CHEMISTRY 420/520 – Principles of Biochemistry

Instructor: Professor Anthony S. Serianni
Fall 2015

A. General Information

Lecture Time and Location
10:30 – 11:20 MWF, 141 DeBartolo

Instructor
Prof. Anthony S. Serianni (Office: 428 SCH; Lab: 432 SCH)
Email: aseriann@nd.edu
Website: www.nd.edu/~aseriann
Office Hours: By appointment. Please email me, or see me before or after class, to set up an appointment. Unscheduled office visits are also welcome if I am not occupied with a visitor or prior commitment.

Graduate Student Teaching Assistants
Alissa Schunter (aschunte@nd.edu)
Office hours: 4-5:30 PM, Wednesdays, 435 Stepan Chemistry
Primary Responsibilities: WileyPlus management and quizzes; grading problem sets; management of grade database; exam grading
Marwa Asem (asem.2@nd.edu)
Primary Responsibilities: Exam grading

Required Textbook
Donald Voet and Judith Voet, *Biochemistry* (4th Edition; green cover), Wiley, 2011 (available at the Notre Dame Bookstore). The loose-leaf form of this textbook is available in the ND Bookstore and is cheaper to purchase than the bound form. You can also purchase a new or used version of the textbook on Amazon or elsewhere if you wish.

Other Reference Texts
****D. Voet, J. G. Voet and C. W. Pratt, *Fundamentals of Biochemistry*, 4th Edition, Wiley, 2013.

T. M. Devlin (Ed.), *Textbook of Biochemistry with Clinical Correlations* (7th Edition), Wiley, 2010.

R. H. Garrett and C. M. Grisham, *Biochemistry* (5th Edition), Brooks/Cole, 2013.

B. Alberts, A. Johnson, J. Lewis, D. Morgan, M. Raff, K. Roberts and P. Walter, *Molecular Biology of the Cell* (6th Edition), Garland Publishing, Inc., 2014.

D. L. Nelson and M. M. Cox, Lehninger *Principles of Biochemistry* (6th Edition), W.H. Freeman, 2013.
D. R. Ferrier, *Biochemistry* (6th Edition), Lippincott's Illustrated Reviews, Wolters Kluwer, 2013.

J. M. Berg, J. L. Tymoczko and L. Stryer, *Biochemistry* (7th Edition), W.H. Freeman, 2012.

N. V. Bhagavan and C.-E. Ha, Essentials of Medical Biochemistry With Clinical Cases, Academic Press, 2011.

L. A. Moran, R. A. Horton, G. Scrimgeour and M. Perry, *Principles of Biochemistry* (5th Edition), Prentice Hall, 2012.

R. F. Weaver, *Molecular Biology* (5th Edition), McGraw-Hill, 2012.

C. K. Mathews, K. E. van Holde, D. R. Appling and S. J. Anthony-Cahill, *Biochemistry* (4th Edition), Pearson, 2013.

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C. Branden and J. Tooze, *Introduction to Protein Structure* (2nd Edition), Garland Publishing, 1999.

R. F. Luduena, *Learning More Biochemistry - 100 New Case-Oriented Problems*, Wiley-Liss, 1997.

R. H. Abeles, P. A. Frey and W. P. Jencks, *Biochemistry*, Jones and Bartlett Publishers, 1992.

M. H. Saier, Jr., *Enzymes in Metabolic Pathways*, Harper and Row, Publishers, 1987.

A. L. Lehninger, *Principles of Biochemistry*, Worth Publishers, Inc., 1982.

Enzyme Nomenclature 1992: Recommendations of the Nomenclature Committee of the International Union of Biochemistry, Academic Press, 1992. (For more recent information see: www.chem.qmul.ac.uk/iubmb/enzyme).

I. H. Segel, Biochemical Calculations, 2nd Edition, Wiley, 1976.

B. Lecture Dates and Topics

Total Lectures: 41

August (3 lectures)

Self-Study	Introduction (Chapter 1, pp. 3-19, 28-36)
26, 28, 31	Covalent/Non-Covalent Bonding; Chemistry of Aqueous Solutions; Ionization; pK_a; Buffers; Functional Groups (Chapter 2, pp. 40-50)

September (13 lectures)

2, 4	Biothermodynamics (Chapter 3, pp. 52-61) (Chapter 16, pp. 578-589)

Review Session 1
Tuesday, September 8 - Chapters 2, 3, 16

7, 9	α-Amino Acids and Oligopeptides: Structure, Properties and Purification (Chapter 4, pp. 67-80)
7, 9	Protein Primary Structure (Chapter 7, pp. 163-175, 185-209)
11, 14	Protein/Enzyme Classification, Isolation and Purification (Chapter 6, pp. 129-156)
16, 18	Protein Secondary, Tertiary and Quaternary Structure (Chapter 8, pp. 221-259, 266-271)
21, 23	Protein Stability, Folding and Dynamics (Chapter 8, pp. 259-266) (Chapter 9, pp. 278-316)

Review Session 2
Thursday, September 24 - Chapters 4, 6, 7, 8, 9 + First Exam Review

25, 28	Ligand Binding, Allosterism and Cooperativity (Chapter 10, pp. 323-343, 347-354)

Tuesday, September 29
First Examination - 14 Lectures (~9 Chapters)
15% of Grade

30	Enzyme Fundamentals (Chapter 13, pp. 469-479)

October (10 lectures)

2	Enzyme Fundamentals (Chapter 13, pp. 469-479)
5, 7	Enzyme Kinetics (Chapter 14, pp. 482-501)

Review Session 3
Thursday, October 8 - Chapters 10, 13, 14

9, 12	Mechanisms of Enzyme Catalysis (Chapter 15, pp. 506-538)
14, 16	Carbohydrates and Glycobiology (Chapter 11, pp. 359-383) (Chapter 23, pp. 880-892)
26, 28	Lipids, Membrane Structure, and Membrane Proteins (Chapter 12, pp. 386-422)

Review Session 4
Thursday, October 29 - Chapters 11, 12, 15, 23 + Second Exam Review

30	Membrane Transport (Chapter 20, pp. 744-752, 758-771)

November (11 lectures)

2	Biological Metabolism Fundamentals (Chapter 16, pp. 559-578)

Tuesday, November 3
Second Examination - 12 Lectures (~8 Chapters)
25% of Grade

4	Biological Metabolism Fundamentals (Chapter 16, pp. 559-578)
6, 9	Glucose Transport, Glycolysis and Hexose Metabolism (Chapter 17, pp. 593-619, 630-633)
11, 13	Other Carbohydrate Metabolic Pathways (Chapter 23, pp. 871-880, 892-898)
16	Glycogen Metabolism (Chapter 18, pp. 638-666)

Review Session 5
Tuesday, November 17 – Chapters 16, 17, 18, 23

18	Glycogen Metabolism (Chapter 18, pp. 638-666)
20, 23	The Tricarboxylic Acid (TCA) Cycle (Chapter 21, pp. 789-819)
30	Electron Transport/Oxidative Phosphorylation (Chapter 22, pp. 823-866)

Review Session 6
Monday, November 30 – Chapters 18, 21, 22 + Third Exam Review

Tuesday, December 1
Third Examination - 10 Lectures (~7 Chapters)
25% of Grade

December (4 lectures)

2, 4	Lipid Metabolism (Chapter 25, pp. 940-975)
7, 9	Integration of Metabolism (Chapter 27, pp. 1088-1104)

Review Session 7

Friday, December 11 – Chapters 25, 27 + Review for Final Exam

Monday, December 14
Final Examination - 41 Lectures (23 Chapters)
20% of Grade

C. Course Description

Based on *Biochemistry*, 4th Edition, Voet & Voet, Wiley, 2011

Course Aims and Methods. My aim in CHEM 420/520 is to introduce you to core principles relating biological structure to biological function and reactivity. Major emphasis is placed on the chemical and physical aspects of biochemistry, and relatively minor emphasis on the biological/biomedical aspects (*i.e.*, cell biology; genetics). Topics range from the underlying thermodynamics and kinetics of biological systems and reactions and to biological metabolism and metabolic regulation. This course is a survey course in that it covers a wide range of topics but not in great depth. If time allows, I will use the Review Sessions to comment further on a given topic, although you will not be tested on these additional treatments.

CHEM 420/520, as I teach it, is not intended solely as an MCAT preparatory course. While I will make a significant effort to identify and discuss material that is treated on the MCAT, course content and topic emphasis are not dictated solely by the MCAT. I will treat different topics in varying degrees of depth based on my personal appraisal of their relative importance in the field of biochemistry, and I place far more emphasis on quality of material covered than on quantity of material covered, especially when the latter leads to weaker understanding of the key concepts that underlie biochemistry. My global mission is to help you think as a biochemist, not as a medical doctor.

I will use the blackboard and PowerPoint slides interchangeably throughout the semester. The PowerPoint slides will be available through Sakai as we move through the material. *The PowerPoint slides are not self-contained – you will need to take careful notes in class to fill out the material outlined on the slides*. I will move through the course material in the sequence shown on pages 3-5, although lecture dates may vary as the semester unfolds. It is your responsibility to *read the relevant sections of the textbook and work the on-line quizzes (WileyPlus) prior to class*. This class preparation is absolutely critical – you may find it difficult to follow the lecture material without having spent some time examining the material beforehand. I will try to end each lecture about 2 minutes early to answer questions. However, please interrupt me at anytime during lecture for clarification and/or for additional explanation.

The careful recording of lecture notes is, in my view, critical to success in this course. To that end, I have no objection to you making personal audio recordings of the lectures if you feel it helps you better understand the material. I will not, however, allow video recordings of the lectures.

Makeup Lecture Policy. During the semester, it is possible that I will need to travel off campus for a few days for professional reasons. If this travel conflicts with our lecture times, I will reschedule the missed lectures for another time, most likely in the evenings. I will consult with the class to determine the optimal time(s) for the makeup lecture(s), with the expectation that it may not be possible to find a time(s) for everyone in the course to attend. I will work with those students who are unable to attend the makeup lectures if they need help understanding material discussed during these lectures.

1. Review and General Concepts

A. Water, pH, Ionization, pK_a; Non-covalent Bonding (**Chapter 2**)
- Nature of non-covalent interactions
- Role of water in biological processes
- Ionic equilibria; pH; buffers
- Interactions between macro-ions in solution

B. Biothermodynamics (**Chapters 3** and **16**)
- Energy, heat and work
- Entropy and the Second Law of Thermodynamics
- Free energy and the Second Law in open systems
- Free energy and concentration
- Free energy and chemical reactions: chemical equilibrium
- High-energy phosphate compounds: free energy sources in biological systems
- Phosphate transfer potential and the central role of ATP as a free energy currency
- Free energy and redox reactions

2. Molecular Architecture of Living Matter

A. α-Amino Acids (**Chapter 4**)
- Amino acid structures
- Reactions of amino acids
- Physical properties of amino acids
- Separation and purification of amino acids
- ***techniques:*** amino acid analysis by HPLC

B. Protein Primary Structure (**Chapter 7**)
- Biological functions of proteins
- Peptide structure; peptide bond; primary structure
- Protein primary structure
- ***techniques:*** amino acid analysis of proteins; *N*- and *C*-terminal residue determinations; protein sequencing; chemical synthesis of polypeptides

C. Proteins: Isolation and Purification (**Chapter 6**)
- Protein purification
- Protein solubility
- Chromatography of proteins
- Electrophoresis
- Ultracentrifugation

D. Proteins Secondary, Tertiary and Quaternary Structure (**Chapter 8**)
- Secondary structure (fibrous proteins)
- Tertiary structure (globular proteins)
- Quaternary structure; subunit interactions

E. Protein Stability, Dynamics and Folding (**Chapter 9**)
- Forces influencing protein structure
- Protein folding
- Protein folding accessory proteins
- Protein motions and dynamics
- Conformational diseases (amyloids and prions)

F. Ligand Binding, Allosterism and Cooperativity (Myoglobin and Hemoglobin) (**Chapter 10**)
- Binding constants (K_ds)
- Oxygen transport and storage
- Mechanism of oxygen binding by heme proteins
- Oxygen transport (hemoglobin)
- Allosteric behavior of hemoglobin
- Protein evolution (myoglobin and hemoglobin)
- Hemoglobin variants

3. Catalysis and the Control of Enzyme Reactions

A. Enzyme Fundamentals (**Chapter 13**)
- Roles of enzymes; enzyme nomenclature
- Reaction rates and catalysis
- How enzymes work: basic principles
- Coenzymes, vitamins, essential metals

B. Enzyme Kinetics (**Chapter 14**)
- Enzyme inhibition; pH effects
- Regulation of enzymatic activity
  - ***techniques:*** measurement of rates of enzyme-catalyzed reactions

C. Mechanisms of Enzyme Catalysis (**Chapter 15**)
- Nucleases: RNase
- Proteases: serine and aspartic proteases
- Glycosidases: lysozyme

Potentiation in enzyme catalysis

4. Other Biological Building Block Molecules; Membrane Transport

A. Carbohydrates and Glycobiology (**Chapters 11** and **23**)
B. Lipids and Membrane Structure (**Chapter 12**)
C. Membrane Transport (**Chapter 20**)

5. Biological (Molecular) Metabolism

A. Fundamentals of Metabolism (**Chapter 16**)
B. Glycolysis (**Chapter 17**)
C. Other Carbohydrate Metabolic Pathways (**Chapter 23**)
   Pentose phosphate pathway
   Gluconeogenesis
   Protein glycosylation
D. Glycogen Metabolism (**Chapter 18**)
   Glycogen phosphorylase (phosphorolysis)
   Glycogen synthase
E. Citric Acid Cycle (**Chapter 21**)
   Glyoxylate cycle
F. Electron Transport-Oxidative Phosphorylation (**Chapter 22**)
G. Lipid Metabolism (**Chapter 25**)
   β-Oxidation (fatty acid degradation)
   Fatty acid biosynthesis
H. Integration of Metabolism (**Chapter 27**)

D. Examination Schedule, Aims and Policies, and Course Grading

Exam Philosophy and Aims. Examinations in CHEM 420/520 have a multiple-choice and/or short answer format. About 80% of the exam questions draw from material covered directly in lecture. The remaining ~20% may require you to apply what you have learned to new circumstances and/or conditions. The latter type of question is arguably more challenging to answer, but fulfills the expectations and requirements of a 400-level university course.

Make-up Exam Policy. Only University-approved reasons will be accepted for taking an examination at a time other than when originally scheduled. *Students may request one (1) makeup exam during the semester.* Potential conflicts should be brought to the attention of the instructor at least two (2) weeks in advance of the exam. Make-up exams will be given a day or so *prior to* the scheduled exam.

CHEM 420/520 operates under the provisions of the University Code of Honor. All students taking this course are expected to abide by all aspects of the Code. If you

have questions about your responsibilities with regard to the Honor Code, please discuss them with the Course Instructor.

Cell phone use is prohibited during examinations. Cell phones must be stored out of sight while taking the exams. Students observed holding a cell phone during an exam for reasons other than an emergency will receive zero credit for the exam.

Course Grading. Final grades in CHEM 420/520 are based partly on performance on four (4) written examinations, points earned from the submission of Problem Sets and on-line quizzes, extra-credit points earned from attendance at supplementary lectures, and other extra credit assignments (see Section H). The class mean is normally defined as a B grade; few, if any, students receive a letter grade below C^-, and 20-25% of students may earn A^-/A grades. Most student grades fall in the B^+/B range.

Course Written Examinations

- Three (3) examinations (scheduled separately from the class period; see below for the *pre-scheduled* exam dates, times and locations)
- Final *cumulative* examination

Exam	*Percent of Final Grade*
Exam 1	15
Exam 2	25
Exam 3	25
Final Exam	20

Examination Schedule[a]

Exam 1	Tuesday, September 29 127 Nieuwland Science Hall
Exam 2	Tuesday, November 3 127 Nieuwland Science Hall
Exam 3	Tuesday, December 1 127 Nieuwland Science Hall
Final Exam	Monday, December 14 (1:45-3:45 PM)

[a]Exams 1-3 will be held from 7:30-9:15 AM on the indicated day.

Performance on course written examinations determines 85% of your total grade in the course. 10% of your final grade is determined from the submission of Problem Sets, and 5% from performance on on-line quizzes/problems (WileyPlus). Additional points may be earned by participating in the Extra-Credit exercises (see Section F below).

Breakdown of Course Evaluation

A: Three 1.25 h written examinations	65%
B: Final (cumulative) written examination	20%
C: Submitted problem sets (See Section F)	10%
D: On-Line WileyPlus quizzes	5%

Extra Credit Assignments are also available (see Section H below).

E. Review Sessions (7)

Times and locations will be announced during the semester.

September
- 8 (Tuesday)
- 24 (Thursday)
- 29 - First Exam

October
- 8 (Thursday)
- 29 (Thursday)

November
- 3 – Second Exam
- 17 (Tuesday)
- 30 (Monday)

December
- 1 – Third Exam
- 11 (Friday)
- 14 – Final Exam

F. The Assigned Textbook and Submission of End-of-Chapter Problem Sets

Textbook: *Biochemistry*, Voet & Voet, Wiley, 2011

A) Comments on the Nature and Purpose of the Assigned Textbook. The organization of this course follows that used in the assigned Voet/Voet *Biochemistry* textbook. Many of the graphics used in the PPT slides come from this book. However, a good number

do not – they have been taken from other sources. Thus, the textbook should be viewed as a means to reinforce what you learn in class – not all points raised in the text are discussed in class and not all points raised in lecture are discussed in the textbook, so any notions you may have about the textbook perfectly mimicking the lecture material should be abandoned immediately. The textbook is a resource – use it to help clarify what may not have been clear in lecture. I confess openly that the assigned Voet/Voet textbook is dense – it is an advanced text, as it should be since many of you are only a year away from advanced study in graduate school, medical school or elsewhere, and should be exposed to more advanced treatments of a subject at this point in your academic training.

B) Comments on the Problem Sets. Problems at the end of each chapter in the Voet/Voet textbook are to be worked on a regular basis as we move through the course material. These exercises will reinforce your learning of the material presented in lecture; problem solving often exposes weaknesses in your understanding that you can then subsequently address. Detailed solutions will be made available via *Sakai* after each Problem Set has been submitted for grading.

The end-of-chapter problems are intended to reinforce what you are learning in lecture. **You should not expect these problems to reappear on the course examinations**. They may appear, but it is equally if not more likely that they will not. Their intent is to expand/reinforce your learning of biochemistry by touching on topics not directly discussed in lecture. Working these problems also requires you to read the assigned Voet/Voet chapter material (see Section C), which will help you perform better on the course examinations.

I encourage you to work collaboratively on all of the Problem Sets. You are free to work with any of your classmates, or consult with other people as you see fit. But each of you must submit a separate Problem Set for grading.

Problem Sets will be collected throughout the semester. They will be graded for completeness only. Credit for any given Problem Set is all-or-nothing. If complete and submitted on time, you will earn full credit. If incomplete and/or submitted late, you will earn zero credit. No credit will be given for sets submitted after the submission deadline, even if complete. Submission deadlines will be announced in class and will occur a few days after a given chapter or chapters have been covered in class. Problem Sets will be submitted in class via hardcopy – a submission box will be available before and after class for these submissions. Please write your name and Problem Set number clearly at the top of each submission.

Course credit for submitted Problem Sets will be given as follows. Each Problem Set is worth 0.5 point if complete, for a maximum of 10 points if all are completed and submitted on time. The exact number of assigned problem sets will be depend on how much material we are able to cover in the course during the semester.

Problem Set 1: Water, pH, Buffers
Chapter 2: 1, 8, 10, 15, **16**

Problem Set 2: Biothermodynamics
Chapter 3: 8, 9, 11, 12
Chapter 16: 1, 4, 5, 8

Problem Set 3: Amino Acids and Protein Primary Structure
Chapter 4: 2, 5, 9, 12
Chapter 7: 1, 4, 5, 7

Problem Set 4: Protein Isolation and Purification
Chapter 6: 3, 5, 7, 11, 13

Problem Set 5: Protein Secondary, Tertiary and Quaternary Structure
Chapter 8: 4, 9, 14, 18, 23

Problem Set 6: Protein Stability, Dynamics and Folding
Chapter 9: 2, 3, 7, 8, 10

Problem Set 7: Ligand Binding, Allosterism and Cooperativity
Chapter 10: 2, 6, 9, 19

Problem Set 8: Enzyme Catalysis
Chapter 13: 1, 6, 7, 9

Problem Set 9: Enzyme Kinetics
Chapter 14: 1, 3, 4, 7

Problem Set 10: Mechanisms of Enzyme Catalysis
Chapter 15: 1, 2, 4, 6, 12

Problem Set 11: Carbohydrates and Glycobiology
Chapter 11: 1, 4, 7, 9, 12

Problem Set 12: Lipids, Membrane Structure and Membrane Proteins
Chapter 12: 1, 5, 6, 9, 11

Problem Set 13: Membrane Transport
Chapter 20: 1, 4, 5, 6, 15

Problem Set 14: Glycolysis and Hexose Metabolism
Chapter 17: 2, 4, 6, 7, 10, 11

Problem Set 15: Other Carbohydrate Metabolic Pathways
Chapter 23: 1, 2, 5, 6, 9

Problem Set 16: Glycogen Metabolism
Chapter 18: 1, 4, 6, 9, 13

Problem Set 17: Citric Acid Cycle and ET/OxPhos
Chapter 21: 1, 3, 7, 12, 17
Chapter 22: 1, 2, 7, 9, 14

Problem Set 18: Lipid Metabolism
Chapter 25: 2, 4, 5, 9, 11

Problem Set 19: Integration of Metabolism
Chapter 27: 1, 3, 4, 6, 10

Problem Sets – Summary Guidelines

1. Problem Sets are to be submitted at the beginning or end of class on the day they are due. Only hardcopy submissions will be accepted. Please write your name and Problem Set number clearly at the top of the first page, and number the problems clearly.

2. Working in groups to complete each assignment is allowed and encouraged.

3. Assignments will be graded for completeness, not correctness. An incomplete Problem Set will result in zero credit for that set. No partial credit will be given.

4. Each Problem Set is worth 0.5 point if complete, for a maximum of 10 points if all assigned sets are completed and submitted on time. The exact number of assigned problem sets will be depend on how much material we are able to cover in the course during the semester.

5. Problem Sets that are submitted after their due dates will not be accepted.

6. Answer keys to the assigned problems will be posted on Sakai after each set is submitted for grading.

G. On-Line Quizzes (WileyPlus)

Pre-lecture quizzes will be posted on WileyPlus before each chapter is covered in lecture. Students need to log into WileyPlus to answer these questions prior to the submission deadline. You can expect 4-8 questions per chapter and the quizzes will be graded. All quizzes must be worked independently by each student. You may use your textbook and class notes while you are working the quizzes. Posting and submission deadline dates will be announced by the TA as we move through the material.

WileyPlus Instructions
CHEM 420 – Principles of Biochemistry
Alissa Schunter – Course Teaching Assistant

1. Log into WileyPLUS (see Information on Sakai)

You need your Student Access Number to set up an account.

2. Select Course: CHEM 420/520: PRINCIPLES OF BIOCHEMISTRY
3. On the Home Page, select Assignments.
4. Select the appropriate on-line quiz, complete, and submit.

H. Extra Credit Assignments (Optional)

Extra Credit #1: Two (2) evening lectures on nucleic acid structure (times and locations will be announced during the semester). Attendance at each 45-min lecture is worth 0.5 points that will be added to your final numerical average in the course prior to the assignment of your letter grade. You may attend as many of these lectures as you wish. PPT slides will be provided on Sakai to assist your learning of this supplemental material. **(total points available = 1.0)**

Nucleotides, Nucleic Acids, and Nucleic Acid Structure
(**Chapter 5**, pp. 82-106; **Chapter 7**, pp. 209-211; **Chapter 29**, pp. 1145-1158; **Chapter 28**, pp. 1107-1109, 1114-1116; 1119-1122; **Chapter 32**, pp. 1338-1354)

nucleotide structure
primary structure of nucleic acids
nucleic acid hydrolysis
secondary and tertiary structure
plasticity of secondary and tertiary DNA structure; RNA structure
stability of secondary and tertiary structure
techniques: nucleic acid sequencing; chemical synthesis of oligonucleotides

Extra Credit #2: Extra credit points can be earned on each of the three in-semester exams (12 extra credit points per exam; total of 36 extra credit points): The 36 extra-credit exam points translate into 1 point that will be added to your final numerical average in the course, after letter grade cutoffs have been assigned. **(total points available = 1.0)**

Extra Credit #3: Office visit with Prof. Serianni (maximum of one). This visit is worth 0.5 point that will be added to your final numerical average in the course, after letter grade cutoffs have been assigned. **(total points available = 0.5)**

Extra Credit #4: Case Studies in Medicine/Biochemistry. This assignment is pertinent after fall break.

A total of four (4) case studies are posted on Sakai. You can choose any one (1) of the four case studies to investigate. You may work alone or in pairs; no assignment will be accepted if more than two authors are indicated on the report. You will read the case study and provide a 3-page typewritten (single-spaced; Helvetica 11) summary of the underlying biochemistry pertinent to each case, with technical figures/schemes if appropriate (see below). The assignment is worth 1.0 point that will be added to your final numerical average in the course, after letter grade cutoffs have been assigned.

Case study reports will be accepted anytime after fall break, but must be submitted no later than the last day of class (December 9) **(total points available = 1.0).**

The four Case Study topics are as follows (see Sakai):
Case Study 1: Methanol Toxicity (metabolites)
Case Study 2: Celiac Disease (proteins)
Case Study 3: Glycogenin Deficiency (carbohydrates)
Case Study 4: MCAD Deficiency (fatty acids)

The organization of the 3-page report is as follows:
(a) Restate the case.
(b) Discuss and explain the symptoms (physiological; behavioral; etc).
(c) Discuss and explain the medical abnormality.
(d) Discuss and explain the underlying biochemistry (*e.g.*, specific enzyme reactions or binding reactions responsible for the disease and its symptoms).
(e) Provide a brief summary of what you learned.

I. MCAT-Related Ancillary Materials (Self-Study)

As we move through the course material, ten (10) sets of multiple choice problems will be available on Sakai that have been taken from a MCAT preparatory text. Working these problems is not required, but I encourage you to do so in order to reinforce what you have learned in lecture. Answer keys will be provided to these problems.

MCAT Problems/Solutions 1: Amino acids, peptides and proteins
MCAT Problems/Solutions 2: Enzymes
MCAT Problems/Solutions 3: Non-enzymatic protein function and protein analysis
MCAT Problems/Solutions 4: Carbohydrate structure and function
MCAT Problems/Solutions 5: Lipid structure and function
MCAT Problems/Solutions 6: Biological membranes
MCAT Problems/Solutions 7: Carbohydrate metabolism I
MCAT Problems/Solutions 8: Carbohydrate metabolism II
MCAT Problems/Solutions 9: Lipid and amino acid metabolism
MCAT Problems/Solutions 10: Bioenergetics and regulation of metabolism

Other Key Dates

♦ Classes Begin: August 25
♦ Fall Break: October 17-25
♦ Thanksgiving: November 25-29
♦ Last Class Day: December 10
♦ Final Examinations: December 14-18