Advanced Biochemistry I (BMB 461)
Fall Semester 2014

Lectures
9:10 – 10:00 a.m. MWF
1281 Anthony Hall

Instructor and Course Coordinator
Professor Jon Stoltzfus (Lectures 1 – 19 and 29 – 35)
Biochemistry & Molecular Biology
305 Biochemistry Building
Tel.: (517) 432-8775
Email: stoltzfu@msu.edu (must include "BMB461" in the subject line)
Office hours: T, 10:00 – 11:00 am, W 1:30 – 2:30 pm, F 10:30 – 11:30 am

Other Instructors
Professor Christoph Benning (Lectures 20 – 28)
Biochemistry & Molecular Biology
3280 Molecular Plant Science Building
Tel.: (517) 355-1609
Email: benning@msu.edu
(must include "BMB461" in the subject line)
Office hours: Flexible, by email appointment

Professor Daniel Ducat (Lectures 36 – 39)
Biochemistry & Molecular Biology
206 Plant Biology Laboratory
Tel: (517) 432-5118
Email: ducatdan@msu.edu
(must include "BMB461" in the subject line)
Office hours: Flexible, by email appointment

Graduate Student Assistant
The graduate student assistant for BMB 461 is listed below with his contact information. The graduate student will be available to answer student questions. The primary venue for these graduate student interactions is weekly review sessions which will consist of a short presentation followed by an open question period. Due to the large size of the lecture sessions, students are encouraged to take advantage of these opportunities for small-group instruction. In addition, the graduate student will also help answer questions posted on the BMB 461 Discussion Board on Desire 2 Learn (D2L) as well as LON-CAPA.

Graduate student: Tim Carey
Email: careyti1@msu.edu
Graduate student review sessions:
Wednesdays 6:00 – 7:30 p.m. in BCH101
Thursdays 6:00 – 7:30 p.m. in BCH111

During exam weeks, instructors will also lead optional “Question and Answer” sessions in Biochemistry room 101. These instructor-led review sessions will occur on the following days and locations:
Thursday, September 18 (4:00 – 5:30 p.m.)
Tuesday, October 14 (2:15 – 4:45 p.m.)
Thursday, November 6 (4:00 – 5:30 p.m.)
Friday, December 5 (4:00 – 5:30 p.m.)
Course Structure
This three-credit course will be given as three hour-long lectures per week (MWF at 9:10 a.m.) and is designed primarily for students majoring in Biochemistry or a closely related field. Optional homework assignments will be posted on D2L (d2l.msu.edu). These assignments will be neither collected nor graded. Nevertheless, the problem sets are an essential part of the course and completion will prepare students for the exams. Working in groups on the problem sets is encouraged. There are also questions in the textbook at the end of each chapter. Students should incorporate these questions into their studies. The answers to these questions are provided in the back of the book.

Important course materials, including homework and lecture notes, will be posted on D2L. Multiple choice questions from previous year’s exams, arranged by topic, will be available in LON-CAPA (www.loncapa.msu.edu). In addition, we will maintain a BMB 461 Discussion Board on D2L where questions can be posted. Students are expected to check these sites regularly for newly posted material.

Course Objectives
BMB 461 is the first semester of the undergraduate series, BMB 461-462, which provides students with an introduction to biochemistry at the advanced undergraduate level. BMB 461 reintroduces basic biochemistry concepts including protein structure and function and focuses on carbohydrate and energy metabolism. The following topics will be discussed during this term:

- Buffers, pH
- Protein Structure
- Protein Purification
- Protein-Ligand Binding
- Enzyme Catalysis and Mechanism
- Enzyme Kinetics
- Carbohydrates
- Glucose Metabolism
- Pentose Phosphate Pathway
- Glycogen metabolism and regulation
- Citric Acid Cycle, Glyoxylate Cycle
- Electron Transport, Oxidative Phosphorylation
- Photosynthesis

Textbook

The study guide associated with this textbook (The Absolute, Ultimate Guide to Lehninger Principles of Biochemistry: Study Guide and Solutions Manual by Marcy Osgood and Karen Oncorr, 6th ed., 2013) is completely optional, but in the past some students have found it helpful.

Note on Introductory Material
BMB461 is an integrative course that draws on material covered in undergraduate biology, introductory chemistry, and organic chemistry. Chapter 1 of your textbook (Lehninger Principles of Biochemistry, D.L. Nelson and M.M. Cox, 5th ed.) provides a useful review of several topics from these prerequisite courses. We will not cover this material directly in lecture; students who encounter difficulty with terms, concepts, or calculations are encouraged to consult this section of the book.

Lecture Notes
We will not assemble a printed course pack in advance. Instead, we will rely heavily on D2L for postings of materials. Lecture notes will be posted in advance of the lectures. You can print them out in your preferred format and bring them to class. Many of the slides will be identical to figures in the book and you might consider bringing your book instead. You should consult the figure legends in the book and the relevant text for studying purposes.
**Course Recordings**

We will be recording the audio and projected material from each lecture using the “Camtasia” system and posting the recordings on the D2L course site. Keep in mind that it is at the instructor’s discretion to turn on the recording only after announcements regarding exams, etc. have been made. It is important to emphasize that BMB461 is *not* an online course. We strictly recommend against relying on the recordings as a substitute for lecture attendance. Technical issues with Camtasia may occasionally cause the recording and/or posting of lectures to fail, and such events are not considered an excuse for missing the covered material. More importantly, research shows that the best way to use Camtasia is to attend the live lecture, take good notes, and then use the recordings as a resource to go back over material you may have missed or not completely understood. It helps to mark down the time during lecture at which you have trouble understanding so that you can later skip quickly to the section in question.

**Clickers**

This course will use i-clickers to facilitate active learning. Clickers may be registered at the beginning of lecture any time during the first two weeks of the semester. If you do not register your clicker during this time you may not receive credit for previous clicker questions. During each lecture you will have one or more opportunities to answer questions using the clicker. You will receive 9/10th of a point for sending in any answer and an additional 1/10th of a point for sending in the correct answer. Some questions are designed to generate discussion and may not have a correct answer. In this case, you will receive one point for any answer. To receive full credit for i-clickers you only need to earn 90% of the possible clicker points (points earned/(possible points * .9) = points received). Clicker points for the entire semester are worth 4% of your final grade. It is your responsibility to understand the feedback lights on your clicker and verify that your answers are received. If your clicker malfunctions during class, please notify the TA immediately. It is your responsibility to bring your clicker to class each day and if you forget to bring your clicker or miss class for any reason, you will receive no points for that day. Because you only need 90% to get full credit, you can miss class occasionally for emergencies, religious days, or other commitments without seriously impacting your clicker scores. There are no make ups for clicker points.

**Exams and Grades**

The grade in BMB461 will be based mainly on three exams given during class and a *noncumulative* fourth exam given during finals week (see course schedule). Exams may contain multiple choice or free response questions at the instructor's discretion. Each exam is worth 24% of your final grade making exams worth 96% of your final grade. An additional 0.5% bonus can be earned for completion of optional online concept assessments.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Class Ranking</th>
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<tbody>
<tr>
<td>4.0</td>
<td>≥90.0</td>
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<tr>
<td>3.5</td>
<td>≥75.0</td>
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<td>≥ 5.0</td>
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<tr>
<td>0.0</td>
<td>&lt; 5.0</td>
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The grading scale shows the **class rank** you must attain in BMB461 to earn a particular grade. Note that percentage IS NOT the same as class rank.

*There will be no rounding.* Scores from graduate students will NOT be used when determining the class ranking and these scores will therefore not affect undergraduate grades. Final grades for graduate students will be determined from the undergraduate distribution.
**Rules for the Exams**

To ensure fairness of the exam, we have developed a set of rules. The use of calculators, notes, or any other aids is NOT permitted on any of the exams. Exams will be given in 1281 Anthony Hall unless otherwise noted. We use multiple forms for each exam. You will enter the room and will be assigned to a seat by the instructor or test proctor. Nothing may be placed on the seat next to you. All bags, jackets, etc. must be placed on the floor, and eating and drinking are not allowed. Books, notes and other papers need to be in your bag before you enter the room. Once you are in the room, refrain from talking to your classmates. You should fill in your name, PID, and the code from the upper left corner of the exam but you must not open the exam or begin the exam until instructed. Exam time is 50 min. You will get warnings 15 min and 5 min prior to the end of the exam. Filling in any part of the scantrons after the end of the official exam time is considered cheating and will be dealt with accordingly! When finished, give both the exam and the scantron to a proctor at the front of the room. There should be no talking until you have left the room. A copy of the exam with key will be posted when grades are available.

**Missed Exams**

If you unexpectedly miss an exam due to extenuating circumstances, you must contact the instructor within 24 hours of the exam. In order to be considered for a make-up exam, it is your responsibility to provide adequate written documentation of the extenuating circumstance. You may or may not be eligible for a makeup exam at the discretion of the instructor. Make-up exams are administered at the instructor’s convenience, typically within 72 hours of the original exam. Make-up exams may consist of essay questions or multiple choice questions at the instructor’s discretion.

**Academic Integrity**

Academic honesty is expected. As discussed in the Spartan Life Student Handbook General Student Regulation Part 1, PROTECTION OF SCHOLARSHIP AND GRADES:

“The principles of truth and honesty are fundamental to the educational process and the academic integrity of the University; therefore, no student shall:

1.1 claim or submit the academic work of another as one’s own.
1.2 procure, provide, accept or use any materials containing questions or answers to any examination or assignment without proper authorization.
1.3 complete or attempt to complete any assignment or examination for another individual without proper authorization.
1.4 allow any examination or assignment to be completed for oneself, in part or in total, by another without proper authorization.”

You are authorized and encouraged to discuss clicker questions and homework questions with your classmates. However, you must actually send in clicker answers with your own clicker. Using multiple clickers to send in answers for classmates who are not present is academic dishonesty. Exams are an individual effort, and you should neither give nor receive help during an examination. Policies to ensure academic integrity will be strictly enforced. Any instance of academic dishonesty will result in a failing grade for that assessment and may result in a failing grade for the course.

**Honors Option**

Students may elect to take BMB461 with an H-option provided they obtain a grade of 3.0 or higher in the course. The honors option consists of a term paper that address an unsolved biochemical question related to one of eight topics provided by the instructors. Students interested in the honors option should consult D2L during the first week of class for more information and deadlines.
<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture</th>
<th>Topic</th>
<th>Reading</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/27</td>
<td>1</td>
<td>Aqueous solutions and pH &amp; buffers; acid/base problems</td>
<td>45-70</td>
<td>Stoltzfus</td>
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<tr>
<td>8/29</td>
<td>2</td>
<td>Amino acids and peptides</td>
<td>75-89</td>
<td>Stoltzfus</td>
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<tr>
<td>9/1</td>
<td>Labor Day – University Closed (No Class)</td>
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<td>9/3</td>
<td>3</td>
<td>Protein purification</td>
<td>89-96</td>
<td>Stoltzfus</td>
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<td>9/5</td>
<td>4</td>
<td>Proteins: Primary structure and evolution</td>
<td>96-108</td>
<td>Stoltzfus</td>
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<tr>
<td>9/8</td>
<td>5</td>
<td>Proteins: Secondary structure</td>
<td>115-125</td>
<td>Stoltzfus</td>
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<tr>
<td>9/10</td>
<td>6</td>
<td>Proteins: Three-dimensional structure</td>
<td>125-133</td>
<td>Stoltzfus</td>
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<tr>
<td>9/12</td>
<td>7</td>
<td>Proteins: Structure and folding</td>
<td>134-156</td>
<td>Stoltzfus</td>
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<td>9/15</td>
<td>8</td>
<td>Protein-ligand binding: Myoglobin and hemoglobin</td>
<td>157-174</td>
<td>Stoltzfus</td>
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<tr>
<td>9/17</td>
<td>9</td>
<td>Enzymes: The basics</td>
<td>189-200</td>
<td>Stoltzfus</td>
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<tr>
<td>9/18</td>
<td>Optional Q and A by Instructor: 4:00 – 5:30 in 101 Biochemistry</td>
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<td>9/19</td>
<td>Exam I: Lectures 1-9 ONLY</td>
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<tr>
<td>9/22</td>
<td>10</td>
<td>Introduction to enzyme kinetics</td>
<td>200-207</td>
<td>Stoltzfus</td>
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<tr>
<td>9/24</td>
<td>11</td>
<td>Enzymes and inhibition</td>
<td>207-213</td>
<td>Stoltzfus</td>
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<tr>
<td>9/26</td>
<td>12</td>
<td>Catalytic strategies</td>
<td>214-221</td>
<td>Stoltzfus</td>
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<tr>
<td>9/29</td>
<td>13</td>
<td>Regulation of enzymes</td>
<td>226-236</td>
<td>Stoltzfus</td>
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<tr>
<td>10/1</td>
<td>14</td>
<td>Enzymology and medicine: The cytochrome P450 system</td>
<td>844-845</td>
<td>Stoltzfus</td>
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<td>10/3</td>
<td>15</td>
<td>Carbohydrates: I</td>
<td>243-253</td>
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<td>10/6</td>
<td>16</td>
<td>Carbohydrates: II</td>
<td>254-273</td>
<td>Stoltzfus</td>
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<tr>
<td>10/8</td>
<td>17</td>
<td>Bioenergetics: The basics</td>
<td>501-517</td>
<td>Stoltzfus</td>
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<td>10/10</td>
<td>18</td>
<td>Bioenergetics: Phosphoryl transfer</td>
<td>511-527</td>
<td>Stoltzfus</td>
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<tr>
<td>10/13</td>
<td>19</td>
<td>Bioenergetics: Redox reactions</td>
<td>528-537</td>
<td>Stoltzfus</td>
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<td>10/14</td>
<td>Optional Q and A by Instructor: 2:15 – 4:45 p.m. in 101 Biochemistry</td>
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<td>10/15</td>
<td>Exam II: Lectures 10–19 ONLY</td>
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<tr>
<td>10/17</td>
<td>20</td>
<td>Glucose metabolism: Glycolysis</td>
<td>543-568</td>
<td>Benning</td>
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<tr>
<td>10/20</td>
<td>21</td>
<td>Glucose metabolism: Glycolysis</td>
<td>543-568</td>
<td>Benning</td>
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<td>10/22</td>
<td>22</td>
<td>Glucose metabolism: Glycolysis</td>
<td>543-568</td>
<td>Benning</td>
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<td>10/24</td>
<td>23</td>
<td>Glucose metabolism: Gluconeogenesis</td>
<td>568-575</td>
<td>Benning</td>
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<tr>
<td>10/27</td>
<td>24</td>
<td>Pentose phosphate pathway</td>
<td>575-580</td>
<td>Benning</td>
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<tr>
<td>10/29</td>
<td>25</td>
<td>Pentose phosphate pathway</td>
<td>575-580</td>
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<tr>
<td>10/31</td>
<td>26</td>
<td>Glycogen metabolism and regulation</td>
<td>587-596</td>
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<td>11/3</td>
<td>27</td>
<td>Glycogen metabolism and regulation</td>
<td>601-627</td>
<td>Benning</td>
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<tr>
<td>11/5</td>
<td>28</td>
<td>Glycogen metabolism and regulation</td>
<td>601-627</td>
<td>Benning</td>
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<td>11/6</td>
<td>Optional Q and A by Instructor: 4:00 – 5:30 pm in 101 Biochemistry</td>
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<td>11/7</td>
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<td>11/10</td>
<td>29</td>
<td>Pyruvate dehydrogenase complex</td>
<td>633-638</td>
<td>Stoltzfus</td>
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<tr>
<td>11/12</td>
<td>30</td>
<td>Citric acid cycle</td>
<td>638-653</td>
<td>Stoltzfus</td>
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<tr>
<td>11/14</td>
<td>31</td>
<td>Citric acid cycle and Glyoxylate cycle</td>
<td>653-659</td>
<td>Stoltzfus</td>
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<tr>
<td>11/17</td>
<td>32</td>
<td>Mitochondrial electron transport</td>
<td>731-747</td>
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<tr>
<td>11/19</td>
<td>33</td>
<td>Mitochondrial electron transport</td>
<td>731-747</td>
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<td>11/21</td>
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<td>Oxidative phosphorylation</td>
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<td>Oxidative phosphorylation</td>
<td>747-765</td>
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<tr>
<td>11/26</td>
<td>36</td>
<td>Photosynthesis: Light-driven ATP synthesis</td>
<td>769-791</td>
<td>Ducat</td>
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<tr>
<td>11/28</td>
<td>Thanksgiving Break - University Closed (No Class)</td>
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<td>37</td>
<td>Photosynthesis: Light-driven ATP synthesis</td>
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<td>38</td>
<td>Photosynthesis: Carbon fixation</td>
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<td>39</td>
<td>Photosynthesis: Carbon fixation</td>
<td>799-782</td>
<td>Ducat</td>
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<td>12/5</td>
<td>Optional Q and A by Instructor: 4:00 – 5:30 pm in 101 Biochemistry</td>
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</table>

Note that the exam dates are fixed, but the exact dates that material is presented and the exact material on exams may vary due to the pace of the course.