Department of Kinesiology
Course Syllabus
Spring 2012

1. Course Number: KINE 8780
Course Title: Biochemistry of Exercise
Credit Hours: 3 semester hours (Lecture 3)
Prerequisite: KINE 7680 and KINE 7700 or equivalent or departmental approval.
Corequisite: None

2. Course Instructor: L. Bruce Gladden, Department of Kinesiology
Meeting Place & Time: Coliseum 2092 at 3:30 – 4:45 pm MWF.

3. Text: Houston, Michael E. (2006). Biochemistry Primer for Exercise Science (3rd ed.). Champaign, IL: Human Kinetics,
and
A required set of course Hand-Outs and a required set of Course Readings which will be available on Blackboard. These are to be treated as textbooks that are of equal importance to the Biochemistry Primer.

4. Course Description: Regulation of the metabolic pathways of energy metabolism with emphasis on the energetic response to acute exercise and exercise training.

This is a Graduate School course. Therefore, much material will be taken for granted as baseline knowledge. Along the same lines, some of the assigned reading material will be from scientific review articles; read this material at least as carefully as you would a textbook. Although the teaching format is that of lecturing, you should come to class prepared to discuss the topic of the day. In order to derive optimal benefits from any discussions, previous knowledge of the topic to be discussed is required. Therefore, all students are expected to read all assignments prior to class. There will be a significant amount of reading for this course; stay on top of it. If the readings sometimes seem too difficult for you, fight your way through them trying to get the overall message. Hopefully, during my lectures I will be able to bring all of the information together in a comprehensible and digestible lump.

5. Course Objectives: Upon completion of this course, students will understand:

1. Energetics, thermodynamics, and kinetics of chemical reactions;
2. Key regulators of glycolysis and their response to exercise;
3. Key regulators of the TCA cycle and their response to exercise;
4. Key regulators of the electron transport chain and their response to exercise.

6. Course Content and Schedule:

Week 1: A Simple Overview of Organic Compounds. Overview of Proteins and Molecular Biology.
Week 2: Overview of Proteins and Molecular Biology, continued.
Week 3: Energetics, Thermodynamics, and Kinetics of Chemical Reactions.

Week 4:	Equilibrium and Nonequilibrium Reactions.
Week 5:	Enzyme Kinetics.
Week 6:	The Immediate Energy System and Its Control.
Week 7:	Glycolytic Pathway.
Week 8:	Lactate Shuttles.
Week 9:	Regulation of Glycolysis During Exercise.
Week 10:	Tricarboxylic Acid Cycle.
Week 11:	Regulation of Tricarboxylic Acid Cycle During Exercise.
Week 12:	Electron Transport Chain.
Week 13:	Electron Transport Chain, continued.
Week 14:	Regulation of Electron Transport Chain During Exercise.
Week 15:	Lactate Formation and Removal.

7. Course Requirements/Evaluation:

There will be four examinations of about 90 minutes each. Each of these exams will be worth 100 points for a total of 400 points. These exams are scheduled outside of class time at approximately February 9 (T), March 4-5 (Th-F) April 8-9 (Th-F) and completely through the course, May 5 (W).

Item			Final Letter Grade		
Scheduled Exams	-	100%	≥ 88	=	A
			≥ 79 but < 88	=	B
			≥ 70 but < 79	=	C
			≥ 60 but < 70	=	D
			< 60	=	F

Curving – DO NOT request that grades be adjusted (curved); the grading scheme above is based on 30 years of teaching this class.

Extra Credit – There is no extra credit in this class; there is only credit. Should "extra" credit opportunities arise, they will be offered to all students in the class.

8. Class Policy Statements:

Participation - 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 current edition of the Tiger Cub (http://www.auburn.edu/tigercub) for the definition of excused absences. Students are expected to show evidence of thorough reading of assigned textbook chapters and supplemental readings. Students are responsible for initiating arrangements for missed work.

Unannounced Quizzes – There could be unannounced quizzes in this class.

Accommodations - Students who need special accommodations in class, as provided for by the American Disabilities Act, should arrange a confidential meeting with the instructor during office hours the first week of classes - or as soon as possible if

accommodations are needed immediately. If you have a conflict with the office hours, an alternate time can be arranged. To set up this meeting, please contact me by E-mail. You must bring a copy of your Accommodation Memo and an Instructor Verification Form to the meeting. If you do not have these forms but need accommodations, make an appointment with the Program for Students with Disabilities, 1244 Haley Center, 844-2096.

Honesty Code – The University Academic Honesty Code and the Tiger Cub Rules and Regulations 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 8780 Course Outline.

The course outline below is a baseline order for our approach. It is subject to change. This allows flexibility in dealing with different topics. For example, if more discussion arises on a particular subject, it may take longer to cover it. In other cases, less time may be required. You will be informed regularly and promptly of any changes. The topics are listed and followed by the readings which accompany them.

Topic # 1:

A Simple Overview of Organic Compounds.

Chapter 3. Chemical Composition of the Body, pp. 24-47, In: Human Physiology: The Mechanisms of Body Function, by Vander, Sherman, and Luciano, 1985, McGraw-Hill Book Company, New York.
Appendix., pp. 123-127, First edition of Houston textbook.
Chapters 1, 3, 9, and 10. Houston textbook.

Topic #2:

How are Reactions Studied? Energetics, Thermodynamics and Kinetics of Chemical Reactions. Equilibrium and Nonequilibrium Reactions.

Chapter 4, pp. 39-42, Houston textbook.
Chapter 2. Bioenergetics, pp.19-26, and Chapter 3. The Maintenance of ATP Homeostasis in Energetics and Human Movement, pp. 31-36. In: Exercise Physiology, by Brooks, Fahey, and Baldwin, Fourth Edition, 2005, McGraw-Hill, Boston.
Chapter 1. Methods and Approaches in Metabolism, pp. 1-9, In: Biochemistry for the Medical Sciences, by Newsholme and Leech, 1983, John Wiley & Sons, New York.
Chapter 12. Introduction to Metabolism, pp. 434-438, In: Biochemistry, by Mathews, van Holde, and Ahern, Third Edition, 2000, Addison Wesley Longman, Inc., San Francisco.

Topic # 3:

ATP and High Energy Compounds - The Energy Derived From ATP Breakdown.

pp. 42-54 of Chapter 4, Houston textbook.
Chapter 2. Bioenergetics, pp. 26-29, In: Exercise Physiology, by Brooks, Fahey, and Baldwin, Fourth Edition, 2005, McGraw-Hill, Boston.
Chapter 2.B. The Thermodynamics of the Role of ATP in Metabolism, pp. 29-36, In: Biochemistry for the Medical Sciences, by Newsholme and Leech, 1983.
Chapter 3. The Energetics of Life, pp. 74, 76-79, In: Biochemistry, by Mathews, Van Holde, and Ahern, Third Edition, 2000, Benjamin/Cummings, New York.

Topic # 4:

Metabolic Rate, Energy Expenditure, Oxygen Uptake and Carbon Dioxide Output.

Chapter 4. Basics of Metabolism, pp. 43-58, In: Exercise Physiology, by Brooks, Fahey, and Baldwin, Fourth Edition, 2005, McGraw-Hill, Boston.
Chapter 5, Appendix 5.2. Methods of Investigating Fuel Utilization in a Tissue, pp. 239-243, In: Biochemistry for the Medical Sciences, by Newsholme and Leech, 1983.
Chapter 8. Measurement of Human Energy Expenditure, pp. 174-186, In: Exercise Physiology: Energy, Nutrition, and Human Performance, by McArdle, Katch, and Katch, 2001, Lippincott, Williams & Wilkins, Baltimore, MD.

Topic # 5:

Enzyme Kinetics (Michaelis-Menten, Lineweaver-Burke, Eadie-Hofstee, and Hanes).

Chapter 2. Enzymes, pp. 15-28, Houston textbook.
Chapter 4. Molecular Control Mechanisms: DNA and Protein, pp. 48-58, and Chapter 5. Energy and cellular metabolism, pp. 80-89, In: Human Physiology: The Mechanisms of Body Function, by Vander, Sherman, and Luciano, 1985.
Chapter 3. The Maintenance of ATP Homeostasis in Energetics and Human Movement, pp. 36-41, In: Exercise Physiology, by Brooks, Fahey, and Baldwin, Fourth Edition, 2005, McGraw-Hill, Boston.
Chapter 7.A. Introduction to Metabolic Regulation, pp. 300-311, In: Biochemistry for the Medical Sciences, by Newsholme and Leech, 1983.
Enzymes, Energy and Endurance, pp. 1-35, by Newsholme, In: Principles of Exercise Biochemistry, 3rd, revised edition, ed. by Poortmans, 2004, Karger, Basel, New York.

Topic # 6:

Immediate Energy System.

pp. 42-54 of Chapter 4, Houston textbook.
High-Energy Phosphates and Muscle Energetics, pp. 87-107, by Sahlin, In: Principles of Exercise Biochemistry, 3rd, revised edition, ed. by Poortmans, 2004, Karger, Basel, New York.

Topic # 7:

Carbohydrate Metabolism - Glycolytic Pathway, The Shuttles, Control.

Chapter 6. Carbohydrate Metabolism, pp. 81-112; Houston textbook.
Chapter 13. Carbohydrate Metabolism I: Anaerobic Processes in Generating Metabolic Energy, pp. 446-479, In: Biochemistry, by Mathews, Van Holde, and Ahern, Third Edition, 2000, Benjamin/Cummings, New York.
Chapter 5. Glycogenolysis and Glycolysis in Muscle: The Cellular Degradation of Sugar and Carbohydrate to Pyruvate and Lactate, pp. 59-96, In: Exercise Physiology, by Brooks, Fahey, and Baldwin, Fourth Edition, 2005, McGraw-Hill, Boston.
Lactate Metabolism during Exercise, pp. 152-196 (but only pp. 157-160 and 181-185), by Gladden, In: Principles of Exercise Biochemistry, 3rd, revised edition, ed. by Poortmans, 2004, Karger, Basel, New York.

Topic # 8:

The TCA Cycle - Pathway and Control.

Chapter 5. Oxidative Phosphorylation, pp. 55-57, 60-65, 73-75, Houston textbook.
Chapter 14. Oxidative Processes: Citric Acid Cycle and Pentose Phosphate Pathway, pp. 483-508, In: Biochemistry, by Mathews, Van Holde, and Ahern, Third Edition, 2000, Benjamin/Cummings, New York.
Chapter 6. Cellular Oxidation of Pyruvate and Lactate, pp. 97-123, In: Exercise Physiology, by Brooks, Fahey, and Baldwin, Fourth Edition, 2005, McGraw-Hill, Boston.

Topic # 9:

The Electron Transport Chain - Pathway and Control.

Chapter 5. Oxidative Phosphorylation, pp. 57-60, 65-73 75-79, Houston textbook.
Chapter 14. Energy Conversion: Mitochondria and Chloroplasts, pp. 767-793, In: Molecular Biology of the Cell, by Alberts, Johnson, Lewis, Raff, Roberts, and Walter, Fourth Edition, 2002, Garland Science, Taylor & Francis Group, New York.
Chapter 6. Cellular Oxidation of Pyruvate and Lactate, pp. 97-123, In: Exercise Physiology, by Brooks, Fahey, and Baldwin, Fourth Edition, 2005, McGraw-Hill, Boston.
Lactate transport and metabolism during exercise, pp. 614-648 (but only 618-621), by Gladden, In: Handbook of Physiology. Exercise: Regulation and Integration of Multiple Systems, ed. By Rowell and Shepherd, 1996, Oxford University Press, New York.

Topic # 10:

Lactate Formation and Removal.

Chapter 6. Carbohydrate Metabolism, pp. 90-92, 95-97, 103-106, 108-110, Houston textbook.
Chapter 9. Neural-endocrine Control of Metabolism: Blood Glucose Homeostasis During Exercise, pp. 196-202, In: Exercise Physiology, by Brooks, Fahey, and Baldwin, Fourth Edition, 2005, McGraw-Hill, Boston.
Pascoe, David D. and L. Bruce Gladden. Muscle glycogen resynthesis after short term, high intensity exercise and resistance exercise. Sports Medicine 21:98-118, 1996.
Donovan and Pagliassotti. Quantitative assessment of pathways for lactate disposal in skeletal muscle fiber types. Medicine & Science in Sports and Exercise 32:772-777, 2000.
Lactate Metabolism during Exercise, pp. 152-196 (but only pp. 160-165), by Gladden, In: Principles of Exercise Biochemistry, 3rd, revised edition, ed. by Poortmans, 2004, Karger, Basel, New York.

Topic # 11:

Lipid Catabolism - Digestion and Oxidation, Pathways and Control.

Chapter 7. Lipid Metabolism, pp. 113-140, Houston textbook.
Chapter 18. Lipid Metabolism I: Fatty Acids, Triacylglycerols, and Lipoproteins, pp. 627-650, In: Biochemistry, by Mathews, Van Holde, and Ahern, Third Edition, 2000, Benjamin/Cummings, New York.
Chapter 7. Lipid Metabolism, pp. 124-157, In: Exercise Physiology, by Brooks, Fahey, and Baldwin, Fourth Edition, 2005, McGraw-Hill, Boston.
Chapter 18. The Metabolic Systems: Lipid Metabolism by Spriet, pp 396-409, In: ACSM's Advanced Exercise Physiology, ed. by Tipton, 2006, Lippincott, Williams & Wilkins, Philadelphia.

Topic # 12:

Integration of Carbohydrate and Lipid Metabolism.

Chapter 19. The Metabolic Systems: Interaction of Lipid and Carbohydrate Metabolism by Spriet and Hargreaves, pp 410-420, In: ACSM's Advanced Exercise Physiology, ed. by Tipton, 2006, Lippincott, Williams & Wilkins, Philadelphia.

2012 SPRING TERM

CLASS DAYS – KINE 8780 Biochemistry of Exercise

1 M Jan 9
2 W Jan 11
M Jan 16 – Martin Luther King, Jr. Holiday – NO CLASS.
3 W Jan 18
4 M Jan 23
5 W Jan 25
6 M Jan 30
7 W Feb 1
8 M Feb 6
9 W Feb 8 – EXAM #1
Th-Sat – Feb 9-11 – SEACSM Meeting in Jacksonville, FL
10 M Feb 13
11 W Feb 15
12 F Feb 17
13 M Feb 20
W-F – Feb 22 – Feb 24 – Gladden out of town – Muscle meeting in Gainesville, FL
14 M Feb 27
Feb 28 – Mid-Semester
15 W Feb 29
Th-F – Mar 1–2 – EXAM #2
16 F Mar 2
17 M Mar 5
18 W Mar 7
Sat-Sun – Mar 10-18 – Spring Break – NO CLASSES.
19 M Mar 19
20 W Mar 21
21 M Mar 26
T Mar 27 – EXAM #3
22 W Mar 28
23 M Apr 2
24 W Apr 4
25 F Apr 6
26 M Apr 9
27 W Apr 11
28 F Apr 13
29 M Apr 16
30 W Apr 18 – EXAM #4
Sat-W – Apr 21-25 – Experimental Biology Meeting in San Diego, CA
W – Apr 25 – Last Class Day – No class; Gladden out of town.
Th-F – Apr 26-27 – Study/Reading Days
M-F – Apr 30-May 4 – Final Exam Days
M Apr 30 – 4:00 – 6:30 pm, KINE 8780 **Scheduled** Final Exam Time
Sun-Mon May 6-7 – COMMENCEMENT

TENTATIVE TESTING SCHEDULE

W Feb 8	**EXAM #1**	T	Mar 27	**EXAM #3**
Th-F Mar 1-2	**EXAM #2**	W	Apr 18	**EXAM #4**