

Maintaining Homeostasis

Course

Principles of Health Science

Unit III

Anatomy and Physiology

Essential Question

What does the body do to help itself maintain life-sustaining conditions?

TEKS

130.202 (c) 1D, 1E, 1G, 2D

Prior Student Learning

Basic understanding of homeostasis from Biology.

Estimated time

2-3 hours

Rationale

Survival is dependent on maintaining homeostasis. It is crucial that students recognize the importance of the body's mechanisms for maintaining homeostasis.

Objectives

Upon completion of this lesson, the student will be able to:

- Identify biological processes that maintain homeostasis;
- Identify chemical processes that maintain homeostasis;
- Characterize the use of biological and chemical processes in response to common homeostatic disruptions;
- Investigate the process of how homeostasis maintains a stable internal body temperature when the external temperature changes.

Engage

Brainstorm with the class about familiar feedback mechanisms, such as thermostats.

Key Points

- I. Homeostasis is a state of equilibrium.
 - A. The maintenance of a stable internal environment
 - B. Maintains the conditions necessary to support life
- II. Homeostatic mechanisms operate at all levels of organization in the body
 - A. Including molecular, cellular, tissues, organs, and systems.
- III. There are hundreds of monitored events in the body that must be maintained in order for the body to function efficiently.
 - A. These conditions are maintained by feedback mechanisms.
 1. The vast majority of feedback mechanisms are negative feedback mechanisms.
 - a. A negative feedback mechanism tells the body to stop doing what it was doing when a monitored event goes outside of its acceptable range.
 - i. Example: When under stress, the heart pumps harder and faster, causing blood pressure to increase. Baroreceptors monitor the increased blood pressure that results from the increased force and frequency of the heartbeat. The negative feedback mechanism stimulates the heart to decrease the force and slow the frequency of the heartbeats. Thus, blood pressure is restored to normal.

2. Very few feedback mechanisms are positive feedback mechanisms.
 - a. A positive feedback mechanism tells the body to continue doing what it has been doing.
 - i. Example: When contractions begin to push the baby into the birth canal, the pressure of the baby in the birth canal stimulates increased strength of contractions. The forceful contractions continue until the pressure of the baby in the birth canal is removed by the baby being born.
3. The nervous and endocrine systems, working together or independently, deliver the signals, electrical or chemical, respectively, that cause corrective measures to occur.
 - a. Blood sugar levels, electrolyte balance, blood pressure, internal and skin temperature, blood oxygenation levels are all examples of monitored events that are controlled by feedback mechanisms.

IV. Methods of maintaining normal body temperature

A. There are two basic methods of gaining heat in our body:

1. Internal heat production (thermogenesis)
 - a. Muscle contraction
 - b. Other metabolic activities such as digestion
2. Environmental changes

B. There are four basic methods of losing heat from our body:

1. Evaporation
 - a. Heat loss from converting water from a liquid to a vapor
2. Conduction
 - a. Through direct contact between objects (such as water)
3. Convection
 - a. Process of conduction where one object is in motion
4. Radiation
 - a. Loss of heat to the environment due to the temperature gradient.
 - b. Occurs only as long as the ambient temperature is below 98.6° F.

C. Mechanisms to cool the body.

1. Sweating
2. Blood vessel dilation

D. Mechanisms to warm the body.

1. Shivering
 - a. Involuntary contractions of skeletal muscles to generate heat.
 - b. Constriction of dermal blood vessels
 - i. Slows passive heat loss

Activity

Complete the Maintaining Homeostasis Activity.

Assessment

Successful completion of activity and data analysis.

Materials

Deep enamel, plastic, or aluminum pan

Water

Ice

Thermistor sensor and associated equipment (see link)

<http://store.pasco.com/pascostore/showdetl.cfm?&DID=9&PartNumber=CI-6527A&groupID=162&Detail=1>

Oral thermometer

Goggles

Surface disinfectant

Paper towels

It may be possible to borrow probeware from the school Science department. If you can use probeware, the readings can be taken as frequently as every 10 seconds.

A similar lab is available through PASCO using probeware which will record the temperature changes. It will also create the data graphs:

<http://www.pasco.com/resources/labdownloads/pdfs/glx/biology/14%20Body%20Heat%20SV.pdf>

Accommodations for Learning Differences

For reinforcement, the student will research the effects of hyperthermia resulting from excessive athletic activity.

For enrichment, the student will research and report on the use of hypothermia as an adjunct to treatment.

National and State Education Standards

National Health Science Cluster Standards

HLC01.01 Academic Foundations

Health care workers will know the academic subject matter required (in addition to state high school graduation requirements) for proficiency within their area. They will use this knowledge as needed in their role.

TEKS

130.202 (c)(1)(D) organize, compile, and write ideas into reports and summaries;

130.202 (c)(1)(E) plan and prepare effective oral presentations;
130.202 (c)(1)(G) describe biological and chemical processes that maintain homeostasis; and
130.202 (c)(2)(D) accurately interpret, transcribe, and communicate medical vocabulary using appropriate technology.

Texas College and Career Readiness Standards
English Language Arts

II. B. Understand new vocabulary and concepts and use them accurately in reading writing and speaking.
III. B. Develop effective speaking styles for both group and one on one situations.
IV. A. Apply listening skills as an individual and as a member of a group in a variety of settings.
IV. B. 2. Listen actively and effectively in one-on-one communication situations.

Science

1.E.1. Use several modes of expression to describe or characterize natural patterns and phenomena. These modes of expression include narrative, numerical, graphical, pictorial, symbolic, and kinesthetic.
1.E.2. Use essential vocabulary of the discipline being studied.
3.A.1. Use correct applications of writing practices in scientific communication.

MAINTAINING HOMEOSTASIS

Purpose:

The purpose of this lab is to illustrate that, regardless of changes in the external environment, our body, through homeostatic mechanisms, maintains a constant internal environment. The student will record changes in oral temperature, skin temperature, and skin color to observe how homeostatic mechanisms maintain normal temperature within the body.

Background Information:

See key points outline.

Materials:

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Procedure:

1. Assemble the equipment and materials.
2. Prepare the work area.
3. Wash your hands and put on your goggles.
4. Record the oral temperature using the oral thermometer, and the dermal temperature (of arm) using a thermistor-thermometer. Observe and record skin color in the arm and face.
5. Submerge one arm in a pan of water containing ice, which is maintained at 10-15 degrees less than room temperature.
6. Record the oral and dermal temperature (of the submerged arm) using a thermistor-thermometer each minute for at least five consecutive readings. Observe and record skin color in the arm and face each time the temperature is recorded.
7. Clean the work area with a surface disinfectant. Remove your goggles and your wash hands.

Data:

Design a data table and prepare a graph illustrating the simultaneous mouth and skin readings at each one-minute interval.

Conclusion:

1. Compare and contrast the oral temperature and the dermal temperature.
2. Why do you think you got the results you did?
3. What is the significance of this?
4. Research the physiology of fever. This link is to an article on fever.
<http://physiologyonline.physiology.org/cgi/reprint/1/1/25> Predict the effect of fever on pulse, respiration, and blood pressure. Describe the process of a fever, including benefits and possible damaging effects.