

Introduction to physiology

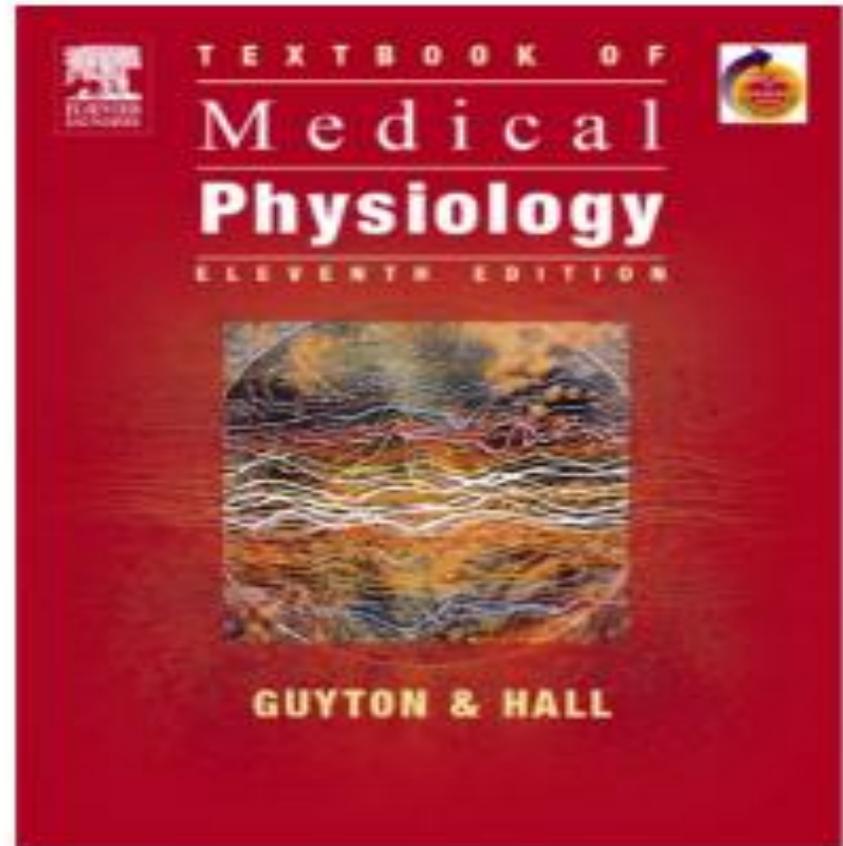
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Objectives

- **Describe homeostatic mechanisms of the major functional systems.**
- **Describe control systems of the body**
- **Examples of control mechanisms**
- **Characteristics of control mechanism**

Suggested books & resources

➤ **Medical Physiology (A.C. Guyton)**



Physiology

- Study of function of the human body and its mechanisms
- Regulation positive feed back and negative feed back
- Communication by neurons or hormones
- Basic building block of human body 100 trillion
- body a coordinated solution 60%

Intracellular 2/3 inside the cell ICF

Extracellular 1/3 plasma and interstitial ECF

- ECF

Ions Na^+ , Cl^- , HCO_3^-

O_2

Nutrients (amino acids, Fatty acids, glucose)

waste products

CO_2 lung volatile

Sulfuric acid, phosphoric acid, lactic acid kidneys non-volatile

- ICF

Water and ions

Na^+ Cl^- Ca^{+2} HCO_3^- Glucose outside

K^+ Mg^{+2} PO_4^- proteins inside

Homeostasis

Homeo: similar (normal)

Stasis: Stable

Maintenance of nearly constant circumstances in your body's internal environment (ECF)

- Hemostasis

Hemo: Blood

Stasis: Stable

The blood is not lost that is clotting (bleeding and Coagulation)

- Blood pH very tightly regulated

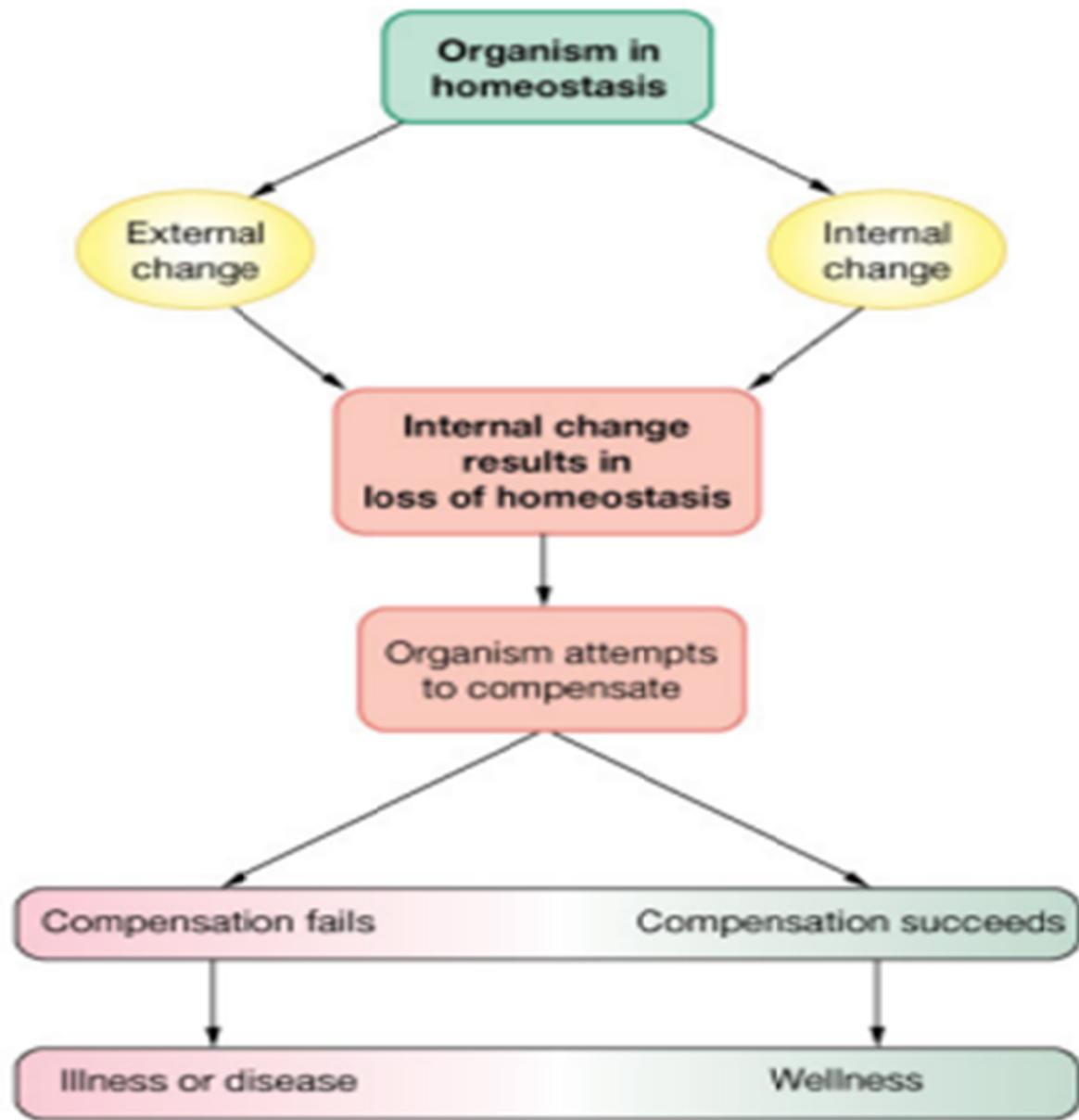
Less than 7 dead 7.4 ABG 7.7

Low

High

- Tetany Ca heart suffer systole Stop
- Arrhythmia K Heart suffers diastole stop
- Coma Glucose coma

- **Successful compensation**
 - Homeostasis re-established
- **Unable to compensate**
 - Pathophysiology
 - Sickness
 - Death



What things in your body need to be kept within a range?

- Body Temperature
- Blood pressure
- Blood pH
- O₂ and CO₂ concentration
- Osmoregulation-Water balance
- Blood glucose

How is your body works?

Good Stuff: Gastrointestinal tract digestion and absorption

Respiratory tract Oxygen

Cardiovascular system cellular respiration

Bad Stuff: Liver Laboratory of your body metabolism of food
and medication

Storage of food Vit B12 elimination of waste product
urea cycle

Kidney non volatile waste

Filtration of plasma reabsorption and excreting urine

Acid Base Balance

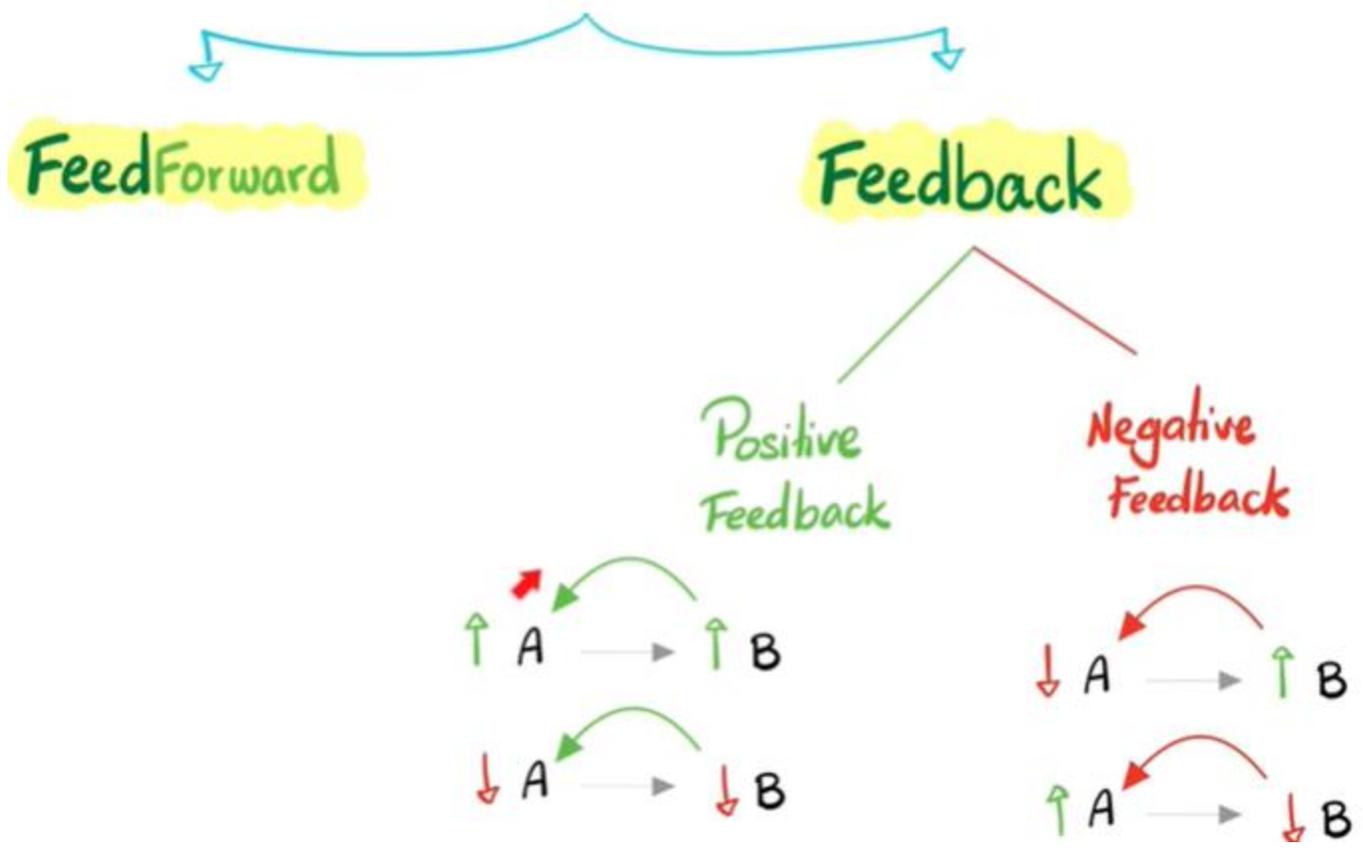
Endocrine function Renin

Lungs volatile waste

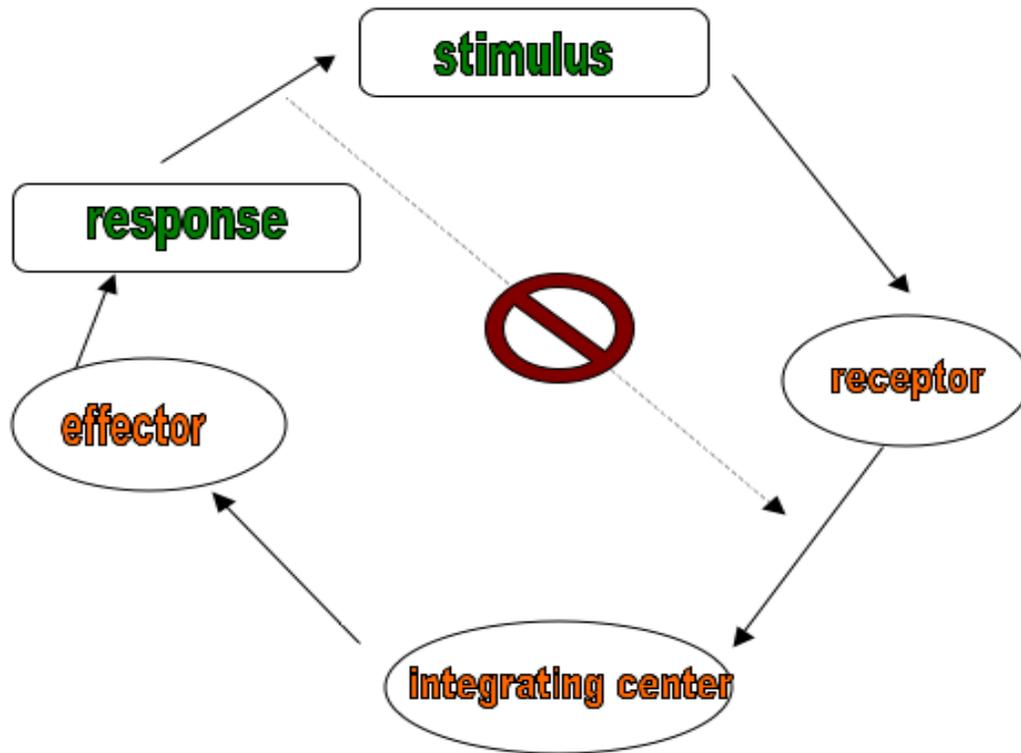
Communications:

Fast - Neurons

Slow- Hormones

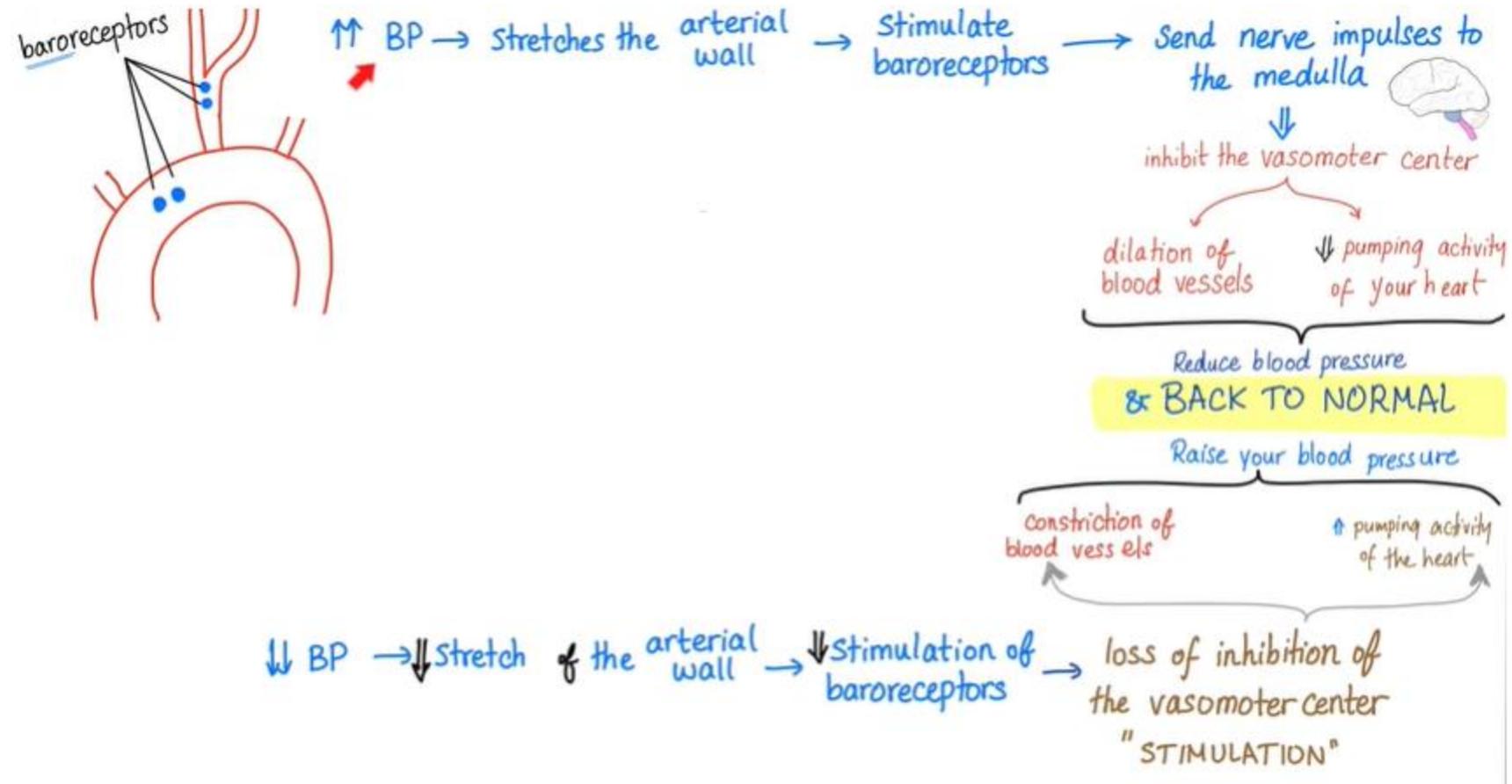


Cellular relay race



- Stimulus
- Receptor
- Integrating center
- Effector
- Response
 - Reverses the stimulus

Negative feedback



Negative feedback

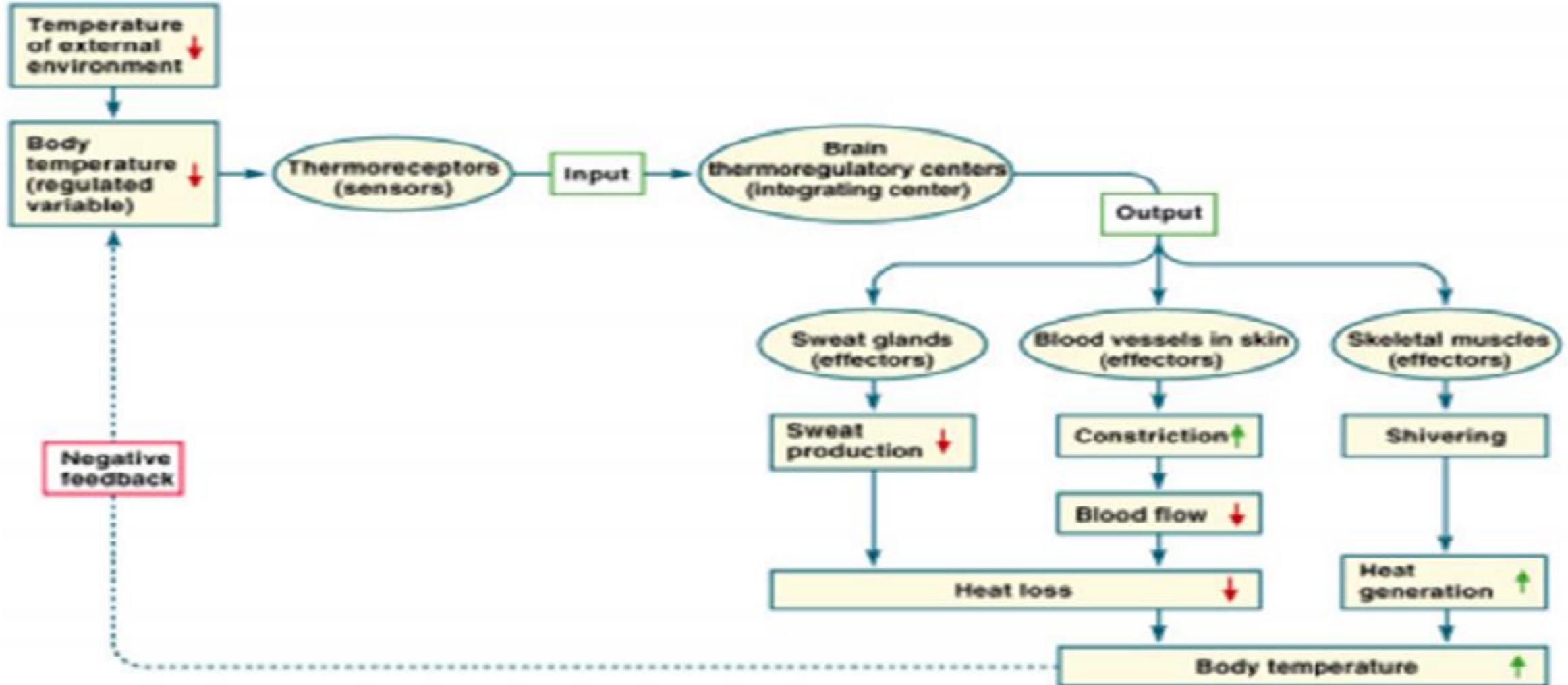
Negative Feedback

\uparrow CO₂ \Rightarrow you breath rapidly and deeply "Hyperventilation" \Rightarrow \downarrow CO₂ \leftarrow The result is opposite to the initiating stimulus

The \uparrow CO₂ started the events that will lead to its reduction "NEGATIVE FEEDBACK"

\downarrow CO₂ \Rightarrow you breath slowly "Hypoventilation" \Rightarrow \uparrow CO₂ \leftarrow The result is opposite to the initiating stimulus

Examples of Negative feedback pathways



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Positive feedback pathways

- **Response enhances the stimulus**
- Examples:
 - Blood coagulation
 - Birth
 - Generation of action potentials

Feed-forward controls (preparing the body for an anticipated change):

- Control of movement and balance
- Monitoring the external environment
- Learning

How the Basal Ganglia and Cerebellum Work Together (One movement → one coordinated output)

BIG PICTURE (Before details) When you move (walk, dance, reach, speak):

Cerebral cortex = plans the movement

Basal ganglia = decides whether the movement should happen and how strongly

Cerebellum = makes the movement accurate, balanced, and smooth

Thalamus = the messenger that sends refined signals back to cortex
Spinal cord & brainstem = execute the movement

👉 Basal ganglia = selection & initiation 👉 Cerebellum = timing, precision & error correction

They work in parallel, not in competition.

Central command

- Hypothalamus
 - Alters circulation due to temperature changes
- Baroreceptors
 - Increases BP setpoint during exercise
- Chemoreceptors
 - Monitor PO_2 , PCO_2 and pH
- Muscle afferents
 - Type III, IV afferent respond to mechanical, thermal and chemical stimuli
 - Most active during intense exercise
 - Minimizes amount of local vasodilation

