Ins and Outs of Respiration

Objective
Students will determine their respiratory rate and explore the factors that affect breathing rate.

Key Questions
• What is your respiratory rate?
• How does your breathing rate change with exercise?

Materials
For each student
• Copy of "Respiratory Rate for Different Activities" chart

For every group of four students
• Watch or clock with a second hand or digital reading
Procedure

1. Respiration rate is the number of breaths taken each minute (a breath is one inhalation and one exhalation). While watching a clock, count the number of times you breathe in two minutes. Make three trials, and find the average. Divide by two to find the average number of breaths per minute. Record respiration rate on your chart.

2. Survey the class to determine if gender has an effect on breathing rate. What did you conclude? What other factors might affect respiration rate? Look over the class data for any patterns.

3. Investigate the effect exercise has on breathing rate. Walk in place for two minutes then count the breaths in one minute. How does the rate after exercising compare to that of normal breathing? Would more vigorous exercise affect the rate? Check it out.

Extensions

1. Conduct an experiment to determine whether age has an effect on normal breathing rate. Select subjects of different ages making sure both genders are equally represented. Select smokers and nonsmokers.

2. Compare the normal respiration rate of various ages with the respiration rate after exercise. Be sure to choose an exercise that will not endanger the health of the various ages.

3. The higher the level of oxygen intake, the harder the cells are working. Have students count their breaths per minute (oxygen intake) during different times of the day and for different activities-running, thinking, before getting up in the morning, etc. Keep a chart of the activity, time of day, and rate. Construct a graph to show the respiration rate per minute of the various activities. Label all parts of the graph and include a title.
4. If you have a pet, determine its resting respiration rate. First decide how to determine when the animal is breathing in and out. Place a hand on its chest and count as the chest expands and contracts with each breath. Or place a hand near its nose and count the breaths as air is exhaled. Survey the class, and graph the at-rest rates of the various animals tested. Analyze the graph for any patterns. Do you see a relationship between size or weight of the animal and the respiration rate?

Notes to the teacher: Oxygen and Breathing

The body can store many of the things it needs to function such as vitamins and food in the form of fat. Oxygen is one item that cannot be stored in sufficient quantities for more than a few minutes. At rest, the blood holds about a quart of dissolved oxygen, but it is continually being used by the cells to produce energy. The lungs need to be constantly working to furnish a sufficient supply for various activities.

Human respiration rate is controlled by a part of the brain called the medulla. It sends signals to the body to adjust the breathing speed to provide enough oxygen for every activity—sleeping, eating, exercising, etc. The level of carbon dioxide, not oxygen, in the blood is measured by the brain, which in turn makes needed adjustments in the respiration rate. During exercise, the cells burn oxygen faster to produce more energy for the body, which creates more carbon dioxide as a waste product. This increased carbon dioxide level is detected by the brain, which signals for a higher respiration rate to provide more oxygen for the cells.

Breathing is an involuntary action controlled by the brain, but it can also be controlled voluntarily. Holding your breath is one example. This can be done only for a few minutes before we become faint and the involuntary control takes over and restores breathing to a normal rate.
Hyperventilating is abnormally rapid, deep breathing and usually occurs when anxiety or emotional stress stimulates the part of the brain that regulates breathing. Kidney failure and diabetes may also cause hyperventilation. Too much carbon dioxide is exhaled, leaving less in the blood. This causes the vessels to constrict, decreasing the flow of blood. With too little blood reaching the brain, the person may become dizzy and faint. Hyperventilation attacks may last a half hour. They can be controlled by trying to slow the breathing rate. Exhaling into a paper bag and rebreathing the air can increase the carbon dioxide content in the blood and shorten the attack.

Similar to the heart, the lungs have two ways to increase oxygen intake in response to a changing demand during exercise. One is to breathe faster (respiratory rate) and the other is to breathe deeper (volume).