INVESTIGATION 4

WHAT IS THE RELATIONSHIP BETWEEN RADON AND BREATHING?

INTRODUCTION

All cells in the human body require oxygen to survive. Oxygen is used during the respiration process, and carbon dioxide is given off as a waste product. Oxygen is carried to the individual cells throughout the body via the blood system; the blood also removes the carbon dioxide waste. The interface between the inside of the body (blood) and the outside of the body (atmosphere) is found inside the lungs within little air cells, called alveoli. There oxygen and carbon dioxide pass across very thin membranes. Oxygen passes from the lung passages into the blood to replenish the oxygen poor blood. Carbon dioxide passes from the blood into the alveoli and moves from the alveoli up through the bronchioles, to be removed from the body via exhalation. From the lungs, oxygen rich blood is pumped to the heart for distribution to the rest of the body.

In this exercise, you will investigate the effect of physical exercise on the rate of respiration and the release of carbon dioxide from the lungs. Exhaled carbon dioxide can be easily detected because it combines with water to form a weak acid, called carbonic acid. The resulting increase in acidity can be determined using a pH meter or a pH indicator solution that changes color in response to changes in pH.

OBJECTIVE

To measure the change in the rate of carbon dioxide released from the lungs in response to exercise.

MATERIALS

- 100 ml graduated cylinder
- bromthymol blue solution (5 ml)
- dropper
- drinking straws
- beaker

PROCEDURE

1. Measure 100 ml of water, using the graduated cylinder, and pour it into a beaker.

2. Add 5 drops of the bromthymol blue solution to the beaker. This should turn the water blue. Bromthymol blue turns yellow in the presence of acids.

3. Blow gently into the beaker of water using the drinking straw. Your breath will inject carbon dioxide into the solution, thus making the solution more acidic.

4. Count and record (using Table 1) the number of breaths required to turn the solution yellow before exercise.

5. Empty and rinse the beaker and repeat the procedure. Record your results for a total of three trials. Average the results of the trials.

6. Run in place for 3 minutes, and then *immediately* repeat the procedure of blowing into the beaker. Record your results for 3 trials, running for 3 minutes each time. Take short rests between trials, as needed.

Table 1. Number of breaths required to turn solution yellow.

Trial	Before Exercise	Immediately After Exercise
Trial 1		
Trial 2		
Trial 3		
Average		

ANALYSIS

7. Carbon dioxide combines with water to produce a weak solution of carbonic acid, according to the following equation:

$$CO_2 + H_2O \text{ ---> } H_2CO_3$$

Why does the solution turn yellow when you breathe into it?

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8. Where did the carbon dioxide in your breath originate?

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9. What is the effect of exercise on CO_2 production?

10. Did it take more or fewer breaths to turn the solution yellow after exercise, as compared to before exercise? Why?

11. What difference did you observe among the three trials before exercise? Among the three trials after exercise? Which set of trials had more variation (before or after exercise)? Why?

CONCLUSIONS

12. Given what you have learned previously about radon and the material presented in this exercise, what are the characteristics of human breathing that makes us so susceptible to radon?

13. Is a person more susceptible to the negative effects of radon gas while asleep in bed or while exercising vigorously to a Richard Simmons or Cathy Smith video? Why?