

EDITORIAL

HOMEOSTASIS

BY

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Homeostasis in a general sense refers to stability, balance or equilibrium. It is the body's attempt to maintain a constant internal environment. Maintaining a stable internal environment requires constant monitoring and adjustments as conditioned change. This adjusting of physiological systems within the body is called **homeostatic regulation**.

Homeostatic regulation involves three parts or mechanisms:

1. **The receptor:** It receives information that something in the environment is changing.
2. **The control center or integration center:** It receives and processes information from the receptor.
3. **The effector:** It responds to the commands of the control center by either opposing or enhancing the stimulus.

Since homeostasis is an attempt to maintain the internal conditions of an environment by limiting fluctuations, it must involve a series of negative and positive feedback loops. Sustainable systems require combinations of the both kinds of feedback. Positive feedbacks are called into play, whereas once the homeostatic condition is approached, negative feedback is used for fine tuning responses. Positive feedback is less common in naturally occurring systems than negative feedback, but it has its application. Although positive feedback is needed within homeostasis, it also can be harmful at times.

A variety of homeostatic mechanisms maintain the internal environment within tolerable limits. Homeostasis is maintained through a series of control mechanisms by the different body systems.

HOMEOSTASIS BY THE INTEGUMENTARY SYSTEM

For The Skeletal System:

Synthesizes vitamin D₃, essential for calcium and phosphorus absorption (bone maintenance and growth).

For The Muscular System:

Synthesizes vitamin D₃, essential for calcium and phosphorus absorption (Calcium ions play an essential role in muscle contraction).

For The Nervous System:

Receptors in dermis and deep epidermis provide sensations of touch, pressure, vibration, temperature, and pain.

For The Endocrine System:

Synthesizes vitamin D₃, precursor of calcitriol.

For The Cardiovascular System:

Stimulation by mast cells produces localized changes in blood flow and capillary permeability.

For The Lymphatic System:

Provides physical barriers that prevent pathogen entry. Macrophages resist infection. Mast cells trigger inflammation and initiate the immune response.

For The Respiratory System:

Hairs guard entrance to nasal cavity.

For The Digestive System:

Synthesizes vitamin D₃ needed for absorption of calcium and phosphorus.

For The Urinary System:

Assists in elimination of water and solutes. Keratinized epidermis limits fluid loss through skin.

For The Reproductive System:

Covers external genitalia. Provides sensations that stimulate sexual behaviors. Mammary gland secretions provide nourishment for newborn infant.

HOMEOSTASIS BY THE LYMPHATIC SYSTEM

For The Integumentary System:

Provides IgA for secretion onto integumentary surfaces.

For The Skeletal System:

Assists in repair of bone after injuries. Macrophages fuse to become osteoclasts.

For The Muscular System:

Assists in repair after injuries.

For The Nervous System:

Cytokines affect hypothalamic production of CRH and TRH.

For The Endocrine System:

Thymus secretes thymosins. Cytokines affect cells throughout the body.

For The Cardiovascular System:

Fights infections of cardiovascular organs. CVS Returns tissue fluid to circulation.

For The Respiratory System:

Tonsils protect against infection at entrance to the respiratory tract.

For The Digestive System:

Tonsils and lymphoid nodules of the intestine defend against infection and toxins absorbed from the digestive tract. Lymphatics carry absorbed lipids to venous system.

For The Reproductive System:

Provides IgA for secretion by epithelial glands.

HOMEOSTASIS BY THE NERVOUS SYSTEM

For The Integumentary System:

Controls contraction of erector pili muscles and secretion of sweat glands.

For The Skeletal Muscles:

Controls skeletal muscle contractions that produce bone thickening and maintenance and determine bone position.

For The Muscular System:

Controls skeletal muscle contractions, coordinates respiratory and cardiovascular activities.

For The Endocrine System:

Controls pituitary gland and many other endocrine organs. It secretes ADH and oxytocin.

For The Cardiovascular System:

Modifies heart rate and blood pressure. Astrocytes stimulate maintenance of blood-brain barrier.

For The Lymphatic System:

Release of neurotransmitters and hormones affect sensitivity of immune response.

For The Respiratory System:

Controls pace and depth of respiration.

For The Digestive System:

Regulates digestive tract movement and secretion.

For The Urinary System:

Adjusts renal blood pressure and controls urination.

For The Reproductive System:

Controls sexual behaviors and sexual function.

HOMEOSTASIS BY THE CARDIOVASULAR SYSTEM

For The Integumentary System:

Delivers immune system cells to injury sites. Clotting response seals breaks in skin surface. CVS carries away toxins from sites of infection and provides heat.

For The Skeletal System:

Provides calcium and phosphate for bone deposition. CVS delivers EPO to bone marrow, parathyroid hormone, and calcitonin to osteoblasts and osteoclasts.

For The Muscular System:

Delivers oxygen and nutrients, removes carbon dioxide, lactic acid, and heat during skeletal muscle activity.

For The Nervous System:

Endothelial cells maintain blood-brain barrier. CVS help generate CSF.

For The Endocrine System:

Distributes hormones throughout the body. Heart secretes ANP.

For The Lymphatic System:

Distributes WBCs and carries antibodies that attack pathogens. Clotting response assists in restricting spread of pathogens. Granulocytes and lymphocytes are produced in bone marrow.

For The Respiratory System:

RBCs transport oxygen and carbon dioxide between lungs and peripheral tissues.

For The Digestive System:

Distributes digestive tract hormones, carries nutrients, water, and ions away from sites of absorption. CVS delivers nutrients and toxins to liver.

For The Urinary System:

Delivers capillaries where filtration occurs. CVS accepts fluids and solutes reabsorbed during urine production.

For The Reproductive System:

Distributes reproductive hormones, provides nutrients, oxygen, and waste removal for developing fetus. Local blood pressure changes are responsible for physical changes during sexual arousal.

HOMEOSTASIS BY THE DIGESTIVE SYSTEM

For The Integumentary System:

Provides nutrients for all cells and lipids for storage by adipocytes.

For The Skeletal System:

Provides nutrients, calcium and phosphates.

For The Nervous System:

Provides nutrients for energy production and neurotransmitter synthesis.

For The Muscular System:

Provides nutrients. Liver regulates blood glucose and fatty acid levels, and removes lactic acid from circulation.

For The Endocrine System:

Provides nutrients to endocrine cells. Endocrine cells of pancreas secrete insulin and glucagon. Liver produces angiotensinogen.

For The Cardiovascular System:

Provides nutrients to cardiovascular organs, absorbs water and ions essential to maintenance of normal blood volume.

For The Lymphatic System:

Provides nutrients required by lymphatic tissues. Digestive acids and enzymes provide nonspecific defense against pathogens.

For The Reproductive System:

Provides additional nutrients required to support gamete production and (in pregnant women) embryonic and fetal development.

HOMEOSTASIS BY ENDOCRINE SYSTEM

For The Integumentary System:

Sex hormones stimulate sebaceous gland activity, influence hair growth, fat distribution, and apocrine sweat gland activity. PRL stimulates development of mammary glands. Adrenal hormones alter dermal blood flow. Stimulate release of lipids from adipocytes. MSH stimulates melanocyte activity.

For The Skeletal System:

Skeletal growth is regulated by several hormones: Calcium mobilization is regulated by parathyroid hormone and calcitonin. Sex hormones speed growth and closure of epiphyseal plates at puberty, and help maintain bone mass in adults.

For The Muscular System:

Hormones adjust muscle metabolism, energy production, and growth. They regulate calcium and phosphate levels in body fluids, and speed skeletal and muscle growth.

For The Nervous System:

Several hormones affect neural metabolism. Hormones help regulate fluid and electrolyte balance.

For The Cardiovascular System:

Erythropoietin regulates production of RBCs. Several hormones elevate blood pressure. Epinephrine elevates heart rate and contraction force.

For The Lymphatic System:

Glucocorticoids have anti-inflammatory effects. Thymosins stimulate development of lymphocytes. Many hormones affect immune system.

For The Respiratory System:

Epinephrine and norepinephrine stimulate respiratory activity and dilate respiratory passageways.

The Digestive System:

Epinephrine and norepinephrine stimulate constriction of sphincters and depress activity along digestive tract. Digestive tract hormones coordinate secretory activities along the tract.

The Urinary System:

Aldosterone, ADH, and ANP adjust rates of fluid and electrolyte reabsorption in kidneys.

The Reproductive System:

Hypothalamic regulatory hormones and pituitary hormones regulate sexual development and function. Oxytocin stimulates uterine and mammary gland smooth muscle contractions.

HOMEOSTASIS BY THE REPRODUCTIVE SYSTEM

For The Integumentary System:

Reproductive hormones affect distribution of body hair and subcutaneous fat deposits.

For The Skeletal System:

Sex hormones stimulate growth and maintenance of bones. Sex hormones at puberty accelerate growth and closure of epiphyseal plates.

For The Muscular System:

Reproductive hormones, especially testosterone, accelerate skeletal muscle growth.

For The Nervous System:

Sex hormones affect CNS development and sexual behavior.

For The Endocrine System:

Steroid sex hormones and inhibin inhibit secretory activities of hypothalamus and pituitary gland.

For The Cardiovascular System:

Estrogen may help maintain healthy vessels and show development of atherosclerosis.

For The Lymphatic System:

Lysosomes and bactericidal chemicals in secretions provide nonspecific defense against reproductive tract infection.

For The Respiratory System:

Changes in respiratory rate and depth occur during sexual arousal under control of the nervous system.

For The Urinary System:

Accessory organ secretions may have antibacterial action that helps prevent infections in males.

HOMEOSTASIS BY THE URINARY SYSTEM

For The Integumentary System:

Excretes waste products, maintains normal body fluid pH and ion composition.

For The Skeletal System:

Provides nutrients, calcium, and phosphate.

For The Nervous System:

Provides nutrients for energy production and neurotransmitter synthesis.

For The Muscular System:

Removes waste products of protein metabolism, and assists in regulation of calcium and phosphate concentrations.

For The Endocrine System:

Kidney cells release renin and erythropoietin when local blood pressure declines, and produce calcitriol.

For The Cardiovascular System:

Releases renin to elevate blood pressure and erythropoietin to accelerate red blood cell production.

For The Lymphatic System:

Eliminates metabolic wastes generated by cellular activity. Acid pH of urine provides nonspecific defense against urinary tract infection.

For The Reproductive System:

Urethra in males carries semen to exterior. Kidneys remove wastes generated by reproductive tissues and (in pregnant women) by a growing embryo and fetus.

HOMEOSTASIS BY THE MUSCULAR SYSTEM

For The Integumentary System:

Skeletal muscles pulling on skin of face produce facial expressions.

For The Skeletal System:

Provides movement and support. Stresses exerted by tendons maintain bone mass. Skeletal system stabilizes bones and joints.

For The Nervous System:

Muscle spindles monitor body position. Facial muscles express emotion. Intrinsic laryngeal muscles permit speech.

For The Endocrine System:

Skeletal muscles provide protection for some endocrine organs.

For The Cardiovascular System:

Skeletal muscle contractions assist in moving blood through veins and protect deep blood vessels.

For The Lymphatic System:

Protects superficial lymph nodes and the lymphatic vessels in the abdominopelvic cavity.

For The Respiratory System:

Muscles generate carbon dioxide, control entrances to respiratory tract, fill and empty lungs, control airflow through larynx, and produce sounds.

For The Digestive System:

Protects and supports soft tissues in abdominal cavity, and controls entrances to and exits from the digestive tract.

For The Urinary System:

External sphincter controls urination by constricting urethra.

For The Reproductive System:

Contractions of skeletal muscles eject semen from male reproductive tract. Muscle contractions during sex act produce pleasurable sensations.

HOMEOSTASIS BY THE RESPIRATORY SYSTEM

For The Integumentary System:

Provides nutrients for all cells and lipids for storage by adipocytes.

For The Skeletal System:

Provides oxygen and eliminates carbon dioxide.

For The Nervous System:

Provides oxygen and eliminates carbon dioxide.

For The Muscular System:

Provides oxygen and eliminates carbon dioxide.

For The Endocrine System:

Provides oxygen and eliminates carbon dioxide.

For The Cardiovascular System:

Provides oxygen and eliminates carbon dioxide.

For The Lymphatic System:

Alveolar phagocytes present antigens and trigger specific defenses. It provides oxygen required by lymphocytes and eliminates carbon dioxide generated during their metabolic activities.

For The Reproductive System:

Provides oxygen and eliminates carbon dioxide.