SYLLABUS FOR KINE 8970

**Special Topics – Maximal Oxygen Uptake**

Fall, 2015

Course Instructor: L. Bruce Gladden – 844-1466; [gladdlb@auburn.edu](mailto:gladdlb@auburn.edu).

Office Hours: T and R – 9:00 – 10:00 am

Meeting Place and Time: Coliseum 2043 at 3:30-4:45 pm Tuesday and Thursday.

Textbook: None. I will be posting materials in Canvas in the “Files” section.

Although there will be a few lectures, the course format will be mainly an open, hopefully wide-ranging discussion of readings. These readings will include old, classic papers, parts of some textbook chapters, as well as recent original papers and reviews. It is **imperative** that you read the assignments prior to attending class.

**GRADING**

1. There will be two examinations, a Midterm and a Final, each about 2.5 hours in length and each worth 100 points, for a total of 200 points.

2. In-class participation will be subjectively assessed and will be worth 50 points. Also, students will periodically be asked to submit potential test questions based on the readings.

88% or greater = A

79%-87% = B

70%-78% = C

60%-69% = D

less than 60% = F

**Class Policy Statements:**

**Unannounced Quizzes -** There could be unannounced quizzes in this class.

**Email –** You are responsible for checking your e-mail regularly and in a timely manner for any communications related to this class. The University has requested that all students use their Auburn University email accounts. This is the most efficient way for instructors to communicate with an entire class, and the University will occasionally send global notices that are important for all students. For this class, it is a requirement that you check your Auburn University email frequently.

**Cell Phones -** As a courtesy to others, turn your cell phone completely off during class or individual meetings with me. If you are expecting an emergency call, please let me know at the beginning of class or appointment. Similarly, texting, surfing, or other electronic use (e.g., computer, iPad, etc.), unless directly related to the class or appointment, is strictly prohibited. If these policies are violated, you will be asked to leave class or the appointment.

**Attendance -** Although roll will not be taken specifically, it is expected that students taking a graduate class will attend every class meeting and will actively participate in class discussions. Please refer to the Student Policy eHandbook ([www.auburn.edu/studentpolicies](http://www.auburn.edu/studentpolicies)) for the definition of excused absences. Students are expected to show evidence of thorough reading of assigned materials. Students are responsible for initiating arrangements for missed work.

**Disability Accommodations -** Students who need accommodations are asked to electronically submit their approved accommodations through AU Access and to arrange a meeting during office hours the first week of classes, or as soon as possible if accommodations are needed immediately. If you have a conflict with my office hours, an alternate time can be arranged. To set up this meeting, please contact me by e-mail. If you have not established accommodations through the Office of Accessibility, but need accommodations, make an appointment with the Office of Accessibility, 1228 Haley Center, 844-2096 (V/TT).

**Honesty Code** – The University Academic Honesty Code and the Student Policy eHandbook ([www.auburn.edu/studentpolicies](http://www.auburn.edu/studentpolicies)) pertaining to Cheating will apply to this class.

**Professionalism** – As faculty, staff, and students interact in educational settings, they are expected to demonstrate professional behaviors as defined in the College of Education’s conceptual framework. These professional commitments or dispositions are as follows: 1) engage in responsible and ethical practices, 2) contribute to collaborative learning communities, 3) demonstrate a commitment to diversity, and 4) model and nurture intellectual vitality.

**KINE 8970 Course Outline.**

T Aug 18 Introduction and O2 calculations.

Reading Assignments “as we go” for all class meetings. See Canvas for updates.

MIDTERM EXAM – Approximately October 6-12.

FINAL EXAM – Approximately November 30.

List of O2max Readings – Additions and Deletions will occur through the semester.

(with thanks to Preben K. Pedersen, University of Southern Denmark; Odense, Denmark)

1. Review of Measurement Principles:

VO2 calculation equations.

Douglas, CG. A method for determining the total respiratory exchange in man. J. Physiol 42:xvii-xviii, 1911.

Beaver, WL, K Wasserman and BJ Whipp. On-line computer analysis and breath-by-breath graphical display of exercise function tests. J Appl Physiol 34:128-132, 1973.

Wasserman, K. How It *Really* Happened - Exercise gas exchange, breath-by-breath. Am J Respir Crit Care Med 165:325-326, 2002.

Davies, CTM and DS Shirling. The rapid sampling, storage and analysis of expired air. Ergonomics 10:349-360, 1967.

Hughson, RL, JM Kowalchuk, WM Prime, and HJ Green. Open-circuit gas exchange analysis in the non-steady-state. Can J Appl Sport Sci 5:15-18, 1980.

Gore, CJ, RJ Clark, NJ Shipp, GEVD Ploeg and RT Withers. CPX/D underestimates VO2 in athletes compared with an automated Douglas bag system. Med Sci Sports Exerc 35:1341-1347, 2003. **only page 1341**.

2. The VO2max concept:

Hill, AV and H Lupton. Muscular exercise, lactic acid, and the supply and utilization of oxygen. Q J Med XVI:135-171, 1923. **only pages 135-154.**

Robinson, S. Experimental studies of physical fitness in relation to age. Int Z angew Physiol 10:251-323, 1938. **only pages 251-253 and 278-281.**

Taylor, HL, E Buskirk and A Henschel. Maximal oxygen intake as an objective measure of cardio-respiratory performance. J Appl Physiol 8:73-80, 1955.

Mitchell, JH, BJ Sproule and CB Chapman. The physiological meaning of the maximal oxygen intake test. J Clin Invest 37:538-547, 1958.

Åstrand, PO and K Rodahl. Maximal aerobic power in Chapter 7. Physical Performance, *in* Textbook of Work Physiology- Physiological Bases of Exercise, 3rd edition, McGraw-Hill Book Company, New York, 1986, p 332-341.

Costill, DL, WJ Fink and ML Pollock. Muscle fiber composition and enzyme activities of elite distance runners. Med Sci Sports Exerc 8:96-100, 1976.

Billat, V, P-M Lepretre, A-M Heugas, M-H Laurence, D Salim and JP Koralsztein. Training and bioenergetic characteristics in elite male and female Kenyan runners. Med Sci Sports Exerc 35:297-304, 2003.

Lindstedt, SL, JF Hokanson, DJ Wells, SD Swain, H Hoppeler and V Navarro. Running energetics in the pronghorn antelope. Nature 353:748-750, 1991.

3. Normalization for body dimensions (scaling, allometry)

Åstrand, PO and K Rodahl. Chapter 9. Body dimensions and muscular exercise *in* Textbook of Work Physiology – Physiological Bases of Exercise, 3rd edition, McGraw-Hill Book Company, New York, 1986, p 391-411.

Svedenhag, J. Maximal and submaximal oxygen uptake during running: how should body mass be accounted for? Scand J Med Sci Sports 5:175-180, 1995.

Lindstedt, SL and PJ Schaeffer. Use of allometry in predicting anatomical and physiological parameters of mammals. Lab Anim 36:1-19, 2002.

4. A scientific feud: Is there a plateau in VO2? When is VO2max, max?

Howley, ET, DR Bassett, Jr., and HG Welch. Criteria for maximal oxygen uptake: review and commentary. Med Sci Sports Exerc 27:1292-1301, 1995.

Duncan, GE, ET Howley, and BN Johnson. Applicability of VO2max criteria: discontinuous versus continuous protocols. Med Sci Sports Exerc 29:273-278, 1997.

Noakes, TD. Challenging beliefs: *ex Africa simper aliquid novi*. Med Sci Sports Exerc 29:571-590, 1997.

Bassett, DR, Jr., and ET Howley. Maximal oxygen uptake: “classical” versus “contemporary” viewpoints. Med Sci Sports Exerc 29:591-603, 1997.

Noakes, TD. Maximal oxygen uptake: “classical” versus “contemporary” viewpoints: a rebuttal. Med Sci Sports Exerc 30:1381-1398, 1998.

Bergh, U, B Ekblom and P-O Åstrand. Maximal oxygen uptake “classical” versus “contemporary” viewpoints. Med Sci Sports Exerc 32:85-88, 2000.

5. Limitations to VO2max.

The O2 cascade – a Gladden lecture plus some conceptual notes from Preben K. Pedersen.

Sutton, JR. VO2max-new concepts on an old theme. Med Sci Sports Exerc 24:26-29, 1992.

Bassett, DR, Jr., and ET Howley. Limiting factors for maximum oxygen uptake and determinants of endurance performance.

A. The Lungs

Åstrand, PO and K Rodahl. Chapter 5. Respiration *in* Textbook of Work Physiology – Physiological Bases of Exercise, 3rd edition, McGraw-Hill Book Company, New York, 1986, p 236-240.

Dempsey, JA, PG Hanson, and KS Henderson. Exercise-induced arterial hypoxaemia in healthy human subjects at sea level. J Physiol 355:161-175, 1984.

Powers, SK, J Lawler, JA Dempsey, S Dodd, and G Landry. Effects of incomplete pulmonary gas exchange on VO2max. J Appl Physiol 66:2491-2495, 1989.

Dempsey, JA and PD Wagner. Exercise-induced arterial hypoxemia. J Appl Physiol 87:1997-2006, 1999.

B. Maximum Cardiac Output

Saltin, B. Physiological adaptation to physical conditioning. *Old problems revisited*. Acta Med Scand Suppl 711:11-24, 1986.

Saltin, B and S Strange. Maximal oxygen uptake: “old” and “new” arguments for a cardiovascular limitation. Med Sci Sports Exerc 24:30-37, 1992.

Mitchell, JH and PB Raven. Chapter 17. Cardiovascular Adaptation to Physical Activity *in* Bouchard, C, RJ Shephard & T Stephens (eds). Physical Activity, Fitness and Health. Int Proc Concensus Statement, Human Kinetics, 1994, p. 286-298.

C. Oxygen Delivery = Cardiac Output (or Blood Flow) X CaO2

Gledhill, N, D Warburton, and V Jamnik. Haemoglobin, blood volume, cardiac function, and aerobic power. Can J Appl Physiol 24:54-65, 1999.

Ekblom B and B Berglund. Effect of erythropoietin administration on maximal aerobic power. Scand J Med Sci Sports 1:88-93, 1991.

Welch, HG and PK Pedersen. Measurement of metabolic rate in hyperoxia. J Appl Physiol 51:725-731, 1981.

D. VO2max in a Small Muscle Group

Andersen, P., RP Adams, G Sjøgaard, A Thorboe, and B Saltin. Dynamic knee extension as model for study of isolated exercising muscle in humans. J Appl Physiol 59:1647-1653, 1985.

Andersen, P and B Saltin. Maximal perfusion of skeletal muscle in man. J Physiol 366:233-249, 1985.

Richardson, RS, DR Knight, DC Poole, SS Kurdak, MC Hogan, B Grassi, and PD Wagner. Determinants of maximal exercise VO2 during single leg knee-extensor exercise in humans. Am J Physiol 268:H1453-H1461, 1995.

Rådegran, G, E Blomstrand, and B Saltin. Peak muscle perfusion and oxygen uptake in humans: importance of precise estimates of muscle mass. J Appl Physiol 87:2375-2380, 1999.

Pedersen PK, B Kiens, and B Saltin. Hyperoxia does not increase peak muscle oxygen uptake in small muscle group exercise. Acta Physiol Scand 166:309-318, 1999.

E. Muscle Enzyme Activity

Holloszy, JO and EF Coyle. Adaptations of skeletal muscle to endurance exercise and their metabolic consequences. J Appl Physiol 56:831-838, 1984. **only pages 831 and 834.**

Blomstrand, E, G Rådegran, and B Saltin. Maximum rate of oxygen uptake by human skeletal muscle in relation to maximal activities of enzymes in the Krebs cycle. J Physiol 501:455-460, 1997.

Rasmussen, UF, HN Rasmussen, P Krustrup, B Quistorff, B Saltin, and J Bangsbo. Aerobic metabolism of human quadriceps muscle: in vivo data parallel measurements on isolated mitochondria. Am J Physiol 280:E301-E307, 2001.

McAllister, RM and RL Terjung. Acute inhibition of respiratory capacity of muscle reduces peak oxygen consumption. Am J Physiol 259:C889-C896, 1990.

Robinson, DM, RW Ogilvie, PC Tullson, and RL Terjung. Increased peak oxygen consumption of trained muscle requires increased electron flux capacity. J Appl Physiol 77:1941-1952, 1994.

F. Peripheral Diffusion

Wagner, PD. Gas exchange and peripheral diffusion limitation. Med Sci Sports Exerc 24:54-58, 1992.

Richardson, RS. Oxygen transport: air to muscle cell. Med Sci Sports Exerc 30:53-59, 1998.

Richardson, RS. What governs skeletal muscle VO2max? Med Sci Sports Exerc 32:100-107, 2000.

G. Integrated View

Honig, CR, RJ Connett, and TEJ Gayeski. O2 transport and its interaction with metabolism; a systems view of aerobic capacity. Med Sci Sports Exerc 24:47-53, 1992.