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Stressing Out? Try Stressing Good Health

Objective

Students will understand the stress response in animals and humans, the physiological changes associated with stress, how it can be measured, and how it can be managed for optimal health.

National Science Education Standards

Content Standard A: Ability to Do Scientific Inquiry (9-12)
Understandings About Scientific Inquiry
Content Standard C: Life Science (9-12)
Behavior of Organisms
Content Standard F: Science in Personal and Social Perspectives (9-12)
Personal and Community Health

Warm-Up

Ask for two student volunteers (male and female) to come up to the front of the classroom to do a simple experiment. Ask them to take their pulse by placing two fingers lightly on the underside of the wrist. Have the class keep track of time for fifteen seconds, then ask the volunteers to multiply the number they got by four to find the number of beats per minute. Compare both students' heart rates. Next, the teacher should find his or her heart rate, and compare it to those of the students. Ask the class how they would explain any differences between males and females, and older vs. younger people. Ask the two student volunteers to do jumping jacks for one minute and measure their heart rates again. Ask the class to explain the differences between the resting heart rates, and the rates after exercising.

Background

The "fight or flight" response is a pattern of physiological changes in the body that help an organism (man or animal) deal with a threatening situation. For an animal, this situation could be a predator, and in order to survive or protect its young, the animal must either fight or run away. It will use all available resources to deal with the threat, and the inner balance of its body will change accordingly. This physical exertion helps to dissipate the stress hormones that are released in the animal's body.

For humans, life is more complex, and stress can take many different forms. The stress response in a true emergency (running away from a fire) is helpful and necessary to our survival. Stress can also have positive influences such as compelling us to work harder, or giving us an exciting new perspective about something. Unfortunately, our bodies cannot distinguish between a serious threat and the stresses of everyday life. We can't (and shouldn't) just get out of our cars in traffic and fight the driver who cut us off, and we cannot run away either. When the candy machine "eats" our dollar, we can't fight with it (although some people try), and fleeing leaves us with no candy and no dollar --both very unsatisfying outcomes. In these examples, the

stress response serves no purpose because we can't control what is happening. However, the body still secretes stress hormones, such as cortisol and adrenaline, to prepare us for the stressful situation. Since we didn't physically exert ourselves by fighting or running, we have not expended the energy necessary to dissipate these stress hormones coursing through our bodies. (This is why aerobic exercise is considered a good "stress-buster.") So what's the harm? The extended wear and tear on our bodies leads to *distress*. High levels of the stress hormones remain, and over time, can lead to health imbalances.

Research has shown that there is a link between the immune system and stress. When you are ill or injured, many different immune system cells stream to the location where they are needed. The cells send certain molecular signals to other cells and the brain, including the part of the brain that controls the stress response. For example, cortisol is released to help control inflammation, and plays a role in suppressing the immune system when the inflammation or infection is under control. If we are chronically stressed, high levels of stress hormones are still being released in the body, and the immune cells are being told that there is no need to do their jobs. They are less responsive to bacteria and other invaders that they should be fighting, and we tend to catch more colds or take longer to recover from illness.

Stress is largely about perception. We may view something as a threat to our well-being, and then we think we cannot cope with the threat. Although at times we really can't change what is happening, we can change the way we perceive it. We can choose how we react. Our bodies are unable to distinguish between real or imagined stress. Even remembering a scary movie or an unpleasant situation can invoke the physical changes of the fight or flight response.

What happens in our bodies when we encounter stress?

- Heart rate increases and pumps blood through the body faster, trying to provide oxygen and sugars to cells.
- Stress hormones, primarily adrenaline (also called epinephrine), are released to help maintain the heart rate and signal the liver to release sugar so the body has extra energy.
- Blood pressure may rise because of the increase in stress hormones.
- Blood supply is prioritized, and directed toward the major muscles and the parts of the brain governing motor skills and other basic functions. It moves away from the skin surface, which is a primitive response that saves us from bleeding to death when we are fighting or fleeing. The digestive and reproductive organs become a low priority, as do the parts of the brain that control thinking and speech.
- Senses sharpen so that we are more aware of our surroundings and can respond more quickly.
- Endorphins, which serve as natural painkillers, are released to provide defense against pain.

In addition to what we perceive as external stresses (traffic, taking tests, etc.), there is another type of stress that occurs inside the body. If you rest your forearm and hand on a desk and raise your index finger, you should feel tightness across the top of your hand and into your forearm. Muscles are activated by signals from the brain, and work within the body by contracting, which is a different kind of stress than the type that elicits the fight or flight response.

Tips for Managing Stress

- Be aware of what stresses you out (i.e. taking a test, lack of sleep, arguments with friends, peer pressure, relationships, family). Also be aware of how you react to these stressors.
- Recognize which stressors you can change or reduce. For example, assess your study environment. Is it pleasant, clean, and quiet, or is it somewhere that you can easily be interrupted? Do you have a comfortable chair and desk to sit at? The more comfortable you are in your study environment, the more productive you will be.
- Reduce your emotional reactions to stress. This is one major aspect of your life that you *can* control. Try to identify the situations where stress will not benefit you (i.e. when your computer is functioning too slow, or even when it crashes.)
- Moderate the way you physically react to stress. Try taking ten slow, deep breaths when you feel yourself stressing out.
- Take care of yourself by exercising regularly, eating well, and getting adequate sleep.

Student Activities

1. a) Your **Basal Metabolic Rate** (BMR), or metabolism, is the amount of energy that your body requires at rest to maintain normal functions such as breathing, keeping your body temperature stable, etc. BMR is measured in calories. Visit the following website to determine your BMR: http://www.global-fitness.com/bmr.php

b) Identify your **Maximum Heart Rate** by subtracting your age from 220.

c) Calculate your **Target Heart Rate**, which is the optimal rate to reach during aerobic exercise. Your target heart rate is generally between 50 and 75 percent of your maximum heart rate.

2. Listen to your favorite music on a walkman for 3-5 minutes. Record your heart rate. Next listen to music that you don't like and record that rate. Does your heart rate change? Why or why not?

3. Working with a partner, sit so that you can see each other's eyes. Turn out the lights and draw the shades in the classroom. Sit in the dark for three minutes. Turn on the lights and note what happens to your partner's pupils. Explain how this reaction is a stress response that is common to everyone.

4. Working with a partner, sit so you can see each other's eyes. Ask each other simple addition problems (2+2, 8+7, etc.) You should try not to move your eyes away from your partner's eyes. Increase the difficulty of the math problems (26+68, 37+54, etc.) Were you able to keep your eyes from moving? Find out why it is difficult to hold your eyes still while calculating the math problems.

5. Design two of your own experiments using your heart rate to infer stress levels. You can use either real or imagined situations (for example, thinking of a scary movie).

6. Make a list of the different types of environments you encounter each day (school, home, work, bus, etc.) List the stressors or potential stressors that you find in those environments, and rank them according to the degree to which they cause you to feel pressured. For one week, be

aware of these situations, and using the stress management tips above, try to reduce your reactions to these stressors. Write a few paragraphs about your experiences.

7. As a class, sit quietly at your desks with your eyes closed and try to relax. Your teacher, or another student, should be designated to observe students' eye movements. Count how many students kept their eyes still, and how many did not. Everyone should then take 5-10 deep breaths, still with their eyes closed. Count again how many students' eyes were moving, and how many were fairly still. Discuss if the breathing made any difference, and the possible reasons for the results.

Assessment

1. Explain how and why the fight or flight response may be activated when you stay up all night studying for an exam that you think will be very difficult.

2. Describe three physiological changes that occur when you encounter stress.

3. You are a very busy person. You go to school, work part-time after school, and are responsible for babysitting a younger sibling at home three times a week for an hour in the evening. Describe three different ways that you can manage the stress you might feel from these situations.

Extension

1. Obtain a sphygmomanometer (blood pressure cuff) and measure your blood pressure. Compare it with readings from other students. Explain the terms systolic and diastolic. Find out what the normal range is for an adult's blood pressure. Explain why high blood pressure is a health concern, and how it can be managed.

Additional Resources

All About Stress
http://www.lindaland.com/stressbook/bookindex.htm

Information on Heart Rates
http://www.heartmonitors.com/heart_rate_basics.htm

The Stress Response
http://www.howtorelax.com/stress_response.htm

Helping Teenagers With Stress
http://www.focusas.com/Stress.html

Music and Stress Reduction
http://faculty.washington.edu/chudler/surgm.html

Blood Pressure and Health
http://www.lifeclinic.com/focus/blood/whatisit.asp