

Homeostasis and Concept of Control System *Its importance and the principle of feedback mechanism*

Body compartments

- External environment (always changing, often hostile)
- Internal environment (relatively stable, actively maintained by cells & organs)
 - The internal environment is under sophisticated physiological regulation
- Communication between external & internal environments at:
 - Respiratory, digestive, & renal systems
- Extracellular fluid (surrounding cells):
 - Vehicles for transport of substances
 - Constantly changing to maintain optimal conditions

Homeostasis

- “*The constancy of the internal environment is the condition for the free and independent life.*”
- Uniform conditions that prevail in the body in face of all the disturbances that tend to change them
- Homeostatic mechanism
 - The key to maintaining a stable internal environment is a regulatory mechanism
 - Homeostatic control cannot maintain complete constancy
 - Regulated variables have a range of normal values (depending on the conditions)

Homeostatic control system

Stimulus (*change in internal environment*)

→ **Receptors**

→ **Control centre** (set point)

→ **Effectors** (muscles/ glands)

→ Response (*change in internal environment is corrected*)

Negative feedback control

- Adopted by most control systems
- Involved in **homeostatic control**
- Output shuts off the original stimulus → Physiological event returns to optimal status
- Examples:
 - Body temperature
 - Blood glucose level / water level in blood / blood gas level / blood pressure
 - Endocrine gland secretions
- Some homeostatic responses are highly localized (e.g. in skeletal muscle cells during exercise)

Positive feedback control

- NOT for homeostatic control
- For a transient physiological change
- The output exaggerates the original stimulus
- Examples:
 - Parturition / ovulation / blood clotting
 - Heat stroke

Feedforward control

- Proactive: prompt the system to act before the changes begin to affect it
- Variation of “other variable” directly compensates the anticipated changes in the controlled variable (independent of a sensor for the controlled variable)

Health & Illness

- Healthcare intervention aims to re-establish patient’s homeostasis