

CHEM 539
Molecular Metabolism: Pathways and Regulation

Spring 2015

Instructor: Anthony S. Serianni

March 2 – March 30, 2015

8:00 - 9:10 AM, MWF; 310 Jordan Hall

A. Course Objectives

This course investigates the underlying bioorganic and physical chemistry of the major metabolic pathways in living systems, including catabolic, anabolic, amphibolic, cataplerotic and anaplerotic pathways. The course will familiarize students with many of the enzymes of the major metabolic pathways and their mechanisms of action, the regulation of these pathways, and how aberrant pathways lead to altered metabolic homeostasis and human disease. *The course seeks to identify common metabolic themes and strategies that exist in biological metabolism regardless of the organism.* While the focus of the course is mainly at the molecular (reductive) level, there will be some discussion of fundamental principles governing a systems approach to metabolic flux, regulation and control in a complex metabolic network (Metabolic Control Analysis, MCA). We will also treat the topic of the *chenome*, that is, the pool of cellular molecules, produced via non-enzyme catalyzed reactions, that exerts a significant effect on metabolic homeostasis.

B. Recommended Text

No specific textbook is required. However, much of the discussion will follow the outline of metabolism given in *Biochemistry, Voet and Voet, 4th edition, 2011 (Part IV, Metabolism, pp. 557-1142).* It is recommended that students consult this textbook on a regular basis as they move through the course. Other advanced biochemistry textbooks published within the past five years may also prove sufficient for the purpose of study, since many of the pathways that will be discussed are common topics of these books. Course PPT slides will be provided via email, and course handouts (if necessary) will be distributed via email as the course unfolds. The latter materials will complement and amplify on topics discussed during class time.

C. Course Topics

- (a) Introduction to metabolism; experimental methods used to elucidate metabolic pathways; principles of metabolic flux (MCA); systems approach to metabolism
- (b) Transport of glucose – GLU transporters
- (c) Glycolysis
- (d) Pentose-phosphate pathway
- (e) Tricarboxylic acid cycle
- (f) Anaplerotic pathways
- (g) Gluconeogenesis; glycogen breakdown and biosynthesis
- (h) Fatty Acid Biosynthesis and Degradation

Aberrant metabolic pathways in human disease will be identified as individual topics (a)-(i) are treated.

D. Student Evaluation

Two (2) take-home written examinations and one (1) Problem Set will be administered during the course (*70% of final grade*).

An independent study project (*30% of final grade*) will be assigned. The topics of these projects, chosen by the students, must focus on one of the following general areas of human metabolism.

- (a) Inborn Errors of Metabolism
- (b) Newly-discovered Metabolic Pathways
- (c) New Methods and/or Techniques to Elucidate Metabolic Pathways
- (d) Oxidative Stress
- (e) The Genome

Independent study papers are typically ~10 pages in length (1 inch margins; Arial 11 font; line-spacing 13), including figures and references. They are comprised of five sections: Abstract, Introduction, Results and Discussion, Conclusion, and References. This assignment will be discussed in more detail in class. This assignment is due on the final day of the course (March 30).