BIOC/BIOL 2200 - SYLLABUS
Fall 2007

Professor: Dr. James J. Cheetham
Office: 205 Nesbitt Biology Building
Office hours: Tuesdays (1:00 – 3:00 pm), or by appointment.
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Lecture: Mondays and Wednesdays at 11:30 - 1:00; Azrieli Theatre 301
Labs: check your schedule.
WebCT: This course has a WebCT page.

Course Timetable: on the WebCT page

Calendar Description

BIOL 2200 [0.5 credit]
Cell Physiology and Biochemistry
A lecture and laboratory course on cellular functions and their inter-relationships. It introduces topics including thermodynamics, membrane structure and function, transport mechanisms, basic metabolic pathways, energy production and utilization, communications between cells. (Listed as BIOC 2200 for students enrolled in the Biochemistry and Biochemistry/Biotechnology programs.) Prerequisites: BIOL 1003 and BIOL 1004, CHEM 1000 or permission of the Department. Lectures three hours a week, laboratory or tutorial four hours a week. It is strongly recommended that Biology Majors and Honours students take this course in their second year of study.

Course Objectives

This course provides an overview of fundamental concepts in biochemistry to give you a strong foundation for future study of biological systems. We will focus on the major macromolecules and chemical properties of living systems. Primary topics include the structure, function, and metabolism of amino acids, proteins, carbohydrates, and lipids; the roles of membranes and organelles in cell function; the physical properties of water, pH, and buffers; enzyme kinetics and metabolic regulation. The biochemistry of nucleic acids is covered in BIOL 2104 – Introductory Genetics.

Furthermore, we will examine some of the critical experimental evidence that supports our current views of cellular function. Student who successfully complete this course will demonstrate a broad knowledge of biochemical concepts, paradigms, and vocabulary as well as be able to critically review experimental evidence in the scientific literature.

Expectations of BIOC/BIOL 2200 Students

I expect you to exhibit self-regulated, autonomous learning behavior. Huh? Simply, I expect you to extend your study of biochemistry outside the classroom and laboratory. For example, the exams will not only test your knowledge of the factual data presented in lecture, but also your synthesis of the information into a logical whole – the big picture. I expect you to consider biochemistry in your other courses and to discover how the concepts presented during the semester impact your health, the environment, and the biological world as a whole. Your success as a student of biology depends upon your ability to think creatively and critically. Therefore, I intend to foster and expand the creative intellect already resident in your everyday thoughts and expect you to be open to new ways of thinking and to challenge old ways of thinking.

Expectations of the professor

Learning is the responsibility of the student. The instructor’s role is to facilitate learning (by lecturing,
answering questions, etc.) and to evaluate learning (by labs, exams, etc.). Remember that you are doing this work for yourself (to prepare for future endeavors), not for the instructor.

What can you expect from me? You can expect me to be prepared for class with both knowledge and enthusiasm. You can expect patient and thoughtful teaching and help both within and outside our scheduled time together. You can expect that I will utilize all reasonable resources to help you succeed in this class. Don’t be afraid to seek help when needed. I am here to help you learn the material covered in this course and to provide an impartial evaluation of your performance. I’m not paid on commission, either. My salary does not depend upon the number of A's, B's, C's, D's, or F's I report, nor on the number of students who continue to attend class. It’s tough sometimes, but it’s OK to ask questions in lecture. Come during office hours if you have more detailed questions.

Electronic Communication

The BIOC/BIOL 2200 webpage is located in WebCT. The Course Webpage will be updated as needed during the term. You will need to download several plug-ins so you can view the tutorials I have included in this course.

I want to be able to contact everyone by E-mail so I can give out updates on the course at any time. Also, you will find that E-mail is an excellent way to contact me outside of class with any questions. You all have CONNECT E-mail addresses (whether you use it or not) by virtue of enrolling at Carleton. If you do not use your CONNECT Email, then set it to automatically forward to your regular email.

Students with Disabilities

Students with a disability who require academic accommodations, please feel free to come and discuss this with me. Students must also contact the Paul Menton Centre (Room 500 University Centre) to complete the required forms at least two weeks prior to the first in-class or ITV test, and no later than September 24, 2007 for December exams. The centre usually hosts an orientation for students with documented Learning Disabilities. For more information call: (613) 520-6608 TTY (613) 520-3937.

Statement on Academic Ethics

You are expected to follow the Academic Regulations of the University. In particular, pay attention to Section E. Student Conduct.

If you are not sure about the definition of cheating, come and see me, and I will explain it to you in more detail.

Reading Materials

Slides used in class and the required reading materials for the course are available on the WebCT pages. You should read the assigned material before the lectures.

Prerequisites

BIOL 1003 and BIOL 1004 and CHEM 1000 are prerequisites for this course. Students taking this course must have a background in physical and organic chemistry, and cellular and molecular biology.

Office Hours

Official office hours will be Tuesdays from 1:00 to 4:00 pm. I am, however, in my office most afternoons. Feel free to send me questions by E-mail or better yet, post them in the CONNECT Course Group. You can also arrange an appointment by sending me an E-mail.

General Course Policies

Your experience in this course (and in life) will be more enjoyable if you treat your classmates and your instructor with courtesy and respect.
1. Come to class regularly, be on time, and be prepared. If you are unavoidably late, enter the room quietly and choose a seat as quickly as possible.

2. Once in class, stay for the duration. If you must leave early, give me advance warning. You will not be allowed to meander in and out of the classroom. This is disruptive and unfair to your fellow students. Take care of your personal needs before class.

3. Turn off communications devices. This includes pagers, PDAs, cell phones, personal entertainment (TV, music, etc.) devices or anything else that will disturb your classmates. Students with special circumstances need to speak with me right away.

4. No chit-chat or unnecessary noise during class. This is a big class, and if everyone is making noise, no one can hear anything. Stay focused on the material under consideration during lecture. You are paying a lot of money to be in this class. If some Bozo is talking near you, he or she is disrupting your learning experience, and essentially stealing money from you. I suggest you ask them to shut up.

5. Academic dishonesty is not tolerated. If you are unclear about what is dishonest, please see the Undergraduate Calendar for clarification. If you are still unsure about specific instructions, ask me. The study of biochemistry is a collaborative endeavor. Therefore, you are encouraged to form study groups and work together as much as possible. However, exams are not collaborative and must be completed without the assistance of your peers.

**Exams and Grading**

Students are responsible for, and may be tested on, all the material discussed during lectures, as well as assigned reading material, whether it was covered in lecture or not. Exams will consist of short answer, calculations, fill-in-the-blanks, matching and carefully designed multiple choice type questions. Students are expected to take exams during the scheduled times. The tests are open-book, the final exam is NOT open book. There will be three tests during the term. The tests will be given on WebCT. I will only count your two best tests out of three (10% each). There are no make up tests.

There will be a total of 100 combined earnable points from the exams and laboratory assignments. The laboratory portion will be worth 40% of your final grade so treat the laboratory assignments accordingly.

- Labs 40%
- Tests 20%
- Final 40%
- Total 100%

The final exam will be administered as per the final exam schedule. The final exam will be comprehensive from both the lecture and laboratory with an emphasis on your synthesis of the lecture material into themes and concepts (the \( \text{big picture} \)).

**About BIOL/BIOC 2200**

Biochemistry is the field of science that investigates the chemical and molecular reactions that sustain life. The goal of this course is to study these reactions in connection to their role in biological systems. The course will begin with a discussion of the structure and function of the biomolecules involved in those important reactions. Students will then study bioenergetic principles that control the synthesis and degradation of biological macromolecules. Finally, the integration and regulation of signaling and metabolic pathways will be discussed.

As a consequence of its interdisciplinary nature, this course will prove to be rewarding to students with a variety of interests. Life and health science lovers will encounter discussions about nutrition, disease, development and evolution. Students interested in physics and chemistry will find applications for thermodynamic principles, reaction mechanisms and electrochemistry. Those who favor engineering and biotechnology will learn about the innumerable applications of biochemistry in industry. More importantly, this course will provide an opportunity for students to expand their range of interests and to find new applications
In many ways, biochemistry students often feel like they are learning a new language. Reading the text book and memorizing structures and reactions will, at best, result in a mediocre, superficial and transient ability to answer questions in an exam. The best way to learn complex disciplines is to become an active participant in them. How can that be achieved in this course? First of all, students will be encouraged to work in groups to discuss and explain concepts out loud. The most satisfying proof of mastering a difficult topic is the ability to explain it to another person. It is expected that groups will work together outside the classroom in preparation for lecture and examinations. The second way to become actively engaged in the study of biochemistry is to take full advantage of the time spent in the laboratory. Exercises and activities have been carefully selected to complement lecture topics.

**Tips for Success**

**1. Come to class**

In some courses all you have to do is read the book; that's not the case here. Regular lecture attendance is essential for success in this class. This is not an online course. Although some material may be posted on the Internet, you cannot expect to get all of the necessary information from this source. The textbook for this course covers more information than can be taught in one semester, and the lectures will key you in to what is important. Also, some of material to be covered in class is not found in the textbook.

If you must miss class, get the notes from a fellow student or the web, and then go over the notes with someone who was present at the live lecture. Get the phone number and/or email of at least one other student now, so that you'll have someone to call if necessary. The notes may be on the web, but it still pays to come to class -- most students get more out of the live lecture than they do out of just reading the notes.

Don't miss out on important information because you weren't there! I won't hold absenteeism against you and penalize your final grade, but my tests come from my lectures. It seems unlikely you could do well without attending class. If you want to try it, go ahead, and let me know how it works out for you.

**2. Take notes**

Your lecture and class notes are, without a doubt, the most important tool for succeeding. Pay attention and take careful notes! Don't just try to write everything I say. Everyone has her own style of note-taking; there is no one "right way". Do what works best for you.

I give clues all the time as to what is important, especially in terms of upcoming exams. Pay attention and pick up the clues, which may be as obvious as, "This will be on the exam." Probably the most important clue is how much time I spend on a topic. Highlight what is important in your notes and in the textbook, so that you won't forget.

There are many styles of taking notes -- some people prefer to get it all down word-for-word and some people prefer to just write down the critical points. Either way is fine, but be sure you get the point (if you are concentrating on transcribing every word) and be sure you understand the necessary details (if you are concentrating on the point). The web notes should help you fill in anything you missed. Taping is permitted, but the transcribing of tapes is very time consuming and I don't recommend it. You are probably better off forming a study group and going over the notes together (with the help of the web notes and textbook) to fill in the holes. You may be tempted to give up note taking altogether because the lecture notes are available on the web, but I strongly advise against it. Taking your own notes is important because it captures your own personal take on the lecture. The taking of notes also helps you to pay attention in class and to remember the material afterwards.

**3. Form a study group**

Don't try to do it alone. With no curve, you are not in competition with anyone else. Their gain is your gain. The best way to learn something is to teach it. Get together with other people soon after class and discuss what happened in lecture. Work on things continuously at a steady pace, and you'll have far less to worry about when test time approaches. To this end, I have established a discussion group in WebCT. Access the
discussion group, and discuss your questions with other students.

I recommend strongly that you form study groups, and otherwise develop strategies to help you master this material. If group learning isn't your style, be sure you give yourself enough time to think about and learn the material. Take lots of notes: You will not learn by hearing once and reading once! Study groups are generally good because they help you go over the material, give you an opportunity to practice explaining your answers and provide moral support.

This may be your first extensive exposure to detailed metabolic pathways, membrane transport, regulatory mechanisms, and so on. You will not learn this without a considerable investment of time and effort, and remember: these are fundamental concepts upon which you will build as you continue your training in science. The more you get involved in the learning process—through lecture and discussion, laboratory activities, reading, and interaction with your classmates—not only is it more likely it is that you will be successful, but the process will be much more enjoyable!

The Library is a great place to study! It's quiet, and there are loads of books for you to use. I will not be insulted if you supplement your studies with other texts. Everybody reads things a bit differently.

4. Do the problems

This is probably the most important thing. The sciences are active subjects, not passive ones. You must be able to solve problems and try many examples to truly learn the material. Passively reading and memorizing information alone will not get you through; there is just too much information to memorize enough of it. Go over problems until you feel confident with the material; go over them more than once if necessary. Once you feel on top of the material, do the problems as if it were a test—write out the answers and write out explanations of how you got your answers.

This material will also be covered directly on the exams. Read and work problems for a minimum of 6 hours per week outside of class. Center your reading and study time on the goal of successfully solving problems. Solving all the problems at the end of each chapter won't guarantee you an "A", either. You must try to integrate information as we cover it; think about how each piece fits into the whole. Working the homework problems is important for a proper and thorough understanding of the material.

5. Make diagrams, pictures, summary charts, concept maps, etc.

The ones in the book, and on the website, may be good, but for best results, you should make your own. Don't copy over your notes or outline the book word-for-word; digest each section of the notes or text first and write your own, private, condensed version (in whatever form you prefer—use diagrams, charts, etc.). As with any subject, you must learn new words in order to understand what's going on. It is probably a good idea to make a list of vocabulary words to learn.

6. Keep up

You cannot master a fast-moving, exciting field like biochemistry in one semester or one year. The best you can hope to do is catch up with it and stay abreast. The best strategy is to turn yourself into an effective independent learner of the subject. You cannot do this overnight, but here's how to start that journey. Follow the steps described below, from the beginning of the course, and at some point you will suddenly realize that you are approaching new biochemical material with greater confidence, getting more out of class, and spending your study hours more effectively.

On the subject of study hours, how many? The current material is always based on what came before, so once you get behind it is very difficult to catch up. Success in this class will require a time commitment outside of class time. Each student should schedule specific blocks of study time devoted exclusively for this class. Ideally, there should be scheduled time between each lecture period for review and preparation. The amount of study time required will vary with individual students. For success (bluntly, A or B performance), invest at least 3 to 6 hours outside of class for every hour you spend in class. And put in this time regularly, not just before exams, in the manner suggested below. Biochemistry doesn't cram very well. It's sort of incompressible—more like a solid or liquid that a gas. You need continuous exposure over a long period.
7. Read the text before class if the material is new to you

Base your readings on the lecture notes because this material is considered to be central to the course. Further understanding of the information that is covered in the lectures can be obtained by reading the text.

Be aware of the amount of work this class entails. We will cover over a chapter per week. Some people prefer to read the text before class; others prefer after lecture. Do what works for you. "A picture is worth a thousand words." Don't ignore figures and tables. Study relevant ones carefully. You may get a better insight into the information than through the text itself.

Try the chapter problems before reading. Focus your attention on the kinds of questions asked and the material that you personally find difficult. Avoid wasting time reading through material you already understand. A text is not a novel; don't read it like one.

If I emphasize a subject you should spend more time on that section, and if I've indicated that some material is not important, your time would be better spent elsewhere. Remember, I write the tests, not the authors of the text. They're here to help me, not the other way around.

8. Ask questions

If you don't understand something, ask. That is what the TAs are here for and that's how the lecturer finds out if he is going at the right pace. Don't wait for someone else to speak up - do it yourself. Don't be afraid of looking stupid - looking dumb before the exam is a lot smarter than looking dumb afterwards. To get the most out of office hours, go over the problems and/or notes first and come prepared with a list of questions. The more effort you put into asking questions, the more you will get out of the answers.

Don't be afraid to ask questions. Pay particular attention to:

- Things that I said during lecture that you didn't understand
- Problems you tried but couldn't figure out
- Things you read but did not understand.
- Lecture notes you took but aren't sure of.

My goal is neither to trick you, nor give you I.Q. tests. The exams will be straightforward. If you understand the concepts in the lecture notes and in the book, and if you can work through the homework problems with relative ease, you will do well in the class.

9. Master the vocabulary.

The stress in this course may be on using biochemical vocabulary, but you won't get anywhere until you learn it first. So try to master all new terms as fast as possible. Be especially careful about words that seem similar but mean different (often related) things (such as peptide/protein, chromosome/chromatid, gene/allele, etc.) and terms whose biological meaning is not the same as their technical or general scientific meaning (spontaneous, adaptation, etc.). Once you get the vocabulary down, you will find it much easier to follow the lectures and do the problems.

10. A word or two about grades

The two most common complaints about grades heard in this class are "the exam grade doesn't reflect my knowledge of the material" and "my grade doesn't reflect the amount of time and effort I put into this course." Sometimes these complaints are justified, but often they mean the student does not understand what is expected of him or her, or is concentrating on (and spending too much time on) the wrong things. In this course you have to know how to use the material, not just repeat it. If you think your performance on the exam does not reflect your knowledge, it often means you have memorized the facts but have not practiced enough at selecting the right ones and applying them to whatever problem is presented to you.

11. Here are three steps to success
Step 1:
Read the Lecture Slides, Notes and Textbook BEFORE class. You can reduce note-taking and increase your attentiveness in class if you are hearing about the subject for the second time when you hear it in class. You will also be better equipped to ask questions and clear up confusion or difficulties. Even if you are not finished with your work in Chapter 5, if you see that your instructor is beginning Chapter 6 at the next class, read it beforehand.

Step 2:
Start working problems as soon as possible, so you can raise questions in class while your instructor is still discussing the material you are studying. The problems at the end of the chapters are not just tests of your knowledge; on the contrary, they are part of the learning process, so do not put off problems until you think you have mastered the material. Working problems will help you master the material. More below about how to solve problems.

Step 3: Reread the material as it is covered in class, and continue working problems. Plan to read every chapter twice. Problem solving will lead you back to the sections where you are weakest.

THIS ADVICE IS CRUCIAL:

TRY TO SOLVE ALL PROBLEMS WITHOUT REFERRING TO THE ANSWERS.

If you are stuck on a problem, don't look up the answer. Instead, look back through the chapter to find and reread related material. If you can't work the problem, let it direct you to the material you need to study further. Then try again to work out an answer to the problem. If you arrive at an approach and then an answer, try to find fault with your answer before you check it. (In real life -- and on exams -- the answers are not in the back of the book. Scientists hold all of their answers tentatively until they find something wrong with them. Nature practically never gives us clear yes-or-no answers to our questions.) If you check your solution and see that you are wrong, don't look further at the answer. Keep trying or go on to other problems and come back to the troublesome one -- your mind will not leave it alone, you'll still be puzzling over it. Give your mind time to turn it over and over. Many important solutions have come to scientists when they least expected it -- during walks, baths (Eureka!), conversations, even dreams. (Remember those resonance forms of benzene? Remember who dreamed them up?)

If you simply read problems and then turn to the answers, you will not develop problem-solving skills. In addition, you will not be prepared for exams (or for real science), where you must first arrive at answers, and then decide for yourself whether the answers are worthy of your confidence. Regular and frequent problem-solving, in the manner described above, is the most important path to success in a biochemistry course.

Sound like a lot of work? It is, but if you want to succeed in one of your university's most challenging courses, and become a competitive contributor in one of science's most exciting and fast-moving fields, you must not be a stranger to hard work.

Good luck in your biochemistry course! Just remember that luck has little to do with it.

What to Read

The lectures may omit or abbreviate some topics that are covered more fully in the Web lecture notes. The reasons for such differences include spending more time reviewing more difficult concepts or expanded class discussion. In these cases students are still responsible for material that is not covered in the live lecture but is present in the Web lectures.

It usually pays to read the text (Becker) before you come to class so you will be familiar with the terminology and the basic ideas. You may find it helpful to read whole chapters in order, especially if you have had no background in biology. After the lecture, you should read whatever you feel is necessary to understand the lectures, to answer the study questions and to satisfy your curiosity. If you want to look up a specific topic in one of the supplementary texts, use the index in the book - don't read whole chapters. Wholesale reading of the supplementary texts is not recommended (it takes too much time and the books are cluttered with details that are unnecessary for this course).
Many of the supplementary texts cover the same topics, and any one of them will do. Read whichever one you have handy or like the best. Do not read them all. Remember, you do not need to buy any of the supplementary texts. A fair number of experimental methods will be discussed in class. To find out where a particular method is described in the texts, consult the indexes or The Guide to Techniques inside the front cover of Becker 5th Ed.

**Recommended Optional Sources of Information.**

**To bolster a weak chemical background:**


Fisher and Arnold, Instant Notes in Chemistry for Biologists, 1999

Theil, Principles of Chemistry in Biology, ACS 1998

**To supplement the biochemistry in the basic texts:**

Lehninger, Bioenergetics, Benjamin. All about ATP, nice and simple.

Stryer, Biochemistry, any ed., W.H. Freeman & Co. A good general biochem. text that includes problems and answers.

Lehninger's Biochemistry or Principles of Biochemistry. These books are similar to Stryer, but a little more complex.


**To supplement the genetics in the basic texts:**

Suzuki, Griffiths, Miller and Lewontin, An Introduction to Genetic Analysis, any ed., Freeman. A genetics text with thorough explanations and a problem-solving emphasis. Older editions are good but lack sections on molecular genetics.


There are many other good, current genetics books, such as those by Zubay, Rothwell, Ayala, Fincham, Hartl et al., Russell and Goodenough.

**Additional Molecular Biology Books (these cover a lot of biochemistry too):**

Alberts et. al., Molecular Biology of the Cell, any eds., Garland. More detailed than necessary but covers a lot of the topics in the course in manageable chunks. Highly recommended by former students.


Miscellaneous:

Scientific American and the science section of the Tues. N.Y. Times. Almost every issue has at least one article on recent developments in molecular biology.

Heppner, Frank, Professor Farnsworth's Explanations in Biology, McGraw Hill. This is a very funny book that explains some of the more difficult concepts in biology and includes good advice on studying.