

Concept of Homeostasis

Homeostasis Definition: The maintenance of a dynamic steady state within the internal bodily environment.

Homeostasis Concept: dynamic mechanisms are the factors that allow for a near-steady state by detecting and responding to deviations from the "set point" through effector responses.

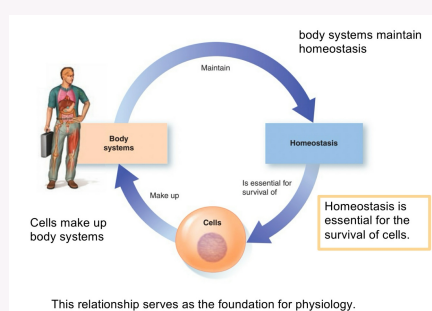
Factors in a Homeostatic Control System

Sensor detects deviations from set point and relays informatory signal to the integrator/control system.

Control Center/Integrator integrates information input from the sensor to allow for a response system to restore the set point back to normal.

Effector Response system that receives information on adjustments in order to restore the set point back to normal.

Homeostasis Conceptual Summary Figure



Intrinsic Control System

Definition *LOCAL* control systems built *INTO* a tissue/organ

Example: Increased CO₂ production by exercising skeletal muscle leads to --> relaxation of smooth muscle and dilation of blood vessels; increased blood flow brings more O₂

Disruptions in Homeostasis

Pathophysiology abnormal bodily function associated with disease

Result homeostatic disruption so severe that death results

Extrinsic Control System

Definition Systems outside of an organ/tissue allowing for the co-ordination of multiple organs/tissues.

Example 1 The *nervous system* detects *LOW* blood pressure leading to --> Increased Heart rate + constriction of blood vessels

Example 2 The *endocrine system* detects *HIGH* blood glucose leading to --> excretion of hormonal control

Homeostasis Maintenance=Cell communication

Direct Intracellular communication *Gap Junctions + Transient Direct linkup of Cells surface markers*

Indirect Intracellular communication via Extracellular messengers Paracrine Secretion + Neurotransmitter secretion

Homeostasis Maintenance=Cell communication (cont)

Endocrine Signaling Hormonal + neurohormonal secretion

Alterations in Homeostasis

Set points can change

- 1) In sickness temperature can change --> Fever
- 2) Throughout Aging --> BMR (basal metabolic rate) can change
- 3) Throughout daily life --> Circadian rhythms can change

Thermoregulation

Shivering when body temp is *LOW*, heat is produced to increase body temp back to normal through shivering

Sweating when body temp is *HIGH*, heat is lost to reduce the body temp back to normal through sweating

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Important Regulatory Systems

Nervous System brain, spinal cord, nerves, and sense organs

Endocrine System all hormone-secreting glands

Negative Feedback (NF)

Systems that operate under Negative Feedback

Intrinsic and Extrinsic control systems operate under the principle of negative feedback

Goal

Remediate an unwanted change

Definition

A change in a controlled variable triggers a response that drives the variable in the opposite direction of the initial change, thus opposing the change

Afferent Signal/Path

Send info from Sensor to control center

Efferent Signal/Path

Send info from Control Center to Effectors in order to help restore homeostasis

Example: Temperature Regulation

High body temp sensed by skin cells --> Send info to brain/control center--> send info to Sweat Glands/Effector-->release Sweat --> Response: Lower Body temp back to normal levels

NF Ex: Regulating Glucose Concentration

Set point of glucose concentration of Plasma

~80mg/dL

Beta Cells

Release *INSULIN* from pancreas when glucose concentration *INCREASES*

Alpha Cells

Release *GLUCAGON* from pancreas when glucose concentration *DECREASES*

B-Cells Negative Feedback Mechanism

Beta cells *SENSE* glucose levels in blood (Increase/Decrease) and compare them to the set point glucose concentration; Too high = send info to control center (afferent path) --> Control center sends info to effector (efferent path) --> Response: release *INSULIN* --> decrease glucose concentration back to set point

Nervous system VS Endocrine system

Nervous System	Endocrine System
<i>WIRED</i> ; specific structural arrangement between neurons + target cells	<i>WIRELESS</i> ; widely dispersed endocrine glands that are unrelated to each other + target cells

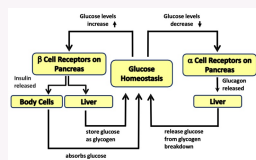
Chemical Messenger= Neurotransmitter into --> synaptic cleft	Chemical Messenger= Hormones released--> blood
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<i>SHORT</i> distance (diffusion across synaptic cleft)	<i>LONG</i> distances (carried by blood)
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<i>RAPID</i> response + <i>BRIEF</i> duration	<i>SLOW</i> response + <i>LONG</i> duration
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Function= co-ords rapid + precise responses	Function= Control long duration activities
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NF: Glucose Homeostasis Figure



Feedforward Mechanisms

Definition:

System that operates without a detector by activating homeostatic mechs + predicting when a change is likely to occur

Potential Mech #1

In response to an anticipated/once in a lifetime (infrequent) event

Ex 1:

The normal anticipatory regulation of heartbeat in advance of actual physical exertion

Potential Mech #2

Through Body Rhythms



Feedforward Mechanisms (cont)

Ex 2: The rhythms are internally driven but entrained (timing is set) by environmental cues.

Non-Homeostatic Mech= Positive Feedback

Definiton: System with no contribution to homeostatis BUT, contributes to specific physiological needs in which the *INITIAL* change is *AMPLIFIED* and moves *AWAY* from set point

Import-ance: In processes such as childbirth or firing an action potential

Childbirth Example During labor (stimulus), the the nerve receptors (sensors) detect cervical stretching and signal to the brain (control center) which allows for the release of oxytocin (effector) from the pituitary gland in order to stimulate more stretching and stronger contractions and stimulate the olacenta to further make prostaglandins stimulating more oxytocin and more cervical stretch/contractions(-opposite of negative feedback which would end the contractions/stretching).

Homeostatic-ally maintained Factors

1. Nutrients
2. Oxygen + Carbon Dioxide
3. Waste Products
4. pH
5. Water, Salt, other electrolytes
6. Volume + pressure
7. Temperature



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