

The Body-Mind Connection of Stress (45 minutes)

Section

Your Life

Investigative Questions

What are the body's physiological reactions to stress? What is the "fight or flight" response? What are the body mechanisms that cause physiological stress symptoms such as fast heartbeat and dry mouth?

Description of Content

In this activity, students will fill out their own "physical reactions to stress" inventory and graph the class results. Then they will work in pairs to learn more about the body mechanisms that cause physiological stress symptoms, such as a fast heartbeat, cold hands, and dry mouth, or even longer-lasting symptoms such as a headache and sleeplessness. Finally, students will discuss their own reactions to stress and understand that many physiological stress reactions are part of the body's normal functioning. Students will also look at ways of dealing with stress.

Relevant Standards

This activity fulfills [science and health education standards](#).

Ideas and Behaviors Common Among Students

This activity offers information from the literature on [ways your students may already perceive stress and act on stressors in their lives](#).

Objectives

Students will:

- Analyze their own physical responses to stress
- Describe the "fight or flight" response to stress
- Explore the physical reactions of the human body under stress, including the effect of hormones
- Draw conclusions about what happens to their own bodies when under stress
- Describe the wide range of normal responses to stress
- Construct a bar graph

Teacher Background

The human body instinctively reacts to stress by releasing hormones that control heart rate and breathing. It's the body's way of providing additional energy to either fight or flee—the innate human response to stress. The "fight or flight" response can also be seen

in animals. (In this activity, we use the example of a cat to help students understand that physiological responses to stress are a part of animal as well as human behavior.)

According to the National Institutes of Health and many other sources, the stress response is caused by hormones. Hormones are chemicals, produced by glands and carried through the bloodstream, that affect the activities of organs in the body. The hypothalamus and pituitary glands, located in the brain, and the adrenal glands, situated on top of the kidneys, control the hormones that help the body cope with change or a stressful situation. The hypothalamus signals the pituitary gland, which signals the adrenal glands to release the stress hormones epinephrine, norepinephrine, and cortisol. These chemicals increase heart rate and breathing, which provides a burst of energy (to fight or flee), as well as affect other bodily functions. The release of these hormones can result in a wide range of physical reactions to stress, including headache, dry mouth, difficulty swallowing, rapid heartbeat, nausea, cold hands, lack of concentration, difficulty sleeping, certain food cravings, and angry outbursts.

Research to develop the *BAM! Body and Mind*TM Web site showed that kids and teens are very concerned about stress in their lives and interested in learning how to manage it. Parents are interested in helping their kids manage stress as well.

In this lesson we suggest using two segments of the *BAM!* Web site. The “Got Butterflies” game at www.bam.gov/sub_yourlife/yourlife_gotbutterflies.html and the “Feelin’ Frazzled?” 10 tips for relieving stress at www.bam.gov/sub_yourlife/yourlife_feelingfrazzled.html. You may want to review them first. If your students do not have easy access to the Internet, you can still use this lesson.

Materials

- Student Reproducible 1: *Taking Stock: My Body’s Reaction to Stress*
- Student Reproducible 2: *Cold Hands, Fast Heart: The Body’s Physiological Reaction to Stress*

Safety

Normal classroom safety procedures should be followed.

Procedure

Engagement (10 minutes)

1. Before learning about the body's chemical reactions to stress, students will complete a self-assessment of their own physiological reactions to stress. Pass out Student Reproducible 1: *Taking Stock: My Body’s Reaction to Stress*.
2. Talk with students about the drawing of the cat and the information that is included on the top of the student reproducible. Ask them whether they have ever seen a cat respond to a stressful situation—a dog runs by, another cat wanders

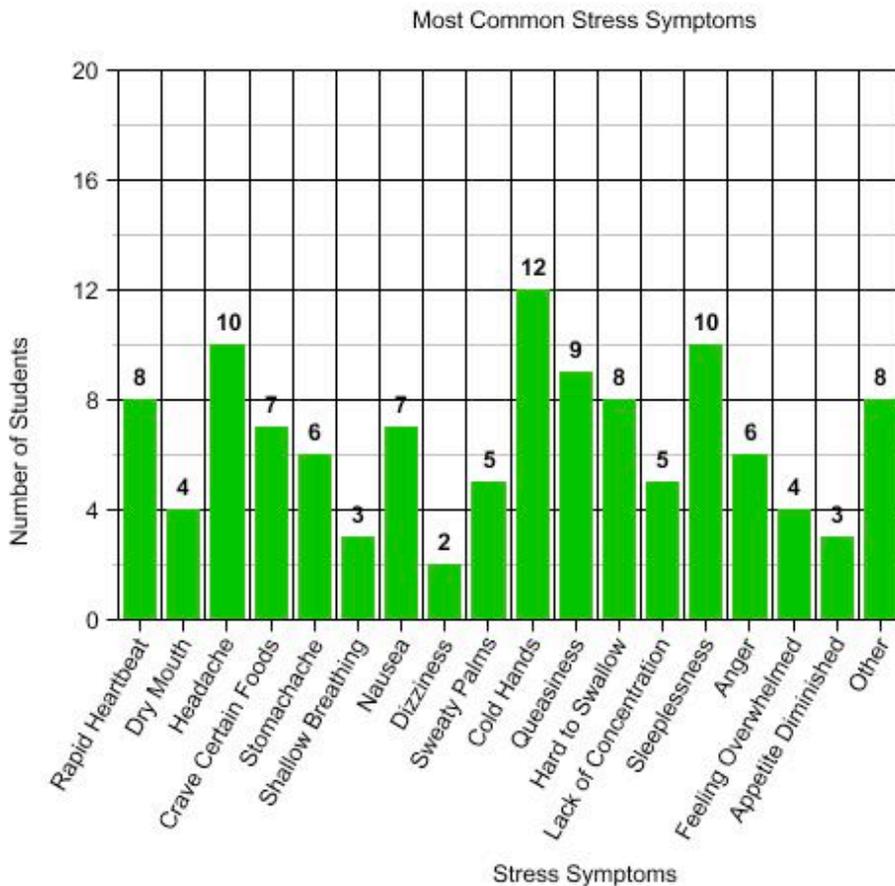
onto its territory, it's time to go to the vet. What do cats do in this situation? Let students discuss briefly.

3. Point out that cats don't have to think about how they will respond. The "fight or flight" response just happens. Ask students to discuss specific adaptations that other organisms possess that allow them to respond to stressors in their environment. (For example, porcupines release their quills. Dogs growl.) Think of other reactions students have seen in animals.
4. Tell students that humans also have this response. The survival instinct ("fight or flight") is hardwired into their bodies.

Exploration (15 minutes)

1. Have students fill out the self-assessment. What are the physiological ways in which *they* react to stress?
2. Once they have completed the self-assessment, compile students' reactions into a bar graph. You can do this as an in-class activity, or you could collect the data in class and assign the bar graph as homework. (One online tool for creating graphs can be found at the National Center for Education Statistics' Create a Graph Web site: <http://nces.ed.gov/nceskids/createagraph/>.)

Here is an example of how a bar graph might look:



Explanation (20 minutes)

1. Hand out Student Reproducible 2: *Cold Hands, Fast Heart: The Body's Physiological Reaction to Stress*. Tell students they will now learn *why* they have these reactions.
2. Explain that hormones produce the “fight or flight” responses in animals, including people. Hormones are chemicals, produced by glands and carried through the bloodstream, that affect the activities of organs in the body.
3. Have students read through Student Reproducible 2 and look at the anatomical drawing. Then, review with the class the glands and hormones that control the physiological reactions to stress. The *hypothalamus* and *pituitary glands*, located in the brain, and the *adrenal glands*, situated on top of the kidneys, (see drawing on the reproducible) control the hormones that help the body cope with change or a stressful situation. The hypothalamus signals the pituitary gland that signals the adrenal glands to release the stress hormones *epinephrine*, *norepinephrine*, and *cortisol*. These chemicals increase the heart rate and breathing, which provides a burst of energy (to fight or flee), as well as affects other bodily functions. [Note: Another hormone is mentioned in the explanation of the body under stress below: serotonin, which both increases good feelings and regulates sleep.]
4. As you review how stress affects the body, ask the students to explain the underlying physiological reaction to a symptom of stress. Then correct, if necessary. The first six items listed below are common responses to short-term stress. The others, headaches, sleeplessness, appetite change, and unusual sudden anger are usually responses to longer-term stress.

Guide for Discussing Student Reproducible 2

- The cold hands you may experience when under stress are a result of the stress hormones shooting through the bloodstream and moving blood away from the skin. While it gives the heart and muscles more strength, it can leave appendages feeling cold.
- Stress hormones send blood to vital organs like the heart, lungs, and liver. Less blood goes to the muscles. The throat, which is a muscle, may tighten and make it hard to swallow.
- Cortisol, one of the stress hormones, shuts down the stomach and won't let food digest, while at the same time putting the digestive tract into high gear. This can make you feel nauseated.
- Once the stress response is running full force, your body sends your blood to only those parts that are truly necessary for survival. With much of the fluid in your body going to your organs, your mouth may become very dry.

- Stress hormones speed up the flow of blood by 300-400 percent. The heart beats faster to move all of that blood to organs and muscles, which is why you feel your heart pounding.
 - Stress hormones affect your short-term memory so that you can focus on the “danger” at hand. They also signal your brain to store the memory of the stressful event in your long-term memory so you know how to respond the next time something stressful happens. One result of these instinctive physiological responses is that it's hard to concentrate.
 - Headaches are one of the common symptoms of long-term stress. Although experts are not clear on the causes, tight head and neck muscles are generally thought to be to blame. Also, the chemical messengers in your brain tell the blood vessels to constrict (get really small). This means that less blood gets to your head, which can cause a headache.
 - In a normal, stress-free day, the levels of hormones that give you energy (epinephrine and norepinephrine) stay consistent. At the end of the day, they naturally begin to decrease and the hormone that helps you sleep (serotonin) kicks into high gear. But if you're under stress for awhile, your body continues to produce epinephrine and norepinephrine, which block out the serotonin, resulting in sleeplessness.
 - Changes in appetite are a common response to stress. For some it's a craving, for others, it's a loss of appetite. Certain foods increase the levels of serotonin (also a feel-good hormone), improving your mood. Many people crave foods under stress such as candy bars, soda, or ice cream, but different people have different cravings. (Point out to students that eating healthy foods helps them have energy and guard against stress.)
 - Stress can make you feel helpless and overwhelmed, which may result in triggering frequent angry outbursts. You just don't have the patience you normally would have.
5. Point out that for many people, understanding what's happening in their bodies—what they've just learned—makes them less self-conscious about their own physiological reactions to stress and can even relieve those symptoms.
 6. Point out to students that their being stressed does not give them an excuse for being hurtful to others or an excuse not to do what they should be doing in school or at home.
 7. If you are not planning to do another *BAM!* activity on stress, “Feeling Frazzled? Stress and What to Do About It,” you may want to copy and hand out “Feeling Frazzled?” tip sheet at www.bam.gov/teachers/handouts.html. It includes 10 suggestions for relieving stress.

Elaboration and Evaluation (time will vary based on number of computers available)

1. Have students go online to www.bam.gov/sub_yourlife/yourlife_gotbutterflies.html and explore the “Got Butterflies?” feature. This feature reviews all the short- and long-term physiological signs of stress and provides ideas for students on beating stress. If your students do not have access to the Internet, you can print out the content and give it to your students as homework.

Performance Descriptors

On each of the criteria below, rate students from 3 to 0, with 3 being the highest possible score and 0 being the lowest.

Scoring Rubric: The Body-Mind Connection of Stress				
Performance Descriptor	Rating			
Student completed the self-assessment of his or her own physiological reactions to stress.	3	2	1	0
Student described the “fight or flight” response to stress in animals, including humans.	3	2	1	0
Student used data collected in class about classmates’ reactions to stress to create a bar graph that shows the data.	3	2	1	0
Student analyzed and drew conclusions about his or her own individual reactions to stress.	3	2	1	0
Student explored the physical reactions of the human body under stress, including the effect of hormones.	3	2	1	0

Extension

1. Some students may be interested in animal behavior. Have them do research and present to the class information about other animals’ fight or flight response.
2. Have students do research and present to the class information on all the glands of the endocrine system and whether or not they are involved in the stress response.

Web Resources

Centers for Disease Control and Prevention (CDC): www.cdc.gov

The CDC Web site includes data on stress in various professions, including statistics on stress suffered by first responders. The site includes a number of fact sheets on stress written for a general audience: “Stress Management for the Health of It” (www.cdc.gov/nasd/docs/d001201-d001300/d001245/d001245.html), “Stress Management: Taking Charge” (www.cdc.gov/nasd/docs/d001201-d001300/d001246/d001246.html), and “From Family Stress to Family Strengths” (www.cdc.gov/nasd/docs/d001201-d001300/d001249/d001249.html) are some examples of the fact sheets.

CDC *BAM! Body and Mind*[™]: www.cdc.gov/bam or www.bam.gov

BAM! Body and Mind is brought to you by the Centers for Disease Control and Prevention (CDC), an agency of the U.S. Department of Health and Human Services (DHHS). *BAM!* was created to answer kids' questions on health issues and recommend ways to make their bodies and minds healthier, stronger, and safer. *BAM!* also serves as an aid to teachers, providing them with interactive activities to support their health and science curriculums that are educational and fun.

eMedicine: www.emedicinehealth.com

Anatomy of the Endocrine System: www.emedicinehealth.com/articles/37539-1.asp

This Web site is written by medical professionals, but geared toward a general audience. It includes an overview on the endocrine system as well as more detailed descriptions about major glands in the endocrine system.

Kids Health: www.kidshealth.org

Endocrine System:

www.kidshealth.org/parent/general/body_basics/endocrine_prt.htm

Basic information on the endocrine system, including descriptions of glands and the physical activities they regulate. Written for a general audience.

Stress: www.kidshealth.org/teen/your_mind/emotions/stress.html

Basic information on stress, including information about the endocrine system. Written for a teenage audience.

American Academy of Child and Adolescent Psychiatry: www.aacap.org

Helping Teenagers with Stress: www.aacap.org/publications/factsfam/66.htm

A fact sheet, written for a general audience, on things families can do to help teens reduce the level of stress in their lives.

National Institutes of Health: www.nih.gov

Stress and Disease: New Perspectives:

www.nih.gov/news/WordonHealth/oct2000/story01.htm

A review of medical literature on the links between stress and disease, including an explanation of the endocrine system. Written for a general audience.

Text Correlations

Centre Point Learning, *Science II: Essential Interactions*, Unit 1: Cells, Tissues, Organs, and Systems

Glencoe, *Science Voyages*, Level Green, Chapter 22, The Endocrine System

Glencoe, *Teen Health Course 1*, Chapter 1, Mental and Emotional Health: Managing Stress

Glencoe, *Teen Health Course 2*, Chapter 7, Mental and Emotional Health: Managing Stress

Glencoe, *Teen Health Course 3*, Chapter 15, Your Body Systems: Your Endocrine System

Relevant Standards

National Science Education Standards

Content Standard F, Grades 5-8

As a result of their activities in grades 5-8, all students should develop understanding of

- Structure and function in living systems
- Reproduction and heredity
- Regulation and behavior
- Populations and ecosystems
- Diversity and adaptations of organisms

Regulation and Behavior

- All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.
- Regulation of an organism's internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required to survive.
- Behavior is one kind of response an organism can make to an internal or environmental stimulus. A behavioral response requires coordination and communication at many levels, including cells, organ systems, and whole organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.
- An organism's behavior evolves through adaptation to its environment. How a species moves, obtains food, reproduces, and responds to danger are based in the species' evolutionary history.

Benchmarks for Science Literacy

Chapter 6, Benchmark C, Grades 6-8: Basic Functions

Nerves and hormones carry messages that contract muscles to help the organism respond to its environment.

By the end of the 8th grade, students should know that:

- Hormones are chemicals from glands that affect other body parts. They are involved in helping the body respond to danger and in regulating human growth, development, and reproduction.
- Interactions among the senses, nerves, and brain make possible the learning that enables human beings to cope with changes in their environment.

Chapter 12, Benchmark D, Grades 6-8: Communication Skills

By the end of the 8th grade, students should be able to:

- Organize information in simple tables and graphs and identify relationships they reveal.
- Read simple tables and graphs produced by others and describe in words what they show.
- Locate information in reference books, back issues of newspapers and magazines, compact disks, and computer databases.
- Understand writing that incorporates circle charts, bar and line graphs, two-way data tables, diagrams, and symbols.

National Health Education Standards

Standard 1

Students will comprehend concepts related to health promotion and disease prevention.

- Explain the relationship between positive health behaviors and the prevention of injury, illness, disease, and premature death.
- Describe the interrelationship of mental, emotional, social, and physical health during adolescence.
- Explain how health is influenced by the interaction of body systems.
- Describe how family and peers influence the health of adolescents.
- Analyze how environment and personal health are interrelated.
- Describe ways to reduce risks related to adolescent health problems.

Standard 3

Students will demonstrate the ability to practice health-enhancing behaviors and reduce health risks.

- Analyze a personal health assessment to determine health strengths and risks.
- Distinguish between safe and risky or harmful behaviors in relationships.
- Demonstrate strategies to improve or maintain personal and family health.
- Demonstrate ways to avoid and reduce threatening situations.
- Demonstrate strategies to manage stress.

Ideas and Behaviors Common Among Students

What Stress Is

- When asked what stress means to them, middle school students responded that stress was characterized as “being under a lot of pressure,” “feeling angry or annoyed,” “too much on your mind and you can’t take it anymore,” and “pressure and more stomach problems” (D’Autuono, 1998).
- In general, children have identified the majority of the stressful events in their lives as stemming from school-related problems (i.e., tests, grades, assignments.) Other stressful areas in their lives were associated with peer relationship problems as well as home and family problems (Henderson & Kelbey, 1992).
- Middle school girls appear more likely to rate traumatic events as more stressful than boys, while those from socially disadvantaged areas rate everyday events as more stressful than children from more affluent backgrounds (Muldoon, 2003).

Effects of Stress

- When describing stressful situations, 4th to 6th grade students were most likely to say that they felt headache and stomachache as their main physiological symptoms. Boys were also likely to say they felt their “heart beating fast,” while girls said that they felt “sweaty” (Sharrer & Ryan-Wenger, 2002).
- Middle school students also reported that stress made them feel “sad and lonely,” “uncomfortable and nervous everywhere I go,” “like it’s never going to end,” and “tense” (D’Autuono, 1998).
- When middle school students were asked specifically about school-related stress, this type of stress was associated with lack of concentration, trouble remembering, and frustration (Mailandt, 1998).
- When describing their reactions to general stressful situations, boys were most likely to say that they felt mad, worried, or nervous, while girls would cry or feel sad, as well as feel mad and worried (Sharrer & Ryan-Wenger, 2002).

How Stress Can Be Mitigated

- Children who perceive a sense of control over their stressful situation are more successful at coping than those with less of a sense of control where they blame their situation on outside sources such as fate or luck (Chandler, 1985).
- Many children use similar coping strategies for different types of stressors in their lives, rather than different strategies for variety of stressful events (Donaldson, et al., 2000).
- Older children use coping strategies for stressful events in their lives more than younger children do (Donaldson, et al., 2000).
- When middle school students were asked what they do during stressful situations, they reported that they “go to [their] room and pound the pillow,” “go to sleep,” “worry a lot,” “watch television,” “yell or scream,” “cry,” and “cuddle the pet” (D’Autuono, 1998; Sharrer & Ryan-Wenger, 1995).
- Additionally, many children believe that coping strategies are moderately helpful in relieving stress (Donaldson, et al., 2000).

References

Centers for Disease Control and Prevention. 2000. Development of a CDC Web site for youth: Insights from kids, teens, parents, and teachers. [Unpublished research report].

Chandler, L.A. (1985). *Children under stress: Understanding emotional adjustment reactions*. Springfield, IL: Charles C. Thomas Publishers, Ltd.

D’Autuono, A. (1998). Children and stress. *Nurse Educator*, 23(4), 5-7.

Donaldson, D., Prinstein, M. J, & Danovsky, M. (2000). Patterns of children's coping with life stress: Implications for clinicians. *American Journal of Orthopsychiatry*, 70(3), 351-359.

Henderson, P.A., & Kelbey, T.J. (1992). Effects of stress-control program on children’s locus of control, self-concept, and coping behavior. *School Counselor*, 40(2), 125-131.

Mailandt, W. (1998). Adolescent perception of workload and stress. *Guidance & Counseling*, 14(1), 4-12.

Muldoon, O.T. (2003). Perceptions of stressful life events in Northern Irish school children: A longitudinal study. *Journal of Child Psychology and Psychiatry*, 44(2), 193-201.

National Institutes of Health, National Institute of Child Health and Development. (2002). Stress system malfunction could lead to serious, life threatening disease. Available at www.nichd.nih.gov/new/releases/stress.cfm. Downloaded November 10, 2005.

Sharrer, V. W, & Ryan-Wenger, N.M. (1995). A longitudinal study of age and gender differences of stressors and coping strategies in school-aged children. *Journal of Pediatric Health Care*, 9(3), 123-30.

Sharrer, V. W, & Ryan-Wenger, N.M. (2002). School-age children's self-reported stress symptoms. *Pediatric Nursing*, 28(1), 21-32.

Student Reproducible 1:

Taking Stock: My Body's Reaction to Stress



This is how a cat responds to stress. He turns sideways so he looks bigger. He fluffs out his fur and his tail so he looks bigger still. He bares his teeth.

All these signs show that he's ready to fight. And if the cat doesn't fight, he's ready to flee—to run away from danger.

Cats really do have a physical reaction to stress. It's called the "fight or flight" response.

Believe it or not, people have this response, too. This response passed to use from our ancestors, who faced predators.

Which of these reactions do you have when you face a stressful situation? A stressful situation might be just before a big test, performing in a school play, or playing a big game. Circle the word that best describes how often you have each of these reactions.

Symptoms of Stress

Rapid Heartbeat	Often	Sometimes	Rarely	Never
Shallow Breathing	Often	Sometimes	Rarely	Never
Nausea	Often	Sometimes	Rarely	Never
Dizziness	Often	Sometimes	Rarely	Never
Sweaty Palms	Often	Sometimes	Rarely	Never
Dry Mouth	Often	Sometimes	Rarely	Never
Cold Hands	Often	Sometimes	Rarely	Never
Queasiness	Often	Sometimes	Rarely	Never
Hard to Swallow	Often	Sometimes	Rarely	Never
Headache	Often	Sometimes	Rarely	Never
Stomachache	Often	Sometimes	Rarely	Never
Lack of Concentration	Often	Sometimes	Rarely	Never
Sleeplessness	Often	Sometimes	Rarely	Never
Anger	Often	Sometimes	Rarely	Never
Feeling Overwhelmed	Often	Sometimes	Rarely	Never
Crave Certain Comfort Foods	Often	Sometimes	Rarely	Never
Appetite Diminished	Often	Sometimes	Rarely	Never
Other	Often	Sometimes	Rarely	Never

Of the above, which are your three most common responses to stress?

1. _____

2. _____

3. _____

What are three things you do to beat stress?

1. _____

2. _____

3. _____

Cold Hands, Fast Heart: The Body's Physiological Reaction to Stress

The human body instinctively reacts to stress by releasing hormones that control the heart rate and breathing. It's the body's way of providing additional energy to either fight or flee—the innate human response to stress.

Hormones are chemicals, produced by glands and carried through the bloodstream, that affect the activities of organs in the body. The **hypothalamus** (high-po-THAL-uh-mus) and **pituitary** (pih-TOO-ih-tair-ee) glands, located in the brain, and the **adrenal** (uh-DREE-nal) glands, situated on top of the kidneys, control the hormones that help the body cope with change or a stressful situation. The hypothalamus signals the pituitary gland that signals the adrenal glands to release the stress hormones **epinephrine** (ep-i-NEF-rin), **norepinephrine** (nor-EP-i-NEF-rin), and **cortisol** (KORT-ti-zol). These chemicals increase heart rate and breathing, which provide a burst of energy (to fight or flee), as well as affect other bodily functions. The release of these hormones can result in a wide range of physical reactions to stress.

