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Measuring Lung Capacity

Background: The amount of air that you move in and out of your lungs while breathing normally is referred to as TIDAL VOLUME. While it is possible to inhale and exhale more forcefully it can be dangerous. Your body regulates this with something known as the maximum amount of air moved in and out of the lungs by limiting your VITAL CAPACITY. In this activity, you will be measuring the vital capacity and the tidal volume of your own lungs using a balloon (not exactly the most accurate measure, but close enough for our needs). This measured and calculated number can after be compared with a number derived from an equation that measures your personal vital capacity. What you are actually doing is getting two different "answers" and comparing your results.

PULSE RATE MEASUREMENT EXERCISE

These activities will involve some physical exertion in an attempt to study your lung capacity and CO_2 production. CAUTION: Do not attempt these exercises in the physical activities could aggravate an existing health problem such as asthma, a cold, hay fever, etc.

Laboratory Safety Precautions: The following symbols represent the precautions that are required for this lab:

Purpose: The purpose of this lab experience is:

-to understand the relationship between your lungs and the outside air that you breathe in and out all the time.

-to understand the correlation between body surface area and your vital capacity.

-to compare a calculated value with a measured value and be able to explain the differences that may exist.

Materials: The following materials are needed to perform this lab experience:

-balloon	-metric ruler
-meter stick	-scale (bathroom type)

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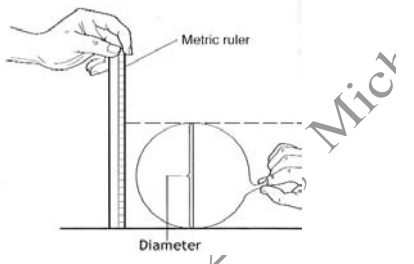
Procedure: The following procedure is utilized to perform this lab experience:

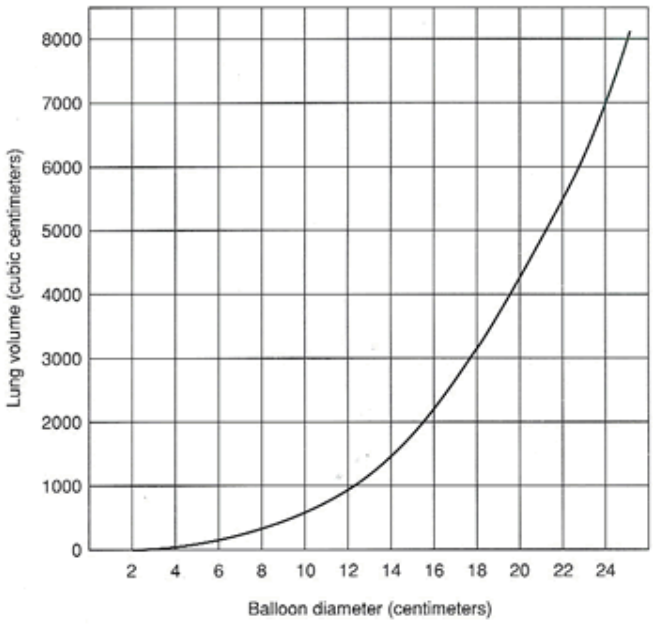
Measuring Tidal Volume

1. Stretch a round balloon several times to stretch it out.
2. Inhale normally and then exhale normally into the balloon. Do not force your breathing. Pinch the end of the balloon and measure its diameter.
3. Repeat this so that you have three total measurements and can take the average and record in the data table.

Measuring Vital Capacity

1. Repeat the procedure, only this time inhale as much air as you can and exhale forcefully.
2. Record three measurements in the data table.
3. Convert the diameters to a volume using the graph and record this in your table.





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Estimated Vital Capacity

1. To estimate your BSA (Body Surface Area) in square meters, multiply as the equation below shows. Show all your work in the space provided.

BSA (m^2) = ([Height in cm) X Weight in kg] / 3600) ^{½}

Your B.S.A. = _____

2. Once you have calculated your surface area, a second equation will calculate your estimated vital capacity. Show your work in the space provided.

Males: S.A. x 2500
Females: S.A. x 2000

Your Estimated Vital Capacity = _____

Data: The following data was collected during this lab experience:

Balloon Measured Vital Capacity Table

	Tidal Volume		**Vital Capacity**	
	Balloon Diameter	Volume (from graph)	Balloon Diameter	Volume (from graph)
Trial 1				
Trial 2				
Trial 3				
Average				

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Estimated Vital Capacity from Calculations

Estimated Vital Capacity	
Height (cm)	
Mass (kg)	
Surface Area	
Vital Capacity	

1. Why is it important to measure tidal volume and vital capacity three times and then get an average?

2. Compare your data to other members of the class. How can you account for differences?

3. How does your measured vital capacity compare to the vital capacity you estimated using the formula? Which do you think is more accurate and why?

4. How might an athlete's vital capacity compare to a non-athlete? Explain your reasoning.

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Conclusion: The following can be concluded from this lab experience:

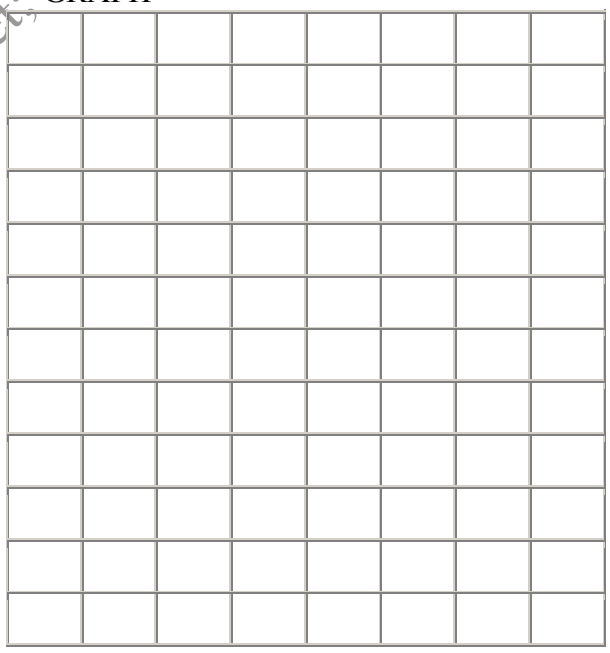
Analysis Questions: Answer the following questions in the space provided.
(Some questions adapted from work by Jim Buckley, Edwards Knox Central School)

1. Examine the data table of a person who entered into a training program. This person's vital capacity was measured over a 60 day period. Use the data to construct a graph.

DATA

Day of Training	Vital Capacity
0	4800
10	4840
20	4890
30	4930
40	4980
50	5180
60	5260

GRAPH



2. What happened to the person's vital capacity over the course of the training period?

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3. What probably caused the change?

4. How might vital capacity be important to a musician?

5. Use the nomogram (next page) to determine your body surface area.
   a. Find your weight in the right column and your height in the left column.
   b. Place a straightedge on the nomogram so the weight and height are connected.
   c. The point where the straightedge crosses the center column denotes your body's surface area in square meters.

Calculate the percent difference between the nomogram and your calculated BSA using this formula:

$$\% \text{ difference} = \frac{\text{Nomogram BSA} - \text{Calculated BSA}}{\text{Calculated BSA}} \times 100$$

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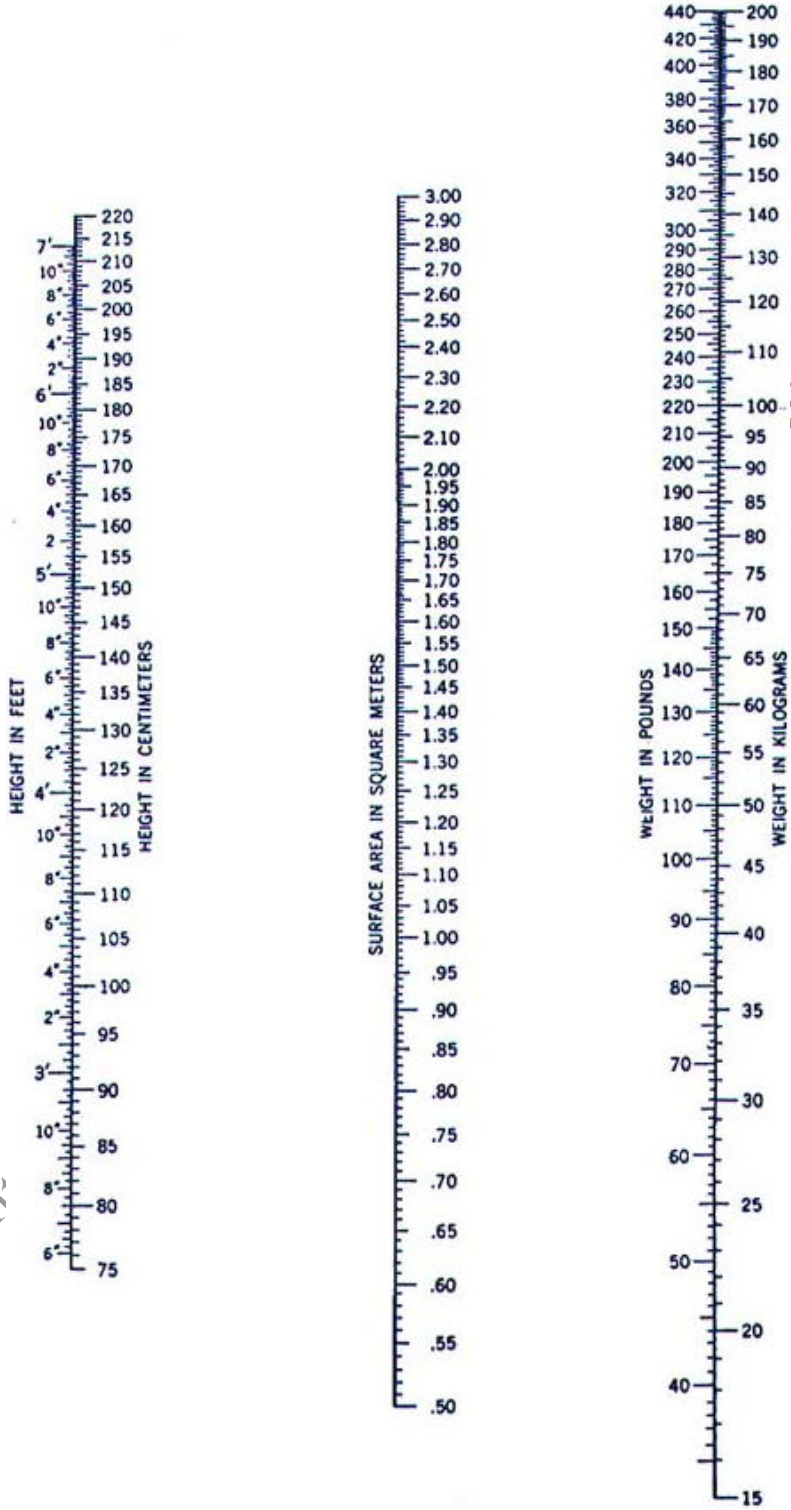
Nomogram for determining body surface area.



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Bibliography of Images used:

Possible Allergy Alert: http://www.wpclipart.com/medical/sneeze.png
In Good Health Caduceus Symbol: http://www.wpclipart.com/medical/symbols/Caduceus.png
Balloon Diameter Measurement:
http://www.sciencebuddies.org/mentoring/project_ideas/MamBio_img005.gif
Balloon Diameter vs. Lung Volume graph:
http://www.sciencebuddies.org/mentoring/project_ideas/MamBio_img006.gif
Body Surface area nomogram: http://www.smm.org/heart/lessons/jpgs/nomogram_child.jpg

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