1-2015

BCH 482.01: Advanced Biochemistry II

J. Stephen Lodmell
University of Montana - Missoula, stephen.lodmell@umontana.edu

BCH482 Advanced Biochemistry II
Spring 2015

Contact and basic information:

Instructor: Dr. Stephen Lodmell
Class time/place: MWF 10:10-11:00am in Forestry 301
Exams: 7-9pm on 3 Wednesday evenings: 2/25, 3/25, 4/29 in HS207
Optional open help session: Wednesdays 5-6pm CHCB230
Office: CHCB 202 Office hours: 11-12 MWF and by appointment
Phone: 243-6393
email: stephen.lodmell@umontana.edu
Text: Garrett and Grisham Biochemistry, 3rd, 4th, or 5th ed.

Overview:

The second semester of Advanced Biochemistry builds on the foundation laid by BCH480. In the second semester, we will explore enzyme kinetics and mechanisms, then we will learn about all of the major metabolic pathways, i.e. the chains of reactions and processes and the mechanisms by which these reactions occur, that are conserved across the tree of life and study how they integrate in living systems.

Prerequisites:

BCH480 (or equivalent) and a good foundation in organic chemistry are the prerequisites for this course. Students with weak preparation in organic chemistry have a more difficult time with biochemistry than those with a solid background. It is easier to see the logic behind biochemistry if you understand the underlying principles. It is a good idea to review basic organic principles and reactions prior to embarking on the biochemical pathways.

Requirements:

The following components are general requirements for success in this course.

- Attend class. Listening, interacting, and asking questions are important for mastery of the material. In general, topics that are emphasized in class are also merit a greater proportion of the material covered on quizzes and exams.
- Read and study the textbook and supplemental materials. Unless otherwise specified, you are responsible for reading and understanding all of the material in covered chapters.
- You should work assigned problems at the end of each chapter of Garrett & Grisham. These problems will not be collected or graded, but they may resemble questions on upcoming quizzes or exams, so familiarity with them will be advantageous to you.
- Tests and quizzes: There will be a weekly quiz most Fridays, three midterm exams, and a comprehensive final exam. Each exam counts as 20% of your final grade (your lowest midterm score will be dropped from your final grade calculation). The average of your quizzes will count as 20% of your final grade. You may drop your two lowest quiz grades (including any missed quizzes), but makeup quizzes will not generally be given. The final exam is comprehensive and mandatory and counts as 20% of your final grade. Midterm exams will be held at **7pm on three**

Wednesday evenings during the semester, as noted below. The midterm exams are scheduled in the evening to allow students more time (two hours) to complete them.

- Writing assignment: There will be one major writing assignment that will constitute 20% of your final grade. This paper will be handed in as a first draft (not a *rough* draft!), and will be returned with comments and suggestions for revisions that should be incorporated in the final draft (See "Review a current research article" section below). This assignment will require research within the scientific literature. You will make use of online resources such as PubMed to find appropriate and relevant materials. Although there are many other online resources that are useful to varying degrees, you should use the primary research literature as your principal source of information. Other online sources (notably Wikipedia) are non-refereed and are not reliably accurate or unbiased. To substantiate arguments and points in your written assignments, you must use and cite the primary research articles that are directly relevant to your topic.

Graduate credit:

If you are taking this course for graduate credit, you are required to do an extra increment of work. To satisfy this increment you will give an oral presentation to the class about your own research, emphasizing connections to material covered in class. Alternatively, you may present a lecture about a realm of research from the current literature that is relevant to the course content. Please see me to arrange the presentation.

Notes and Moodle:

Class notes and PowerPoint presentations will be posted on the course Moodle site. Remember that these notes are what I use as an outline for class preparation. They are not intended to be used as a substitute for coming to class or for studying the text; both of these activities are required for success in the course.

Special accommodations:

The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Disability Services for Students (DSS). If you think you may have a disability adversely affecting your academic performance, and you have not already registered with DSS, please contact DSS in Lommasson 154. I will work with you and DSS to provide an appropriate accommodation.

Learning outcomes for Advanced Biochemistry II

Upon completion of this course:

1. Students should be able to understand and articulate theoretical and practical aspects of enzyme kinetics, inhibition, mechanisms, and regulation. Students should recognize the common features as well as the distinctions between abiotic chemical catalysis and biological reactions.
2. Students should be able to understand and describe the components, general thermodynamics, and mechanisms of the main biological molecular motors, i.e. dyneins/kinesins, actin/myosins, F0F1ATP synthase, and bacterial flagellar motors.
3. Students should be able to understand and articulate general features of nutrient cycling in the biosphere and relate these to cellular anabolic and catabolic pathways.
4. Students should be able to understand the roles of different dietary fuel types, and be able to demonstrate the chemical roles of coenzymes and vitamins for common metabolic reactions.
5. Students should be able to diagram major metabolic pathways and have knowledge of key structures, chemistry, and regulation of the reactions in these pathways. These pathways include glycolysis, gluconeogenesis, the pentose phosphate pathway, glycogen metabolism, lipid metabolism, and selected examples of amino acid metabolism.

6. Students should have a global understanding of the regulation of metabolism at the organism level, including how hormones affect nutrient utilization in health and disease.
7. Students should have an understanding of major cellular signal transduction pathways in cells.
8. Students will gain experience in reading and reviewing the primary biochemical literature and will learn to improve their scientific expository writing skills. Special emphasis will be placed on understanding molecular mechanisms of action of antimicrobial drugs. As an upper division writing course, the student will be expected on his/her writing assignments to:
    - Identify and pursue sophisticated questions for academic inquiry
    - Find, evaluate, analyze, and synthesize information effectively from diverse sources
    - Manage multiple perspectives, as appropriate
    - Recognize the purposes and needs of discipline-specific audiences and adopt the academic voice necessary for the chosen discipline
    - Use multiple drafts, revision, and editing in conducting inquiry and preparing written work
    - Follow the conventions of citation, documentation, and formal presentation appropriate to that discipline
    - Develop competence in information technology and digital literacy

General University Policies

University policies on drops, adds, changes of grade option, or change to audit status will be strictly enforced in this course. These policies are described in the current UM catalog. Briefly:

Dropping Classes

Through the 15th instructional day, **ALL** classes are dropped in CyberBear.

From the 16th through the 45th instructional day, all classes must be dropped using Drop forms (instructor signature required, advisor signature required for undergraduates). **$10 fee applies.**

From the 46th to the last instructional day prior to finals week, classes must be dropped using the Drop form (instructor and Dean signatures required, advisor signature required for undergraduates). **$10 fee applies.**

Changing Grade Option

Through the 15th instructional day, all grade options are changed in CyberBear.

Changes to/from Audit **MUST** be completed by the 15th instructional day.

From the 16th instructional day to the last instructional day prior to finals week, all grade options must be changed using an Add/change form (instructor signature required, advisor signature required for undergraduates).

Variable Credit Change

Through the 15th instructional day, variable credits are changed in CyberBear.

From the 16th instructional day to the last instructional day prior to finals week, variable credits must be changed using an Add/change form (instructor signature required, advisor signature required for undergraduates).

Section Changes (changing section for SAME class only)

Through the 7th instructional day, section changes can be added one of three ways:

1. Directly in CyberBear
2. Registration override forms (instructor signature required)
3. Electronic overrides

From the 8th instructional day to the last instructional day prior to finals week, all section changes must be added using an Add/change form (instructor signature required, advisor signature required for undergraduates). **$10 fee applies.**

Academic honesty

In working through homework and writing assignments, students are encouraged to work together to solve problems, to share information or resources, and to test each other's understanding of the material. Those are all

acceptable forms of collaboration. However, the written work that each student turns in must be his or her own. Only in this way can faculty judge individual understanding of concepts or information. A good rule of thumb for students to follow is to work together up to the point of committing words to paper. At that stage, each student must work independently. A second key guideline is that once a student has written an out-of-class assignment, it must not be shown to another student in the course. Assignments from two or more students that have significant overlap, in the professional judgment of the faculty member, will be regarded as reflecting a violation of the expectation that students turn in independent assignments. Please note that direct copying of sentences from any published without proper citation is considered plagiarism. THIS INCLUDES THE INTERNET. Be sure to put the information in your own words and be aware that the instructor will check literary and Internet resources. Violations will be dealt with according to the Student Conduct Code.

All exams and quizzes are 'closed book', that is, you may not use any notes in print, audio, or electronic form. Please turn off cell phones, calculators, MP3 players and all other electronic devices prior to the start of exams and quizzes.

Instructions for the writing assignment:

Review a current research article:

You will choose a recent (years 2013-2015) research article from the primary research literature that **relates to the mechanism of action of an antibacterial, antifungal or antiviral compound**. You will write a short paper (double spaced, 8-10 pages) centered around this or several closely related articles, stating the problem and relevant background information, the approach/methods, and the results/interpretations in your own words. **Your audience is your peer group**, i.e. a group that is generally knowledgeable about biology/biochemistry/chemistry, but who will be unfamiliar with the specifics of the area covered by your research article. Assume familiarity with basic techniques (e.g., electrophoresis and gene cloning/expression, etc.), but the paper should stand alone and be readable and understandable by someone who has not read this paper or related literature.

This paper must be biochemically-oriented. This means that it must address structure and function of biomolecules. For example, a paper showing that exposing bacteria (or viruses or fungi) to molecule X inhibits growth as measured by counting colonies or measuring growth rate is NOT 'biochemical', but a paper that shows how molecule X interacts with, for example, a bacterial ribosome and thereby inactivates the ribosome would be 'biochemical'. Your best bet is to peruse articles from journals with strong biochemistry emphasis, such as *Biochemistry, Journal of Biological Chemistry, Biochemical Journal, Journal of Molecular Biology*. Other journals may have solid biochemical articles in them, like *PNAS, Antimicrobial Agents and Chemotherapy, Antiviral Research, Science, Nature, EMBO, Cell, etc.* Look for pictures of biomolecules in the figures as a clue that that the paper addresses structure, function, and/or mechanisms of biological reactions. If you are in doubt, let the instructor check out the paper before you begin your review.

You must hand in a copy of the research article with your paper. Your paper will be graded and comments and suggestions provided based on both scientific content and appropriate English usage, style, and organization. You will use the comments provided to revise your paper and hand it in for a second assessment. 75% of the grade will come from the first draft, and 25% comes from the revised version.

Tips for writing a review of a research article:

Most important, consider (and be considerate of) your audience/ reader. Who are they? What background are they likely to have? Think about what terms would need to be defined so that the reader has the tools (background and terminology) to understand what you are saying.

Make the paper user-friendly by defining specialized terms and setting up the subject

Make the paper able to stand alone, so that someone without further outside reading could understand (almost) all of the points you make in the paper.

- Introduce the subject (use about one page). Frame the research in 'big picture' terms: Why is the subject important and interesting to study? Briefly state what approaches the authors used to address some aspect of the problem at hand.

- Go through the experimental data (use about four pages). Describe the actual experiments and data (you should go through the paper essentially figure by figure). What was each experiment designed to show? How was it done (uncommon experimental techniques require more description)? What was the outcome, and how did the data obtained shed light on the overall problem? For each assertion you make, make sure to support it with examples, data, or analogies. Do not leave points that you are trying to make unsubstantiated. A major objective of this assignment is to demonstrate the relationship between actual experimentation and overall conclusions and concepts. Heavy emphasis is placed on your description of the experiments. The data taken from the experiments are subsequently pooled together to make overall conclusions in the next section.

- Conclusions (about 1 page). What did the experimental results tell us about the research problem at hand? What is the significance of these new results? You may also want to discuss whether the authors conclusions match your own in light of the experimental results presented. Remember that interpretation of experimental results can be subjective. If the authors' interpretations of the data are different than your own, this is a good place to talk about it.

- Proofread your paper carefully! This serves two purposes:
  - You will locate and correct typographical errors and awkward sentence constructions.
  - As you are reading, you should ask yourself: "If I read this paper for the first time, without any additional outside reading, would I be able to understand it? Would I be convinced of points being made in the paper?" If there are places where this is unclear, you should rewrite to clarify and support as necessary.

Tentative class topics schedule:

Jan 26-Jan 30 *Enzyme specificity and kinetics (Ch 13)*
Feb 02- Feb 6 *Enzyme mechanism (Ch 14)*
Feb 9- Feb 13 *Enzyme regulation (Ch 15)*

(Monday Feb 16- President's Day- no class)

Feb 18-Feb 20 *Molecular Motors (Ch 16)*
Feb 23- Feb 27 *Overview of metabolism (Ch 17)*

- ***Feb 25 (Wednesday)- First midterm exam 7-9 pm Room HS207***

Mar 2- Mar 6 *Glycolysis (Ch 18)*

- ***March 4 (Wednesday)- First draft of written assignment due***

Mar 9- Mar 13 *Tricarboxylic Acid cycle (Ch 19)*
Mar 16- Mar 20 *Electron Transport (Ch 20)*
Mar 23- Mar 27 *Electron Transport and Photosynthesis (Ch 20-21)*

- ***March 25 (Wednesday)- Second midterm exam 7-9pm Room HS207***

Mar 30 – Apr 3 No class- Spring break!

Apr 6-Apr 10 *Gluconeogenesis, glycogen metabolism, PPP (Ch 22)*
Apr 13 – Apr 17 *Fatty Acid catabolism (Ch 23)*

- ***April 15 (Wednesday) Final draft of written assignment due***

Apr 20 – Apr 24 *Lipid biosynthesis, amino acid metabolism (Ch 24-25)*
Apr 27 – May 1 *Metabolic integration (27)*

- ***Apr 29 (Wednesday) – Third midterm exam 7- 9pm Room HS207***

May 4- May 8 *Signal transduction (Ch 32)*

- *Wednesday May 13* ***Final examination*** *(cumulative) 10:10-12:00 in Forestry 301*

Important dates for Spring 2015 (see also: http://www.umt.edu/registrar/PDF/Spring2015RegistrationDeadlineChart.pdf)

	Jan 26 – Feb 3 @ 5pm	February 4 – February 13 @5pm	February 14 – April 6 @ 5pm	April 7 – May8@5pm	May 9 & Beyond
Instructional Days	Day 1 - 7	Day 8 - 15	Day 16 - 45	Day 46 – Friday before Finals Week	After Last Regular Class Day
Add a Course	CyberBear	Registration Override with instructor signature	Course Add/Change Form with advisor[1] & instructor signatures + $10.00 fee	Course Add/Change Form with advisor[1] & instructor signatures + $10.00 fee	Only to fix registration errors (see reg. counter)
Drop a Course[2] (see reg. counter to drop all/only course)	CyberBear	CyberBear	Course Drop Form with advisor[1] & instructor signatures + $10.00 fee (W on transcript)	Course Drop Form with advisor[1], instructor, & Dean's signatures + $10.00 fee (WP or WF on transcript)	Not permitted
Switch Sections	CyberBear	Registration Override with instructor signature to add, then CyberBear to drop	Course Add/Change Form with both instructors' signatures	Course Add/Change Form with both instructors' signatures	Only to fix registration errors (see reg. counter)
Credit/No Credit Grading Option (change to or from)	CyberBear	CyberBear	Course Add/Change Form with advisor[1] & instructor signatures	Course Add/Change Form with advisor[1] & instructor signatures	Not permitted
Adjust Variable Credit Load (variable credit courses only)	CyberBear	CyberBear	Course Add/Change Form with advisor[1] & instructor signatures	Course Add/Change Form with advisor[1] & instructor signatures	Not permitted
Audit		CyberBear			