HPHY 670: Advanced Respiratory Physiology

Fall 2004
Detailed course syllabus

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Description of course: Exploration of advanced concepts in respiratory physiology, including exercise adaptations and examples of pathophysiology, in a problem-based learning format. Topics will include exercise physiology, altitude physiology, underwater diving physiology, asthma, chronic obstructive pulmonary disease, pulmonary edema, acute respiratory failure and other pathophysiologies. Students will learn the material via problem-based learning using case studies and by preparing lecture material for their peers. Significant reading assignments will come from the primary peer-reviewed literature and will focus on historical perspectives, innovative methodologies, and current research frontiers. In addition, laboratory exercises will be used to demonstrate and explore these concepts in respiratory physiology.

Times and locations: TBD. Conference Room and Halliwill Lab.

Prerequisites: HPHY 470/570

Basis for grading:

Students will be evaluated on preparation and participation in class discussions. A series of quizzes will be given on a biweekly basis. A final oral examination will be given. Grading will be based on the following: Preparation and class participation, 50 %, quizzes, 25 %, final exam, 25 %.

Student workload and expectations:

Students will be expected to attend all class and lab sessions. In addition, student workload will include significant out-of-class preparation that will include reading the primary text, reading the course package contents, and reading laboratory handouts. It is expected that students will arrive prepared for in-depth discussions of the reading material on an advanced level. Students will also be expected to set up and complete the laboratory exercises based on the laboratory handouts.

Required reading:

Textbook: West, JB. Pulmonary Physiology and Pathophysiology: An Integrated, Case-Based Approach. Lippincott Williams & Wilkins, Baltimore, 2001.

Contents of packet

Lab Handouts

O_2 consumption lab
CO_2 rebreathing lab
Work of breathing lab

Schedule of instructional themes:

Week 1	Normal physiology of exercise; maximal oxygen intake as an objective measure of cardiorespiratory performance; exercise-induced arterial hypoxemia
Week 2	Neural versus humoral control of ventilation during exercise: the ongoing debate
	Lab: Determining cardiac output by the CO_2 rebreathing method
Week 3	Normal physiology of altitude; oxygen sensing by the carotid body chemoreceptors; predicted gas exchange on the summit of Mt. Everest
	Lab: Hypoxic ventilatory response with and without hypocapnia
Week 4	Normal physiology of underwater diving; Alveolar gas exchanges during breath-hold dives; mathematical models of diffusion-limited gas bubble dynamics in tissue
Week 5	Chronic obstructive pulmonary disease; work of breathing; determinants of maximal expiratory flow from the lungs; assessing pulmonary gas exchange via MIGET
	Lab: Work of breathing; effect of gas density, airway resistance, and lung compliance
Week 6	Asthma; airway hyperresponsiveness; emerging concepts in evaluation of ventilatory limitation during exercise
Week 7	Diffuse interstitial pulmonary fibrosis; lung compliance
	Lab: Spirometry and clinical pulmonary function testing
Week 8	Pulmonary embolism; ventilation-perfusion matching; shunt
Week 9	Pulmonary edema; lung edema clearance; diffusion limitations
Week 10	Coal worker's pneumoconiosis; Acute respiratory failure

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Fall 2004 - CRN 16061
Course Packet Contents

1. Common symbols for respiratory physiology
2. The respiratory system and exercise. Miscellaneous sources.
3. HL Taylor, E Buskirk, A Henschel. Maximal oxygen intake as an objective measure of cardio-respiratory performance. *J Appl Physiol* 8: 73-80, 1955.
4. Collier CR. Determination of mixed venous CO2 tensions by rebreathing. *J Appl Physiol* 9: 25-29, 1956.
5. JA Dempsey and PD Wagner. Exercise-induced arterial hypoxemia*. J Appl Physiol* 87: 1997-2006, 1999.
6. JA Dempsey and BJ Whipp. The respiratory system. In *Exercise Physiology: People and Ideas.* Edited by CM Tipton. Oxford University Press, New York, 2003.
7. JB West, PD Wagner. Predicted gas exchange on the summit of Mt. Everest. *Respir Physiol* 42: 1-16, 1980.
8. NR Prabhakar. Oxygen sensing by the carotid body chemoreceptors. *J Appl Physiol* 88: 2287–2295, 2000.
9. AB Craig Jr and AD Harley. Alveolar gas exchanges during breath-hold dives. *J Appl Physiol* 24: 182-189, 1968.
10. NB Pride, S Permutt, RL Riley, and B Bromberger-Barnea. Determinants of maximal expiratory flow from the lungs. *J Appl Physiol* 23: 646-662, 1967.
11. JB West and PD Wagner. Pulmonary gas exchange. *Am J Respir Crit Care Med* 157: S82-S87, 1998.
12. Ken Beck notes on MIGET
13. GC Sieck. Airway hyperresponsiveness: from molecules to bedside. *J Appl Physiol* 95: 1-2. 2003
14. DJ Fernandes, RW Mitchell, O Lakser, M Dowell AG Stewart, and J Solway. Do inflammatory mediators influence the contribution of airway smooth muscle contraction to airway hyperrresponsiveness in asthma? *J Appl Physiol* 95: 844-853, 2003.
15. S Levine. Tidal flow-volume analysis of ventilation during exercise: A useful approach for diagnosing the mechanism of ventilatory limitation to exercise during cardiopulmonary exercise testing. Chest 116: 277-278, 1999.
16. BD Johnson, IM Weisman, RJ Zeballos and KC Beck. Emerging concepts in the evaluation of ventilatory limitation during exercise: The exercise tidal flow-volume loop. *Chest* 116: 488-503, 1999.
17. GC Sieck. Lunge edema clearance: 20 years of progress. *J Appl Physiol* 93:1183-1184, 2002
18. ED Crandall and RM Effros. Historical perspectives on lung edema clearance. *J Appl Physiol* 93: 1527-1532, 2002.
19. JI Sznajder, P Factor, and DH Ingbar. Lung edema clearance: role of Na+-K+-ATPase. *J Appl Physiol* 93: 1860-1866, 2002.