

Maintaining Homeostasis

How the body maintains a stable internal environment for optimal functioning.

Think of a time when your body had to adjust to a change (e.g., feeling hot or cold). How did your body respond?

Introduction to Homeostasis

Homeostasis

The body's ability to maintain a relatively stable internal environment.

Claude Bernard

Cells flourish in a constant internal environment.

Mechanisms

The body uses various mechanisms to maintain homeostasis.

Discussion




Why is a stable internal environment important for athletes?

The Hypothalamus

The hypothalamus is located within the diencephalon of the brain.

It regulates blood pressure, heart rate, respiration, digestion, body temperature, thirst and fluid balance, nervous and endocrine system interactions, appetite and food intake, and sleep-wake cycles.

Control of Homeostasis

-  **Nervous System**
Sends rapid nerve messages to organs.
-  **Endocrine System**
Secretes hormones into the blood, working more slowly than nerve messages.
-  **Activity**

Feedback Mechanisms



Receptor

Senses changes in the environment.



Control Center

Processes the information.



Effector

Carries out the response.

Negative vs. Positive Feedback

Negative Feedback

Reverses the effects of the stimulus. For example, regulation of blood pressure.

Positive Feedback

Enhances the stimulus.

Regulation of Blood pH

The normal pH range of arterial blood is 7.35-7.45. CO₂ concentration affects blood pH.

Chemoreceptors

Monitor blood pH and CO₂ concentration

Respiratory Control Center

In the brain

CO₂ Concentration

Affects blood pH

Conduct a simple experiment to measure CO₂ production and its effect on pH using vinegar and baking soda.

Regulation of the Heart

1

Intrinsic Excitation

Controlled by the sinoatrial (SA) node.

2

Extrinsic Excitation

Controlled by the autonomic nervous system.

3

Adjustments

Through sympathetic and parasympathetic branches.

4

Role Play

Have students role-play the different parts of the heart's regulation process.

Notice: Unauthorized duplication or distribution of this document is prohibited and may result in legal consequences. This work/product/service has been developed independently from and is not endorsed by the International Baccalaureate Organization. International Baccalaureate®. Edsprit LLC

Regulation of Blood Glucose

1. Pancreas

The pancreas secretes insulin and glucagon.

3. Glucagon

Glucagon promotes glycogenolysis and gluconeogenesis.

2. Insulin

Insulin facilitates glucose transport into cells.

4. Exercise

Exercise improves insulin sensitivity.

Regulation of Body Temperature

Thermoregulation

Maintains a core body temperature of $37 \pm 1^\circ\text{C}$.

Heat Production

Muscle contraction generates heat.

Heat Dissipation

Heat must be released from the body.

Use an online simulation tool to demonstrate how the body regulates temperature during exercise.

Heat Transfer Mechanisms



Conduction

Heat transfer through direct contact.



Convection

Heat transfer through moving air or water.



Radiation

Energy transfer from one object to another.



Evaporation

Conversion of sweat from liquid to water vapor.

Factors Affecting Thermoregulation

Training status

Training status can influence an athlete's ability to regulate body temperature.

Body composition

Body composition, particularly the ratio of muscle to fat, can affect heat production and dissipation.

Environment

Environmental factors, such as temperature and humidity, play a significant role in thermoregulation.

Sex differences (including hormonal phases)

Sex differences and hormonal fluctuations can influence an athlete's thermoregulatory response.

Key Terms and Definitions

Adenosine Triphosphate (ATP)

Provides energy for muscle contraction.

Negative Feedback

Reverses a deviation from the set point.

Positive Feedback

Enhances the original stimulus.

Thermoregulation: Process of maintaining core body temperature.

Insulin Sensitivity

Efficiency of insulin in transporting glucose into cells.

Practice Questions

1. Describe the hormonal mechanism that helps maintain body water balance. (AO1, 4 marks)
2. Explain why sports drinks are a popular nutritional intervention for athletes. (AO2, 6 marks)
3. Outline how water intake is controlled at rest and during exercise. (AO1, 3 marks)

Answer the questions in pairs and then review each other's answers.

Summary



Homeostasis

Maintains a stable internal environment through feedback mechanisms.



Nervous and Endocrine Systems

Regulate physiological processes.



Temperature Regulation

Critical for optimal body function during various activities.



Exercise

Improves insulin sensitivity and helps maintain homeostasis.