



**BSC529.01W RESPIRATORY PHYSIOLOGY  
COURSE SYLLABUS: FALL 2014**

**Instructor:** Mark D. Slivkoff, Ph.D.

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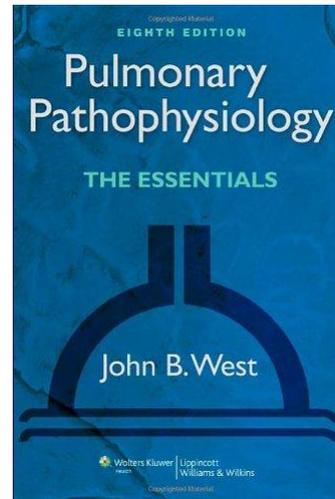
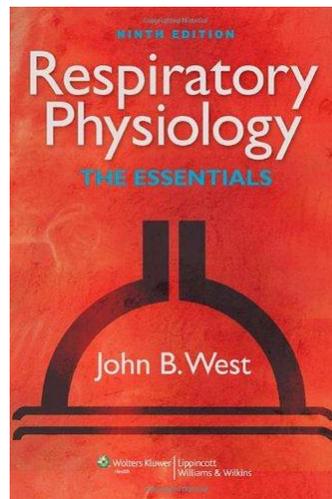
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**COURSE INFORMATION**

**Materials – Textbooks, Readings, Supplementary Readings**



***Textbook(s) Required:***

West, John B. *Respiratory Physiology: The Essentials, Ninth Edition*. ISBN-13: 978-1609136406

West, John B. *Pulmonary Pathophysiology: The Essentials, Eighth Edition*. ISBN-978-1451107135

***Online Lecture Supplement (Required):*** Dr. West (the author of your textbook, and unarguably the most well-known respiratory physiology in the world) has numerous lectures available online, for free. The lectures follow and build on all the topics discussed in his book. His online lectures are available at <http://meded.ucsd.edu/ifp/jwest/>.

**Course Description:**

This advanced medical/graduate school-level physiology course, which is completely online, focuses on human respiratory physiology and pathophysiology. The student's understanding of the material will be assessed via multiple choice question sets and case study write-ups. All assessments will be posted on the course's home page within eCollege.

## **Student Learning Outcomes (SLOs):**

At the end of this web-based course, the student should be able to sufficiently address each of the following objectives. I have made the list comprehensive since this is a web-based course, and I prefer to have all outcomes in a single document. These outcomes are a part of the The American Physiological Society Medical Curriculum Objectives Project. The complete curriculum objectives are available at: <http://www.the-aps.org/MedPhysObj/>

### Pulmonary Ventilation

1. Diagram how pleural pressure, alveolar pressure, airflow, and lung volume change during a normal quiet breathing cycle. Identify on the figure the onset of inspiration, cessation of inspiration, and cessation of expiration. Describe how differences in pressure between the atmosphere and alveoli cause air to move in and out of the lungs.
2. Draw a normal pulmonary pressure-volume (compliance) curve (starting from residual volume to total lung capacity and back to residual volume), labeling the inflation and deflation limbs. Explain the cause and significance of the hysteresis in the curves.
3. Define compliance and identify two common clinical conditions in which lung compliance is higher or lower than normal.
4. Draw the pressure-volume (compliance) curves for the lungs, chest wall, and respiratory system on the same set of axes. Show and explain the significance of the resting positions for each of these three structures.
5. Identify the forces that generate the negative intrapleural pressure when the lung is at functional residual capacity, and predict the direction that the lung and chest wall will move if air is introduced into the pleural cavity (pneumothorax).
6. Draw a normal spirogram, labeling the four lung volumes and four capacities. List the volumes that comprise each of the four capacities. Identify which volume and capacities cannot be measured by spirometry.
7. Define the factors that determine total lung capacity, functional residual capacity, and residual volume. Describe the mechanisms responsible for the changes in those volumes that occur in patients with emphysema and pulmonary fibrosis.
8. Define surface tension and describe how it applies to lung mechanics, including the effects of alveolar size and the role of surfactants. Define atelectasis and the role of surfactants in preventing it.
9. Describe the principal components of pulmonary surfactant and explain the roles of each.
10. Describe the effects of airway diameter and turbulent flow on airway resistance.
11. Describe how airway resistance alters dynamic lung compliance.
12. Draw a spirogram resulting from a maximal expiratory effort. Label the forced vital capacity (FVC), timed forced expiratory volumes (FEVs), and the maximal expiratory flow rate between 25-75% of FVC (FEF25-75%).
13. Describe the regional differences in alveolar ventilation in healthy and diseased lungs and explain the basis for these differences.

### Alveolar Ventilation

14. Define partial pressure and fractional concentration as they apply to gases in air. List the normal fractional concentrations and sea level partial pressures for O<sub>2</sub>, CO<sub>2</sub> and N<sub>2</sub>
15. List the normal airway, alveolar, arterial, and mixed venous PO<sub>2</sub> and PCO<sub>2</sub> values. List the normal arterial and mixed venous values for O<sub>2</sub> saturation, [HCO<sub>3</sub>-], and pH.
16. Define and contrast the following terms: anatomic dead space, physiologic dead space, wasted (dead space) ventilation, total minute ventilation and alveolar minute ventilation.
17. Describe the concept by which physiological dead space can be measured.
18. Define and contrast the relationships between alveolar ventilation and the arterial PCO<sub>2</sub> and PO<sub>2</sub>.
19. Describe in quantitative terms the effect of ventilation on PCO<sub>2</sub> according to the alveolar ventilation equation.

20. Estimate the alveolar oxygen partial pressure ( $P_{A}O_2$ ) using the simplified form of the alveolar gas equation. Be able to use the equation to calculate the amount of supplemental  $O_2$  required to overcome a reduction in  $P_{A}O_2$  caused by hypoventilation or high altitude.
21. Define the following terms: hypoventilation, hyperventilation, hypercapnea, eupnea, hypopnea, and hyperpnea.

### Pulmonary Circulation

22. Contrast the systemic and pulmonary circulations with respect to pressures, resistance to blood flow, and response to hypoxia.
23. Describe the regional differences in pulmonary blood flow in an upright person. Define zones I, II, and III in the lung, with respect to pulmonary vascular pressure and alveolar pressure.
24. Describe how pulmonary vascular resistance changes with alterations in cardiac output or pulmonary arterial pressure. Explain in terms of distention and recruitment of pulmonary vessels. Identify the zones in which these two mechanisms apply.
25. Describe how pulmonary vascular resistance changes with lung volume. Explain in terms of alterations in alveolar and extra-alveolar blood vessels.
26. Describe the consequence of hypoxic pulmonary vasoconstriction on the distribution of pulmonary blood flow.
27. Describe the effects of inspired nitric oxide on pulmonary vascular resistance and hypoxic vasoconstriction.
28. Explain the development of pulmonary edema by a) increased hydrostatic pressure, b) increased permeability, c) impaired lymphatic outflow or increased central venous pressure, and d) hemodilution (e.g., with saline volume resuscitation).

### Pulmonary Gas Exchange

29. Name the factors that affect diffusive transport of a gas between alveolar gas and pulmonary capillary blood.
30. Describe the kinetics of oxygen transfer from alveolus to capillary and the concept of capillary reserve time (i.e., the portion of the erythrocyte transit time in which no further diffusion of oxygen occurs).
31. Define oxygen diffusing capacity, and describe the rationale and technique for the use of carbon monoxide to determine diffusing capacity.
32. Describe how the ventilation/perfusion (V/Q) ratio of an alveolar-capillary lung unit determines the  $PO_2$  and  $PCO_2$  of the blood emerging from that lung unit.
33. Identify the average V/Q ratio in a normal lung. Explain how V/Q is affected by the vertical distribution of ventilation and perfusion in the healthy lung.
34. Describe the normal relative differences from the apex to the base of the lung in alveolar and arterial  $PO_2$ ,  $PCO_2$ , pH, and oxygen and carbon dioxide exchange.
35. Predict how the presence of abnormally low and high V/Q ratios in a person's lungs will affect arterial  $PO_2$  and  $PCO_2$ .
36. Describe two causes of abnormal V/Q distribution.
37. Define right-to-left shunts, anatomic and physiological shunts, and physiologic dead space (wasted ventilation). Describe the consequences of each for pulmonary gas exchange.
38. Describe the airway and vascular control mechanisms that help maintain a normal ventilation/perfusion ratio. Name two compensatory reflexes for V/Q inequality.
39. Calculate the alveolar to arterial  $PO_2$  difference, (A-a)  $DO_2$ . Describe the normal value for (A-a)  $DO_2$  and the significance of an elevated (A-a)  $DO_2$ .
40. Name five causes of hypoxemia.

### Oxygen and Carbon Dioxide Transport

41. Define oxygen partial pressure (tension), oxygen content, and percent hemoglobin saturation as they pertain to blood.

42. Draw an oxyhemoglobin dissociation curve (hemoglobin oxygen equilibrium curve) showing the relationships between oxygen partial pressure, hemoglobin saturation, and blood oxygen content. On the same axes, draw the relationship between  $PO_2$  and dissolved plasma  $O_2$  content (Henry's Law). Compare the relative amounts of  $O_2$  carried bound to hemoglobin with that carried in the dissolved form.
43. Describe how the shape of the oxyhemoglobin dissociation curve influences the uptake and delivery of oxygen.
44. Define  $P_{50}$ .
45. Show how the oxyhemoglobin dissociation curve is affected by changes in blood temperature, pH,  $PCO_2$ , and 2,3-DPG, and describe a situation where such changes have important physiological consequences.
46. Describe how anemia and carbon monoxide poisoning affect the shape of the oxyhemoglobin dissociation curve,  $PaO_2$ , and  $SaO_2$ .
47. List the forms in which carbon dioxide is carried in the blood. Identify the percentage of total  $CO_2$  transported as each form.
48. Describe the importance of the chloride shift in the transport of  $CO_2$  by the blood.
49. Identify the enzyme that is essential to normal carbon dioxide transport by the blood and its location.
50. Draw the carbon dioxide dissociation curves for oxy- and deoxyhemoglobin. Describe the interplay between  $CO_2$  and  $O_2$  binding on hemoglobin that causes the Haldane effect.
51. Explain why the total gas pressure of the venous blood is subatmospheric and why this situation is accentuated when breathing 100%  $O_2$ . Explain how breathing 100%  $O_2$  can result in further arterial  $O_2$  desaturation in hypoxemic patients who develop mucous plugging of their airways (absorption atelectasis).
52. Define respiratory acidosis and alkalosis and give clinical examples of each.
53. Describe the mechanism and function of respiratory acid base compensations.

### Respiratory Control

54. Identify the regions in the central nervous system that play important roles in the generation and control of cyclic breathing.
55. Give three examples of reflexes involving pulmonary receptors that influence breathing frequency and tidal volume. Describe the receptors and neural pathways involved.
56. List the anatomical locations of chemoreceptors sensitive to changes in arterial  $PO_2$ ,  $PCO_2$ , and pH that participate in the control of ventilation. Identify the relative importance of each in sensing alterations in blood gases.
57. Describe how changes in arterial  $PO_2$  and  $PCO_2$  alter alveolar ventilation, including the synergistic effects when  $PO_2$  and  $PCO_2$  both change.
58. Describe the mechanisms for the shift in alveolar ventilation that occur immediately upon ascent to high altitude, after remaining at altitude for two weeks, and immediately upon return to sea level.
59. Describe the significance of the feedforward control of ventilation (central command) during exercise, and the effects of exercise on arterial and mixed venous  $PCO_2$ ,  $PO_2$ , and pH.

### Nonrespiratory Lung Functions

60. Identify the mechanism by which particles are cleared from the airways.
61. Describe mechanisms for clearance of vasoactive substances from the blood during passage through the lung. Identify a substance that is almost completely cleared and one that is not cleared to any significant extent.

## **COURSE REQUIREMENTS**

### **Instructional Methods / Activities / Assessments**

This course consists of a series of activities and assessments to assist you in achieving the outcomes for the course and instructional units.

Your entire course grade is based on your performance on various assignments. Some assignments will require you to answer a set of multiple choice questions (MCQs) whereas other assignments (case studies) will require you to write short answers and/or mini essays. Each assignment will therefore not be worth the same number of points.

### **Grading**

The total number of points possible for each assignment will vary. At the end of the semester, the student's grade is determined by calculating the percentage of the total possible points received by the student. Percentages are then converted to letter grades using the following rubric:

<b>Percentage of Total Possible Points Received by Student</b>	<b>Letter Grade</b>
Greater than or equal to 89.5	A
Greater than or equal to 79.5 , but less than 89.5	B
Greater than or equal to 69.5 , but less than 79.5	C
Greater than or equal to 59.5 , but less than 69.5	D
Less than 59.5	F

## **TECHNOLOGY REQUIREMENTS**

This course is web-based, and will therefore be administered via eCollege (see "ACCESS AND NAVIGATION). All course announcements, which mainly include news about assignments, are posted through eCollege (usually via email). In addition to reading the announcements (my emails), you will be uploading your assignments to the Dropbox. As grades are updated, I update the Gradebook. Thus, the three major components used in eCollege are Announcements, Dropbox, and Gradebook.

The following information has been provided to assist you in preparing to use technology successfully in this course.

- Internet access/connection – high speed recommended (not dial-up)
- Word Processor (Microsoft Word, OpenOffice Writer, et cetera) and Slide Program (Microsoft PowerPoint, OpenOffice Impress, et cetera)

Our campus is optimized to work in a Microsoft Windows environment. This means our courses work best if you are using a Windows operating system (XP or newer) and a recent version of Microsoft Internet Explorer (6.0, 7.0, 8.0, or 9.0). Your courses will also work with Macintosh OS X and most Linux distributions. To launch a browser test within any operating system, login in to eCollege, click on the 'myCourses' tab, and then select the "Browser Test" link under Support Services.

## **ACCESS AND NAVIGATION**

### **eCollege Access and Log in Information**

This course will be facilitated using eCollege, the Learning Management System used by Texas A&M University-Commerce. To get started with the course, go to: <https://leo.tamuc.edu/>  
You will need your CWID and password to log in to the course. If you do not know your CWID or have forgotten your password, contact Technology Services at 903.468.6000 or [helpdesk@tamuc.edu](mailto:helpdesk@tamuc.edu).

### **Being a Successful Student**

- [What Makes a Successful Online Student?](#)
- [Self-Evaluation for Potential Online Students](#)
- [Readiness for Education at a Distance Indicator \(READI\)](#)
  - o *Login Information:* Login = **tamuc**; password = **online**

## **COMMUNICATION AND SUPPORT**

### **Interaction with Instructor Statement**

I will communicate with you primarily through your college email address (MyLeo email address). If you email me, expect a response within 24 hours; if I email you, I'll expect a response within 48 hours.

## **COURSE AND UNIVERSITY PROCEDURES/POLICIES**

### **Course Specific Procedures**

#### ***Academic Honesty Policy***

Texas A&M University-Commerce does not tolerate **plagiarism** and other forms of academic **dishonesty**. Conduct that violates generally accepted standards of academic honesty is defined as academic dishonesty. "Academic dishonesty" includes, but is not limited to, plagiarism (the appropriation or stealing of the ideas or words of another and passing them off as one's own), cheating on exams or other course assignments, collusion (the unauthorized collaboration with others in preparing course assignments), and abuse (destruction, defacing, or removal) of resource material.

#### ***Assignment Policy***

Official due dates are for each assignment will be announced through eCollege or directly by email. Assignments must be uploaded to the eCollege Dropbox. The format of the file may vary, depending on the assignment. Please note that for every file you submit, you must have your last name included in the filename as well as in the header.

#### ***Late Work***

Late work will not be accepted.

#### ***Drop a Course***

A student may drop a course by logging into their myLEO account and clicking on the hyperlink labeled 'Drop a class' from among the choices found under the myLEO section of the Web page.

***Incompletes***

Incomplete grade ("I") may be granted under extreme circumstances.

**University Specific Procedures*****ADA Statement***

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you have a disability requiring an accommodation, please contact:

Office of Student Disability Resources and Services

Texas A&M University-Commerce

Gee Library- Room 132

Phone (903) 886-5150 or (903) 886-5835

Fax (903) 468-8148

[StudentDisabilityServices@tamuc.edu](mailto:StudentDisabilityServices@tamuc.edu)

***Student Conduct***

All students enrolled at the University shall follow the tenets of common decency and acceptable behavior conducive to a positive learning environment. (See *Code of Student Conduct from Student Guide Handbook*).

## COURSE OUTLINE / CALENDAR

Week	Topics	Textbook Chapter	Lecture Video
		RP (PP)*	RP (PP)*
1	Enrollment and Pretest	1	1
2	Structure and Function of the Lung; Ventilation	1, 2	1, 2
3	Blood Gas Transport	6	3
4	Acid-Base Balance	6	4
5	Diffusion	3	5
6	Pulmonary Blood Flow	4	6
7	Pulmonary Gas Exchange	5	7, 8
8	Mechanics of Breathing	7	9, 10
9	Control of Ventilation	8	11
10	Respiration Under Stress	9	13
11	Respiration at the Limit	9	14
12	Pulmonary Function Tests	10 (1)	(1)
13	Obstructive Diseases 1: Chronic Obstructive Pulmonary Disease	(4)	(2)
14	Obstructive Diseases 2: Asthma and Localized Airway Obstruction	(4)	(3)
15	Restrictive Diseases	(5)	(4)
16	Vascular Diseases; Respiratory Failure	(6, 8)	(5, 7)

Assessments will consist of various multiple choice question sets and a few case studies. They are mainly based on the list of chapters and videos above but are NOT limited to this material. Feel free to use all resources available to you including other texts and the internet to answer the questions included in the assessments. All assessments will be posted on our site within eCollege.

\*RP = *Respiratory Physiology, 9<sup>th</sup> Edition*

Corresponding videos available at: [http://meded.ucsd.edu/ifp/jwest/resp\\_phys/index.html](http://meded.ucsd.edu/ifp/jwest/resp_phys/index.html)

PP = *Pulmonary Pathophysiology, 8<sup>th</sup> Edition*

Corresponding videos available at: [http://meded.ucsd.edu/ifp/jwest/pulm\\_path/index.html](http://meded.ucsd.edu/ifp/jwest/pulm_path/index.html)