

**Biology 48 - Human Physiology**  
Lecture Summary Sheet – Norris

Respiratory Physiology

I. Definitions

- A. Ventilation
- B. Respiration - systemic  
- cellular

II. Respiratory System Functional Anatomy

- A. Conduction Zone (dead air space)
  - 1. Transmission
  - 2. Air Treatment - filtration  
- humidifying  
- warming

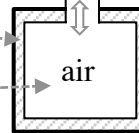
- B. Respiratory Zone (gas exchange membrane)

III. Ventilation - "breathing"

- A. Boyle's Law: (Press. = 1/Volume)  
*-the pressure of a gas is inversely related to its volume*

B. Phases

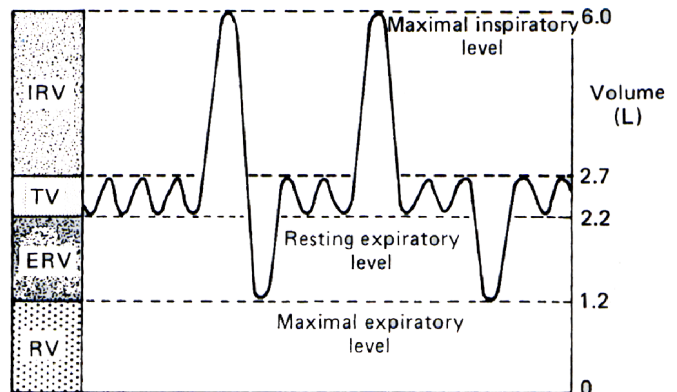
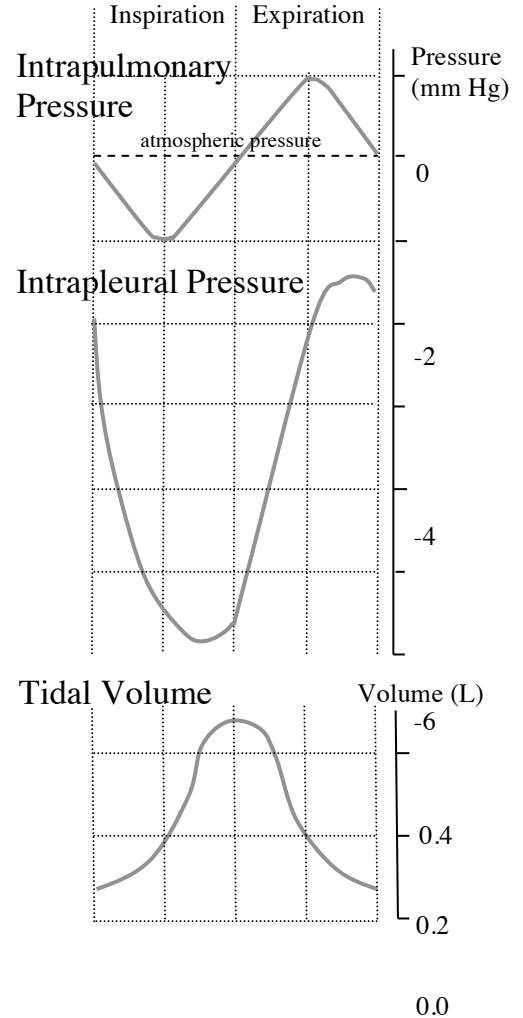
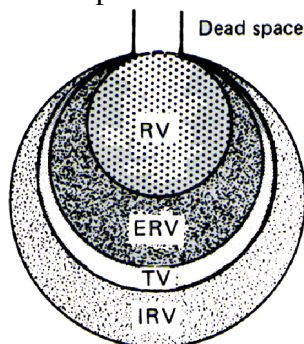
- 1. Inspiration (inhalation)
  - a. Muscles
  - b. Lung Compliance
  - c. Pressure Differences (vs. atmospheric pressure)
    - intrapleural pressure



- 2. Expiration (exhalation)
  - a. Muscles
  - b. Lung Elasticity
    - surface tension
    - Law of LaPlace
    - surfactant

C. Alveolar Ventilation

IV. Volumes and Capacities



IRV = Inspiratory reserve volume      TV = Tidal volume  
ERV = Expiratory reserve volume      RV = Residual volume  
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## V. Factors Affecting Ventilation

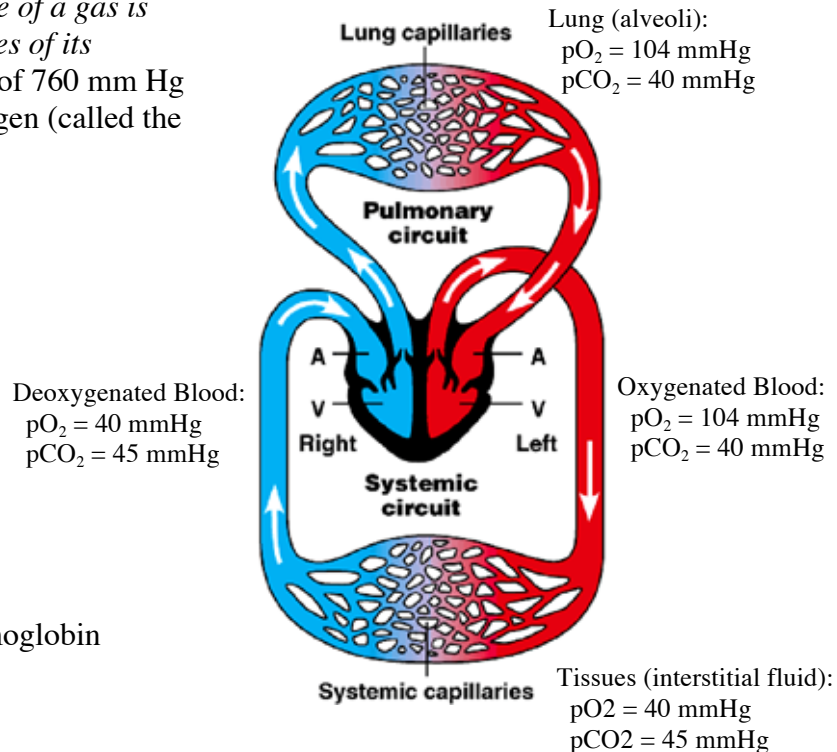
1. Obstructive Disorders
2. Restrictive Disorders

## VI. Gas Exchange and Transport

### A. Overview

Atmospheric Air - composition (21% O<sub>2</sub>, 78% N<sub>2</sub>)  
- sea level air pressure (14.7 psi or 760 mm Hg)

Dalton's Law: *-the pressure of a gas is equal to the sum of pressures of its constituent parts thus 21% of 760 mm Hg (159 mm Hg) is due to oxygen (called the partial pressure = pO<sub>2</sub>)*



### B. Oxygen Transport

- 98% transported by hemoglobin

### C. Carbon Dioxide Transport

- 7% dissolved in plasma
- 23% bound to amino groups of hemoglobin
- 70% transported as bicarbonate ( $\text{CO}_2 + \text{H}_2\text{O} \xrightarrow{\text{ca.}} \text{H}_2\text{CO}_3 \leftrightarrow \text{HCO}_3^- + \text{H}^+$ )

## VII. Regulatory Mechanisms

### A. Respiratory Center

### B. Sensors

1. Chemoreceptors (know this formula:  $\text{CO}_2 + \text{H}_2\text{O} \xrightarrow{\text{ca.}} \text{H}_2\text{CO}_3 \leftrightarrow \text{HCO}_3^- + \text{H}^+$ )
  - a. Central Chemoreceptors (medulla oblongata)
  - b. Peripheral Chemoreceptors (carotid and aortic bodies)
2. Protective Reflexes
  - a. Irritant
  - b. Stretch (Hering-Breuer Reflex)

## VIII. Additional Key Terms / Topics

alveoli	atelectasis	apnea	compliance	embolism	eupnea
hypercapnea	hyperoxia	hyperpnea	hyperventilation		hypocapnea
hypopnea	hypoventilation	hypoxia	pleurisy	pneumonia	pulmonary
surfactant	tracheostomy	COPD (chronic obstructive pulmonary disease)			

### **Study Questions – Respiratory System:**

1. Define “ventilation”.
2. Define “respiration”. Distinguish between systemic respiration (both external and internal) and cellular respiration.
3. Describe the major functions of the respiratory system.
4. Identify the two different functional zones of the respiratory system.
5. Describe the roles of the conduction zone and the significance of each role.
6. Describe the structure of the respiratory “exchange” zone. What are the characteristics of the respiratory zone?
7. Describe Boyle’s Law. Explain how Boyle’s Law relates to ventilation.
8. Describe the process of inhalation. Is it active or passive? Describe the direction of airflow. What is causing it to move?
9. Describe the pressure and volume changes that are occurring during inhalation (in the lungs and in the intrapleural space).
10. What holds the lungs against the chest wall?
11. What is the significance of lung compliance to inhalation?
12. Describe the process of exhalation. Is it active or passive? Describe the direction of airflow. What is causing it to move?
13. Describe the pressure and volume changes that are occurring during exhalation (in the lungs and in the intrapleural space).
14. What is the significance of lung elasticity to exhalation?
15. What is the primary source of lung elasticity? Explain.
16. What is the Law of Laplace?
17. What is surfactant? What is the function of surfactant?
18. Why is the concentration of oxygen lower in the alveoli than in the inhaled air? How does the conduction zone contribute to alveolar ventilation?
19. Name and describe all lung volumes and capacities.
20. What is the significance of the residual volume?
21. Explain what an obstructive disorder is. How do obstructive disorders effect ventilatory volumes and rates?
22. Explain what a restrictive disorder is. How do restrictive disorders effect ventilatory volumes and rates?
23. What is a partial pressure? What is it used for?
24. Describe the process of gas exchange (describe the driving forces causing molecular movement, the path of molecular movement, and the mechanisms that enhance molecular movement in the desired direction).
25. Describe how oxygen is transported in the blood. What factors enhance oxygen movement into the blood when in the lungs and oxygen movement from the blood when in the tissues?
26. Describe how carbon dioxide is transported in the blood. Where is it distributed in the blood and in what proportions?
27. Describe the relationship between carbon dioxide and bicarbonate.
28. Describe the chloride shift.
29. Describe the relationship between carbon dioxide, hemoglobin and oxygen.
30. Describe the location and chemical sensitivity of the different respiratory chemoreceptors.
31. What is the primary stimulus for breathing? Describe how carbon dioxide, pH and oxygen are related to the regulation of ventilation.
32. What is the Hering-Breuer reflex?