

BRAIN CHEMISTRY
TEACHER'S GUIDE

HORMONES AND STRESS

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Page 2: SEM image of neurons courtesy of Anthony van den Pol, PhD © Yale School of Medicine, <http://news.yale.edu/2012/02/28/molecular-duo-dictate-weight-and-energy-levels-yale-researchers-find/>.

OVERVIEW

Students will describe a stressful situation and how their bodies responded to it.



HORMONES AND STRESS

Stress is a common human condition. Most of us can recognize the symptoms: feelings of nervousness, sweating of the palms of the hands, pounding of the heart, or a dry mouth. These are signs that the body is preparing for a difficult situation in which survival may be at stake. Remarkably, our bodies' reactions to stress are controlled by the

brain. Immediate stress responses are directed through pathways in the brainstem and spinal cord to the major internal organs of the body. However, chemicals circulating in the bloodstream also help prepare the body to handle a crisis. The brain coordinates the release of these chemicals, which belong to the family of messengers known as hormones.

Unlike the chemical messengers between neurons (neurotransmitters), hormones can have wide-reaching effects on many dif-

ferent body tissues at the same time. Hormones, which circulate in the bloodstream, act as messengers to the nervous system and other tissues in the body. They act only on cells that have compatible receptors.

Hormones have many vital functions in mammals, such as regulating digestion; controlling the metabolism of sugars, proteins and fats; and regulating growth and development. Many of our most basic drives—sleeping, hunger, thirst, sex—are regulated through hormones.

The master control system for all hormones is located within the brainstem. Known as the hypothalamus, this small structure interconnects with many regions of the brain. It is adjacent to the pituitary gland, which produces hormones that control other glands in the body. Together, the hypothalamus and the pituitary gland regulate many different body functions. During periods of stress, these tiny structures direct the two small adrenal glands near the kidneys to produce hormones, such as adrenaline (also called epinephrine), that prepare the body for action.

MATERIALS

Per student

- Copy of “Fight or Flight?” student sheet

SETUP

Photocopy the student page (one per student). Begin this activity as a

CONCEPTS

- The brain coordinates the release of chemicals, called hormones, that affect many different tissues at the same time.
- The reaction to stressful situations is mediated by hormones.
- Stress can harm health.

SCIENCE & MATH SKILLS

Observing, sequencing and interpreting

TIME

Preparation: 5 minutes


Class: 45 minutes

STRESS AND LEARNING

Changes in the nervous system and body during times of stress make it harder for the brain to learn. Students who are stressed because of circumstances inside or outside of school can have difficulty learning or paying attention in class.

ENDOCRINE TISSUES

Endocrine tissues produce and release hormones. The word, endocrine, comes from the Greek *endo* (meaning within) and *krinein* (meaning to secrete). Hormones are released directly into the blood.



UNIT LINKS

Legacy of Lost Canyon
Chapter 9
Science box, p. 12

Brain Chemistry Explorations
“Think About It,” p. 8

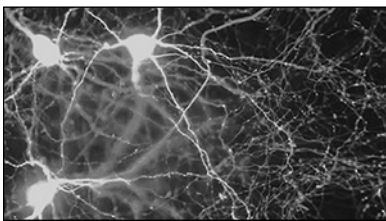


THE HYPOTHALAMUS

Located just above the brainstem, the hypothalamus produces hormones that control many body functions.

- Body temperature
- Hunger
- Moods
- Release of hormones from many glands, especially the pituitary gland
- Sex drive
- Sleep
- Thirst

A BALANCE OF HORMONES



Special neurons in the hypothalamus region, like the three shown above, release hormones associated with high calorie intake and lower energy levels. Other neurons in the hypothalamus release hormones that act in direct opposition, thereby providing clues as to how the brain controls our food intake and sleep patterns.

discussion with the entire class. Have students work individually for the writing portion of the activity and in groups of four to share results and brainstorm stress-reducing solutions.

PROCEDURE

1. Ask students, *Have you ever been in a situation in class where you felt nervous, when perhaps your heart was pounding and your hands became sweaty? Why do you think that you felt the way you did?* Encourage students to share a few experiences.
2. Distribute the “Fight or Flight?” student sheets. Ask students to think of a stressful situation that has happened in class and to describe it under Item 1 on the sheet.
3. After students have finished writing, ask, *Did any of you have a hard time thinking of a class situation that was stressful? Why might that be?* Next, ask, *Why do you think your body responded the way it did to the stress you were feeling?* Help students understand that their bodies were preparing to react to a possibly difficult situation. Ask, *How did your body know that the situation might be stressful?* Lead students to understand that their brains used information coming from their senses and information retrieved from memory to evaluate the situation.
4. Mention that stress is a reaction by many different parts of the body to help an organism survive. Ask, *Can you think of any situations that might be stressful for an animal in its natural surroundings? How might an animal react in a dangerous or other stressful situation?* Help students understand that under stress, the body experiences many changes very rapidly. These changes include an increase in blood pressure and fuel for the brain, and a partial shutdown of body systems (such as the digestive system) not needed for fighting or running. Mention that all of these changes are managed by the brain, both directly through the brainstem and spinal cord, and indirectly, by controlling chemical messengers, such as the hormone adrenaline, that circulate in the blood to many parts of the body. This process sometimes is called the “fight or flight” response. Ask, *When do you think it might be important for humans to be able to respond quickly and efficiently?*
5. Mention that, while these reactions sometimes can improve performance by the body, there are many situations in life in which the “fight or flight” reaction to stress can be unhealthy. For example, high blood pressure can harm the heart and circulatory system over time.
6. Place student into groups of four. Then, direct students to share the stressful experiences they described for Item 1 within their groups. After students have discussed what they wrote, ask, *Was there anything you could have done to make the scenarios you described less stressful?*
7. Have each group share some of the stress-reducing strategies they devised. List the strategies on the board. Ask, *Do you think any of*



these strategies will work for situations outside of school? Allow students to share their ideas. If not mentioned by students, you might want to discuss general stress-reducing strategies, such as being prepared in advance for tests, homework assignments, etc.; allowing adequate time to finish tasks; planning for situations in advance; learning to recognize potentially stressful social situations and finding an appropriate response; creating a mental picture of a successful outcome; and breathing slowly and deeply. Point out that, since the brain interprets and controls the stress reaction, certain things can be done to reduce stress.

8. Have each student complete the second question on his or her “Fight or Flight?” sheet.

EXTENSION

Different species of animals react differently to dangerous situations. Some animals flee, while others become motionless so that they blend into the background. Some look for a safe place to hide, and still others wait for an opportunity to fight. Have students investigate the habits and lifestyles of various animals to learn how the animals react to life-threatening scenarios, and how the responses are related to 1) each animal’s specific characteristics (fast runners, good fighters, etc.), and 2) the characteristics of the environments in which they live.

REACTIONS TO STRESS

During periods of stress, the brain shuts down some bodily functions, such as digestion. In addition, there is an increase in the amount of glucose (an important fuel for the brain) and amino acids (necessary to repair damage to muscles) in the blood. Blood pressure becomes elevated. All of these changes can help an animal, including a human being, deal with a life-threatening situation. However, they are not healthy on a long-term basis.

CHRONIC STRESS

Continuous periods of stress can cause a number of health problems, including high blood pressure, diabetes, and arthritis. Chronic stress also can trigger depression or anxiety and may cause damage to various regions of the brain, including those that are important for learning and memory.





FIGHT OR FLIGHT?

Stress causes a number of changes in the body when it prepares for a difficult situation. While some reactions to stress are good, continuously stressful circumstances can damage the body over time.

1. Think of a recent situation in class in which you felt stressed or worried. Describe the event and how your body responded to it.

2. Could the stress associated with the situation you described above have been avoided? Why or why not? Explain your answer. Use a separate sheet of paper if necessary.

