LAB # _____Lung Capacity

Lab Instructor _____ Name _____

Date _____ Period _____

Objective: To study human lung capacity

******Use full sentences when answering all questions.****** *(It is okay to use a pencil)*

Background

The human body obtains energy through cellular respiration, a process that uses oxygen and produces waste products of carbon dioxide and water. Cellular respiration is supported by a series of events called respiration. Respiration has four phases: 1. breathing, 2. the exchange of carbon dioxide and oxygen in the lungs, 3. the transport of these gases from or to body cells, 4. the exchange of gases between blood and the cells.

Breathing is the process of drawing air into the lungs (inhalation) and expelling it (exhalation). Human lung capacity is influenced by several factors including age, sex, body position, strength of diaphragm and chest muscles and disease. In this activity you will study the capacity of the lungs, i.e. the volume of air the lungs can inhale and exhale.

Several measurements can be made in the study of lung capacity: (1) tidal capacity, the volume of air inhaled and exhaled in a normal breath; (2) inspiratory reserve volume, the amount of air that can be inhaled after a normal inhalation; (3) expiratory reserve volume, the amount of air that can be forcefully exhaled after a normal exhalation; (4) residual volume, the amount of air remaining in the lungs after a forceful exhalation; (5) vital capacity, the maximum amount of air that can be exhaled. Table 1 gives approximate average lung capacity values for young adults, both non-athletic and athletic, of both sexes. In this lab we will be measuring the vital capacity of our lungs and comparing this to the averages given.

TABLE 1. Average lung capacity for young adults

LUNG CAPACITY MEASUREMENT	MALE		FEMALE	
	NON ATHLETIC	ATHLETIC	NON ATHLETIC	ATHLETIC
TIDAL VOLUME (mL)	500	675	375	506
INSPIRATORY RESERVE VOLUME (mL)	3000	4050	2250	3038
EXPIRATORY RESERVE VOLUME (mL)	1100	1485	825	1114
RESIDUAL VOLUME (mL)	1200	1620	900	1215
VITAL CAPACITY (mL)	**4600**	**6210**	**3450**	**4658**

Pre-Lab

Read the entire lab sheet, and appropriate text pages, to answer the following question.

1. Why is increased surface area an efficient structural feature in the human body? Give a specific example.

LAB

Materials: Balloon, string, metric ruler, lung-diaphragm model, calculator

Procedure and Observations Work in pairs.

Take a few deep breaths. Then exhale deeply once into a balloon. Fill the balloon as much as you can, but only with air from one exhalation. Hold the balloon. Have a partner measure the circumference of the balloon at its widest point with a string. Then measure the length of the string to determine the circumference (in cm) of the balloon. Use this value and the formula for volume to determine your vital capacity. Show your work beneath Table 2 as you do calculations. Repeat three times and arrive at an average vital capacity. Do the same for your partner's data.

TABLE 2. Measured Vital Capacity **PARTNER'S NAME:**

		CIRCUMFERENCE (cm)		RADIUS (cm)		VITAL CAPACITY (mL) (Volume of Balloon)	
FORMULA		$C = 2\pi r$		$r = \frac{C}{2\pi}$		$V = \frac{4}{3}\pi r^3$	
		SELF	PARTNER	SELF	PARTNER	SELF	PARTNER
TRIAL	1						
	2						
	3						
NOTES: pi = π = 3.14 cm^3 = mL					**AVERAGES:**		

Name_____

Period _____

Observations

1. Referring to specific numbers in the data tables, explain how your measured lung capacity corresponds to the data in Table 1. Offer some explanation(s) for unusual experimental findings. (For example: Why did an athletic individual have a very small lung capacity?) Think of uncontrolled variables that might have been present in the experiment. Discuss your partner's measured lung capacity as well.

2. Using the bell jar model of the lungs as a guide illustrate the motion of the diaphragm and ribcage during inhalation and exhalation below. **The diagram must be labeled with words and arrows.**

INHALATION

EXHALATION

Conclusions

1.a. Why do athletes generally have a greater lung capacity than non-athletes?

b. How can vital capacity be increased in an individual?

2. Discuss why the lungs are considered part of the excretory system. Why are the lungs also considered part of the circulatory system?

3. a. Why was the value/number you obtained for lung capacity an estimated number?

b. Why is it a good idea to perform three trials of the same experiment?

4. How is the bell jar model different from the human respiratory system?

5. On a separate sheet of paper use the Scientific Method to design your own "do-able" experiment to investigate a specific physical factor that influences an organism's lung capacity. Notes: Read the Background section for some ideas. Begin with an observation – something you've noticed during today's experiment or seen/heard/read. **Follow the steps of the Scientific Method: Observation, Problem, Hypothesis, Materials and Experimental Methods. Include a control, dependent and independent variable, and identify these parts of the experiment.**