivery has been completed.

Pathophysiology

- Homeostasis underlies many, if not all, disease processes. Diseases such as diabetes, hypertension, and atherosclerosis, involve both the disturbance of homeostasis, as well as the presence of inflammation.
- The set-point must confine itself to a strict range in certain body functions, but it is not necessarily static in others. For example, Fever is an example of how the set-point can increase without necessarily killing the individual. An increase in core body temperature is necessary to fight off an invader, but in the case of hyperthermia, the adaptive function of temperature has failed, and the set-point is unable to return to normal.

Thank You