LAB 7

HUMAN RESPIRATORY LAB

Assignments:

Due before lab:

Quiz: *Three Respiratory Interactive Physiology Animations pages 69 – 73.*

Complete the charts on pgs. 67 and 68 and read directions for using BIOPAC

During the lab period: Pages 76 – 81
Do the ***Protocols I & II*** *in your lab manual using the BIOPAC and respiratory spirometer.*

Do the ***Protocols III - V*** *involving control or respiration (Holding your breath, hyperventilating and breathing into a bag) in groups of 3 or 4 at your lab table.*

Due next lab*:*
Read and be familiar with the Terms of Renal Lab (page 83.) Know substances in the urine, the protocol for Lab 8 and how to calculate the chloride concentration in urine.
Quiz: *See Assignment sheet.*

Objectives:

Know the respiratory volumes and capacities

Measure TV, VC, IRV, ERV using the BIOPAC System (Protocol I)

Calculate TV, VC, IRC, ERV and minute ventilation rate (Protocols I & II)

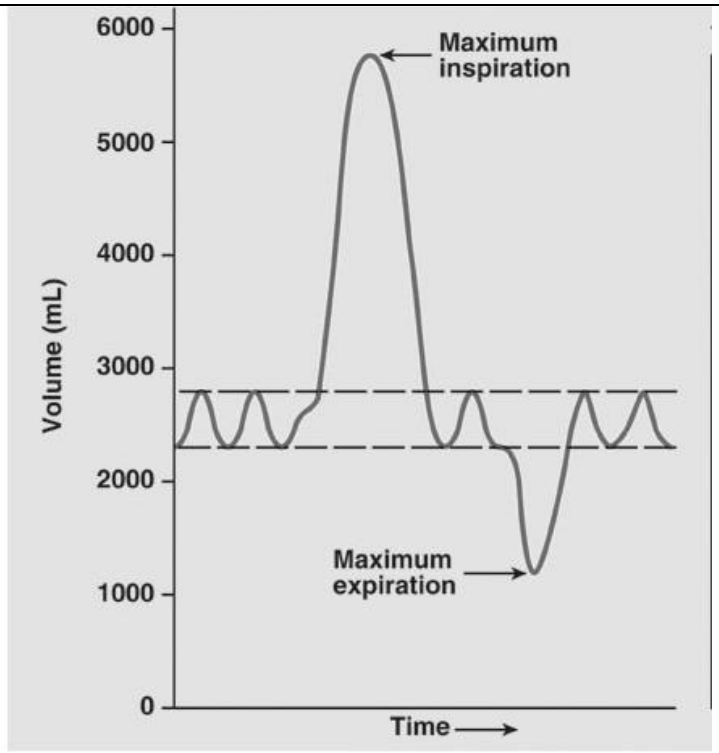
Understand and explain the control of respiration

Make predications concerning breathing rates before and after hyperventilation, breathing into a paper bag, and holding your breath and be able to give physiological explanations for your results.(Protocols III-V)

LUNGS VOLUMES

Measurement	Average Value	Description
Tidal Volume (TV)		
Inspiratory Reserve Volume (IRV)		
Expiratory Reserve Volume (ERV)		
Residual Volume (RV)		
Total Lung Capacity (TLC)		
Vital Capacity (VC)		

Label the chart below using the following terms. Tidal Volume (TV), Inspiratory Reserve Volume (IRV), Expiratory Reserve Volume (ERV), Vital Capacity (VC), Residual Volume (RV)



XXXXXXXXXXXXXXXX

XXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXX

VC = IRV + ERV + TV

Question:

Use the values below to answer question #1.

A patients lung volumes are the following:

VC = 4800 ml
TV = 600 ml
ERV = 1300 ml

Calculate the patient's IRV

Respiratory System: Pulmonary Ventilation (Lab 7)

View “Pulmonary Ventilation” in Mastering A&P and answer the following: (Mastering A&P> study area>A&P Fix>Interactive Physiology>Pulmonary Ventilation)

1. What is Boyle’s Law?

2. If the volume of a container increases, the pressure in the container _____.

3. a. What happens to the diaphragm and external intercostals muscles during inspiration?

   b. What effect does this have on the volume of the thoracic cavity? _____

   c. How does this affect the pressure within the thoracic cavity? _____

4. The intrapleural pressure is always negative compared to the other two pressures (subatmospheric), what purpose does this serve?

5. What are the three causes of the negative (subatmospheric) pressure in the intrapleural cavity?

   a._____
   b._____
   c._____

6. What is a pneumothorax?

7. What happens to the lungs when intrapulmonary pressure = intrapleural pressure?

8. a. What is the effect of Acetylcholine (parasympathetic nerve stimulation) on the bronchioles?

   b. How does this affect airway resistance?

9. a. What is the effect of histamine on airway resistance?

   b. How does this affect airway resistance?

Respiratory System: Gas Exchange (Lab 7)

(View “Gas Exchange” in Mastering A&P and answer the following questions:
(Mastering A&P> study area>A&P Fix>Interactive Physiology>Gas Exchange)

External Respiration

1. What is the P_{O2} of alveolar air? _____

2. What is the P_{O2} of the blood entering the pulmonary capillaries? _____

3. Explain the diffusion of oxygen at the alveolus in terms of its concentration gradient?

4. What is the P_{O2} of the blood leaving the pulmonary capillaries? _____

5. What is the P_{CO2} of alveolar air? _____

6. What is the P_{CO2} of the blood entering the pulmonary capillaries? _____

7. Explain the diffusion of carbon dioxide at the alveolus in terms of its Concentration gradient?

8. What is the P_{CO2} of the blood leaving the pulmonary capillaries? _____

9. What is Henry’s Law?

10. Why is the P_{CO2} concentration gradient much smaller than the P_{O2} concentration gradient?

Internal Respiration

11. What is the P_{O2} in the tissues? _____

12. What is the P_{O2} in the systemic capillaries entering the tissues? _____

13. Explain the diffusion of oxygen at the tissues in terms of its concentration gradient?

14. What is the P_{O2} of the blood in the systemic capillaries leaving the tissues?

_____

15. What is the P_{CO2} of the tissues? _____

16. What is the P_{CO2} in the systemic capillaries entering the tissues? _____

17. Explain the diffusion of carbon dioxide at the tissues in terms of its concentration gradient?

18. What is the P_{CO2} in the systemic capillaries leaving the tissue? _____

Respiratory System - Control of Respiration (Lab 7)

(View “Control of Respiration” in Mastering A&P and answer the following: (Mastering A&P> study area>A&P Fix>Interactive Physiology>Control of Respiration)

1. What are the 3 main chemical factors that control respiration?

   a._____

   b._____

   c._____

2. What part of the brain are the inspiratory neurons located?

3. Inspiratory neurons send impulses along the _____ nerve to the

   _____ (skeletal muscle) and _____ muscles.

4. How is expiration initiated?

5. The most important factor controlling the rate and depth of breathing is _____.

6. What ion stimulates the central chemoreceptors? _____

7. Refer to question #6. Explain how this ion is formed?

8. If a patient hyperventilates, what happens to their CO_2 levels? _____

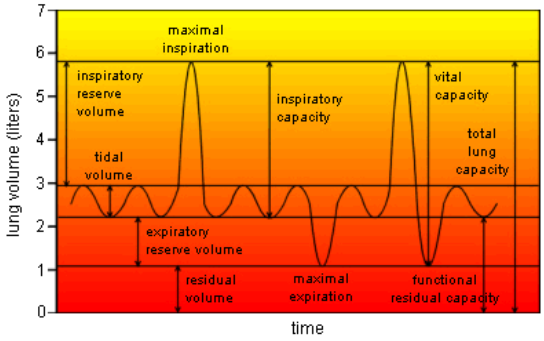
   How does this effect the pH?_____

9. Name 4 other factors that influence ventilation?
   a. _____
   b. _____
   c. _____
   d. _____

10. Explain the Hering-Breuer Reflex and how it prevents over inflation of the lungs?

11. What are the 5 factors that increase ventilation during exercise?
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____

Directions for using the Biopac #12 Lung



Calibration 1 – with filter and large syringe attached – plunger out – hold steady

Calibration 2 – Do 5 push-and-pulls with plunger: 1 sec push or pull, then 2 sec between each.

Remove syringe and add mouth piece to bacteriological filter. Put on nose clip.

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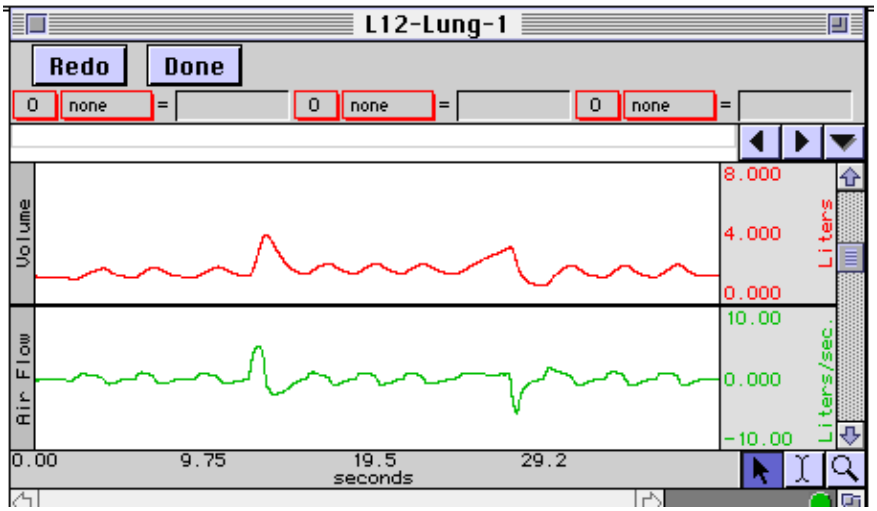
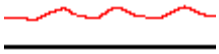
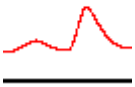


Protocol I

1. Breathe normally for 10-12 breaths

Tidal Volume (p-p) 

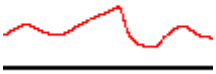
2. Inhale deeply



Inspiratory Reserve Volume (p-p)

3. Breathe normally for 6-7 breaths

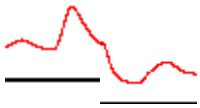
4. Exhale deeply



Expiratory Reserve Volume (p-p)

5. Breathe normally for 6-7 breaths

6. Inhale deeply then exhale deeply



Vital Capacity (max)

Protocol II

Before and after exercise

Use Biopac to determine frequency and tidal volume. Record on next page.

Protocols III – V do not use Biopac

Throw away mouthpiece and bacteriological filter. ***Do not throw away nose clip!***

Worksheets for Respiratory Lab

PROTOCOL I

Measure: TV, IRV, ERV and VC using the Biopac System

TV =
(p-p)

IRV =
(p-p)

ERV =
(p-p)

VC (measuring) =
(max)

VC (adding the volumes) =

Compare these values to normal values given in your textbook. Are they higher, lower or about the same? Record your response next to your values.

PROTOCOL II

Using the Biopac Computers measure normal respirations for one minute. Record TV and count the number of breaths in one minute.

TV = _____ ml

Frequency = _____ breaths/min

Now calculate Minute ventilation (V_E = TV x breaths/minute)

Minute Ventilation ($\dot{V}_E$) = _____ ml/min

Prediction - **Exercise**

Please write down what you think will happen to frequency, tidal volume and the minute ventilation in response to **exercise**. Will it increase, decrease or stay the same. Fill in the chart with arrows.

Frequency	Tidal Volume	Minute Ventilation

Now, measure frequency and tidal volume using the Biopac computer immediately after a few minutes of exercise. Compare with control values calculated above. Record your values and compute minute ventilation:

	Frequency	Tidal Volume	Minute Ventilation
Control			
Exercise			

What happens to frequency and tidal volume with exercise?

PROTOCOL III

Holding your breath.

1. Breathe normally for 2 minutes, then inhale deeply. Now measure how long you can hold your breath. Record in the table below.

2. Breathe normally for 2 minutes and exhale deeply. Now measure how long you can hold your breath. Record below.

A. Measurement:

	How long you can hold your breath
After forced inspiration	
After forced expiration	

B. DATA SHEET:

1. If you inhale deeply before holding your breath, do you have the urge to inspire or expire when you resume respiration? _____

2. Explain your results in #1. Consider what effect lung volume may have on the desire to inspire or expire.(Discuss this in terms of the Hering Breuer reflex)

3. If you exhale deeply before holding your breath, do you have the urge to inspire or exhale when you resume respiration? _____

PROTOCOL IV

Hyperventilation is an increase in ventilation with no change in metabolic rate.

1. First, breathe normally for 1 minute and **record breathing rate**.

2. Then hyperventilate by breathing deeply and forcefully at the rate of about 1 breath/4 sec for about 30 seconds. Record breathing rate **after** hyperventilation has been completed.

3. Rest for 3 minutes. Then, hold your breath for as long as you can and record below.

4. Hyperventilate for 1 minute, then hold your breath for as long as you can and record.

A. **Measurement**

	Breathing rate
Breathing rate before hyperventilation (breaths/min)	
Breathing rate **after** hyperventilation (breaths/min)	
How long can you hold your breath after normal quiet breathing?	
How long you can hold your breath after hyperventilating?	

1. **After** hyperventilating, is your **respiratory rate** faster or slower than during normal quiet breathing? _____

2. Why? Discuss chemoreceptors and respiratory drive

3. After hyperventilating, can you **hold your breath** for a longer or shorter period of time compared to after normal quiet breathing? _____

4. Why? Discuss chemoreceptors and respiratory drive.

5. Why do you become dizzy after hyperventilating?

PROTOCOL V

Breathing into a paper bag.

1. Breathe normally for 3 minutes and record your breathing rate.

2. Then breathe into a paper bag for 3 minutes. After **completing this**, measure your breathing rate for 1 minute.

3. Next, hyperventilate for 1 minute. Then breathe into a paper bag for 3 minutes. After completing this, measure your breathing rate for 1 minute.

A. **Measurement**

What do you think will happen to your subject's ventilation following a period of rebreathing the same gas?

	Breathing rate
1. Normal quiet breathing rate	
2. rebreathing bag air after normal respiration	
3. rebreathing bag air after hyperventilation	

1. **After** breathing into a paper bag for 3 minutes, does respiration become faster or slower than during normal quiet breathing?

   _____

2. Why? – Discuss in terms of chemoreceptors and respiratory drive.

3. Hyperventilate before breathing into a paper bag. Is your respiration slower or faster than after rebreathing in bag after normal respiration?

   _____

4. Explain your results. – Discuss in terms of chemoreceptors and respiratory drive.