Chemistry 258-03 -- Biochemistry **Spring 2014**

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Welcome to Biochemistry! You are embarking on a semester's study of what is, in my humble opinion, the most fascinating material in the intellectual world -- the molecular analysis of life as we know it on earth. This course will touch on many topics that you've visited before, but we are likely to be looking at these familiar issues in new ways, and I hope that you'll be delighted to see how many nuggets of knowledge from earlier coursework fit together in the new analyses you'll be undertaking this term.

I've designed this course, but I strive to create an environment where you will be sufficiently comfortable and sufficiently excited that you will really make this YOUR course, rather than mine. What you are reading is what I call my "syllabook" -- it is a (lengthy) description of the philosophy motivating my design of this course as well as the usual course logistics and scheduling details. It is my sincere hope that it should help you

- get a sense for how I have structured the class
- begin to formulate questions about the course and about Biochemistry
- prepare yourself for what I hope will be an exciting and challenging exploration of the Chemistry of Life.

So please read the whole thing, so that you have a good sense for what is coming in the next fourteen weeks. And please let me know if there is anything in this syllabus that you either don't understand or don't agree with. It is my belief that you will be in the best position to learn biochemistry if we can honestly discuss both the learning process and the chemical content of the course.

What I want to achieve in this course this semester:

- What we term “biochemistry” includes a huge -- HUGE -- realm of knowledge. I expressly do NOT hope to teach you all of it. Rather, I hope to introduce you to a selection of topics in biochemistry, and through these topics, to a set of analytical approaches for probing the molecular underpinnings of life. It is my intent that by mastering these analytical tools that you will be prepared to master the many domains of biochemical topics that we won't have time to explore this term.

- Specifically, I want to guide you to a deep-seated understanding of the relationships between molecular structure and biological function for the major classes of biological macromolecules, and for proteins in particular.
    - First, you will learn to *explain* how elements of the structure of a macromolecule support its function or properties.
    - By the end of this course, you should have begun to develop the ability to *predict* the change in function that might accompany a particular change in structure of a molecule that you have never seen before. To approach this goal, I intend to introduce you to lots of examples of biologically-important macromolecules, with many of these 'molecular case studies' drawn from the primary research literature.
- Finally, you should develop the ability to explain how these structure/function relationships form the basis for the real-time control of macromolecular machines in living biological systems.

- I also want to guide you towards a working familiarity with the logical approach to asking questions about your world that we term "the scientific method". This methodology is far more than a set of steps for designing laboratory experiments. It is truly a way of interacting with life and with information.

Fundamental to my approach to this class is a firm belief in the Liberal Arts approach to learning. At its core, this philosophy states that learning is not so much a process of accumulating information as a process of developing ways to examine and make sense of information. Therefore I most decidedly do NOT view my role as teacher to be the person who tells you all there is to know about biochemistry. Rather, I strive to be the person who encourages you to think critically about chemical information, who helps you to construct your own view of the chemical world.

In this course you will probably cover fewer enzymes, reactions, and metabolic pathways than you might in a comparable course at a large university. On the other hand, you will be asked to go beyond simply knowing about the things we cover, to truly understanding them and predicting outcomes of experiments you've never encountered before. I seek to teach you to think, to question, and to learn. The universe of knowledge is constantly expanding, and no one can expect to know everything, even in a small subfield, such as enzyme kinetics. But if you learn to think critically and learn to learn, then you will always be ready to master new worlds of knowledge as you encounter them.

An important part of thinking critically about a situation is the willingness to explore ideas that run counter to one's preconceived notions. That's not a new idea -- Aristotle is said to have put it this way about 2000 years ago: "It is the mark of an educated mind to be able to entertain a thought without accepting it." I hope that over the course of the coming semester you will come up against some ideas that you find strange, perplexing, or challenging to your worldview. I will make every effort to support you as you 'entertain' these ideas, and I strive to allow you to think about challenging ideas in a non-threatening environment. If you ever feel uncomfortable about confronting new ideas in this class, please do not hesitate to come by and talk with me about it. For a principled discussion of the role of provocative ideas in the Liberal Arts education, I encourage you to visit the website of the American Association of Colleges and Universities at
http://209.29.150.40/About/statements/academic_freedom.cfm

Who I am and how to get in touch with me:

Instructor:	Peter Kuhlman
Office:	Ebaugh 117
Phone:	587-6698 (if you let this ring, it will get forwarded to my cell phone -- or voicemail if I'm not immediately available -- so if you really need to get in touch with me, don't hesitate to call) You're welcome to call at any hour of the day or night (though I reserve the right to not answer at some of those hours!). If you want to text me instead, you may do so at 740-644-7460; the same (lack of) restrictions apply.
E-mail:	kuhlman@denison.edu
Office hours:	To optimize our opportunities to meet outside of class hours to discuss any questions or difficulties you're having, I don't have regular "office hours", but instead set up individual or group appointments. I'll make every effort to ensure that you and I can find a time to meet outside of class hours to discuss any topics that are of concern to you.
Help sessions:	To provide further opportunities for you to go over problems and concerns with me, or to get feedback on past tests or upcoming lab assignments -- really, to discuss any aspect of the class -- I will hold two weekly optional one-hour supplemental sessions. I will ensure that these are scheduled at times that permit *every* member of the class to attend at least one of these sessions each week (if you choose to do so).

Course material:

Texts: *Biochemistry, Fifth Edition*, Garrett&Grisham (2012).
The laboratory manual will be handed out on the first day of lab (free of cost to you).
Electronic versions of the lab manual and other course documents are available online at
personal.denison.edu/~kuhlman/courses/

Old-school sample problems:
A variety of sample problems will be available to you in order to help you review, deepen your understanding, and prepare for tests. The first installment is online at
personal.denison.edu/~kuhlman/courses/biochem/samples/
I will sometimes point you to specific problems from these online question banks, but they are always available for you to pursue on your own. As they come to my attention, I will also publish links to other online Biochemistry resources at
personal.denison.edu/~kuhlman/courses/
I encourage you to take full advantage of them!

Interactive online practice problems:
As an optional companion to this course, I have set up an interactive online homework site through Sapling Learning:
saplinglearning.com or www.saplinglearning.com/ibiscms/login/
Subscription to online homework will cost $30 for the semester; the Sapling exercises are targeted to our textbook and will provide you extensive, immediate-feedback practice on fundamental concepts and skills for this course that will complement (but not substitute for) the (static) sample problems I provide for each section.

Course meeting time:

We will meet on Mondays, Wednesdays, and Fridays at 12:30 in Ebaugh room 002. In consultation with the class, as noted above, I will also schedule two hour-long supplementary meetings at regular times each week to provide interested students an opportunity to spend more time in explanation, or review, or further application of material that we have covered in the regular class sessions.

Finally, we will also meet in the laboratory (Ebaugh 001) for three hours each Tuesday from 1:30 until 4:20 p.m. For me, as for many scientists, the lab is a wonderful place -- a place to explore new ideas, a place to test whether what I *think* I know is borne out in reality, a place to see cool phenomena unfold. I hope that you will take advantage of your opportunities to explore biochemistry with your hands and eyes and mind this semester, and I hope that I will infect you with some of my passion for experimental science.

Our partnership in Learning

Because I view my role here as your *partner* in learning, I invite you to join me in taking responsibility for your education. What does that mean?

For one, it means that I expect that you, as an experienced student, have learned to read textbooks in a fairly sophisticated fashion. I view the text as a complement to the material that I present in class and I will therefore *not* simply re-phrase passages from your book. If you aren't sure how to make best use of your text, I invite you to come scheme with me at your earliest convenience!

Similarly, I will recommend practice problems, and will sometimes pose questions for you to keep in mind while reading passages in the texts, but I will *not* collect your homework or watch over your shoulder to make sure that you are reading and working the problems. That is to say, I will provide you with resources and opportunities, knowing that if you are serious about learning, you will take advantage of them.

Taking responsibility for your half of our partnership also means that you should demonstrate initiative. If you only do those things that I explicitly tell you to do, you will miss out on many opportunities to gain a deeper understanding of biochemistry, of science, and of life. If you only come to class and hand in the required assignments, you will come out of the course with a correspondingly shallow perspective on biochemistry. If you only do the problems that I recommend, without pursuing more problems of the kind that give you difficulty, you are unlikely to achieve mastery of the course material. If you only read the recommended passages in the text, without reflecting on what you've read and asking yourself whether you truly understand it, you are very likely to be surprised in class and on assignments when I ask you to think about the material in new ways. If you wait for me to initiate a conversation with you about your comfort level in the course, without asking yourself (daily!) how well you are doing, then you are apt to gain much less from the course than you would if you came to me as soon as you identified an area of confusion. Similarly, if you have *any* questions about the course material, you should not hesitate to seek me out before class, after class, or by appointment at another time. And if you never take the initiative to explore things that you find interesting, to ask me questions that go beyond the strict requirements of the material, if you never ask *yourself* to think outside the course box, then you are almost certainly not going to have as much fun or do as well as if you make the decision to be an active partner with me in your education.

Finally, I should add that there is no portion of your course grade that is for "taking responsibility for your own learning". However, in this course, as it so often is in life, it will be clear to others whether you're taking your share of the responsibility to help your classmates and me make the most of our time together. It will show up in the way you acquit yourself in class, in lab, and on assignments, and it will definitely be reflected in your course grade. The single biggest difference that I've found between "A" and "B" students over the years is that the former group takes a much more active role in the course, that they demonstrate a *personal* commitment to excellence in learning.

How we'll achieve the course goals:

Research into how humans learn suggests that education is most effective if we encounter a new concept or skill in several different ways, followed by the opportunity to practice it and then to apply it to new situations. I've tried to embrace this theory in my design of this course. I'll try to give you opportunities to engage the course material by *reading about it, seeing it happen, doing it with your hands, thinking about it, and discussing it with your classmates*. I'll structure our class time in ways intended to help you review, reinforce, and synthesize all the material in the course. There will be opportunities over the course of the term for you to practice making *observations* and *reaching conclusions* on the basis of those observations, and there will be times when I will ask you to *make predictions* of the behavior of biochemical phenomena on the basis of what you have observed and learned.

Throughout these classroom activities, I'll be looking more for evidence that you're trying to learn and trying to think than for evidence that you have the "right" answers. I will ask you for predictions and calculations and observations, *not* to be cruel or "tough" or to "put you on the spot", but rather because I believe it's my job to help you *learn to learn* and *learn to think critically*. (Even though I believe that this is one of the most effective ways to help you learn, I'm also aware that different people learn best

in different ways, so please let me know if you feel uncomfortable with this approach to classroom learning!)

This class will be most effective when every member of the class is engaged. If class members either dominate, distract from, or withdraw from the class, we are all likely to learn less. I will therefore base part of your grade on my evaluation of your contribution to the class discourse. That doesn't mean that you should feel compelled to say a lot in class, or that every comment or answer you give has to be "right". On the contrary, we often learn much more from our mistaken answers than from our correct ones. Accordingly, I will note only whether your comments and answers indicate (a) that you are coming to class prepared and (b) that you are thinking. Of course, this also means that you must generally be present in class (and you must arrive on time), for if you aren't there, it will be difficult for you to contribute to the class and to show me that you're engaged and thinking.

Does that mean that I will take role everyday and penalize you for absences? No, but if you feel that you *must* be absent from any laboratory or exam day, please see me beforehand if at all possible, and in any case be prepared to rigorously justify your absence (with supporting documentation from, for example, Student Health or the Academic Support office). Absence on a test date will result in a score of zero for that test if you have not *previously* made an arrangement with me to take the test at another time. You *are* responsible for all class material whether you are present at all class meetings or not, so be sure to make arrangements with me and with your classmates to obtain the information that we covered in class on any days that you are not present.

I will strive to keep the format and content of this class flexible so that I can respond to your needs and interests as we go through the semester. I agree with past students that such flexibility enhances my ability to make this biochemistry course *your* biochemistry course. I also realize, however, that this very flexibility can be unsettling, and I will therefore also strive to make it very clear what my view of the class structure and priorities are, and I reserve the right to make final decisions about course structure, pacing, and assignments. Furthermore, in order to make changes to the course on the fly, we need to be in ready communication, and so I ask that you make it a habit to *check your e-mail daily* in case we need to be in touch about class-related matters. If your classmates or I ever make reference to an email message that you don't think you received, please contact me at once.

Finally, I think that it's important for you to learn how to decide which of the many, many bits of information that you encounter in this class are more important and which are less important. Similarly, I want to encourage you to reflect on which aspects of the material ***I*** think are important and am apt to stress on exams. **To stimulate these kinds of higher-order learning, I'll give you one extra point for every exam question that you predict I will ask.** Of course, I don't expect you to come up with the exact questions, but with some work I think that you'll be able to predict the types of questions I'll ask. I will accept up to three of these sample questions for each exam. In order to receive credit for your submissions, you must *send me sample questions and correct answers by email before the test is administered*. Questions that address similar concepts as those on the test, but are much simpler or shorter than the questions that I ask will receive minimal credit.

Building on your previous knowledge

This course has an uncommonly long list of prerequisite courses: 3 semesters of chemistry and one semester of biology. And we *really will* build explicitly and implicitly on material from all of those courses. I'm not going to test you on that material per se, but some material from those courses is absolutely fundamental to this course and I place a high value on your competency with this material. I

will be totally happy to help you fill in any holes in your repertoire of learning from those courses, but the responsibility for identifying what you do and don't know lies squarely with you. I urge you very seriously to commit the time early in the semester to go over the key topics from the prerequisite courses and make sure you are solid on all of them -- it will allow you to build your learning of the concepts of this class on a firm foundation. The second-to-last page of this Syllabook provides a list of the concept areas you will be responsible for.

Learning from your mistakes

I believe very firmly that learning is an iterative process; very few of us get things exactly right the first time through, and there is often a great opportunity for learning in repeating an assignment after receiving feedback on it. This philosophy underlies much of my approach to grading and point values for assignments in this class. I want you to feel that you can learn and benefit from your mistakes, that you will be rewarded for getting it right the second time around. Accordingly, if you ever want to revise an assignment and submit it for reconsideration, you are welcome to come and discuss that with me. And for *any* assignment on which you receive a grade of 50% or less, you are strongly encouraged to revise and submit the assignment for regrading.

In the same vein, if you receive any assignment back on which any part of one of your answers has been marked in orange highlighter, you should interpret this as a particular invitation to revise your answer and submit it for regrading. Typically this will indicate that I had trouble understanding the logic behind your answer, or felt that you answered a different question from the one I asked. In any event, this indicates that I think you have a better grasp on the material than your answer shows, and I'd like to give you another chance to demonstrate your mastery.

In any resubmission situation, please

- ensure that you include the original graded version of the assignment so that I can compare my original comments with your revised version. Resubmissions that are not accompanied by the original version will not be regraded. **I strongly encourage you to make a copy of your original assignment before giving it back to me, so that you have it to study from.** *Resubmissions get the lowest priority on my grading to-do list, and I won't guarantee getting them back to you before the end of finals week.*
- ensure that you carefully address the deficiencies of the original. I try to put care and time into the comments on your assignments when I hand them back, with the intent that my comments will help you think more carefully about your work. Revised versions that come back to me with the original problems un-addressed are likely to receive a less-than-generous review. **If you have any questions about my comments, by all means come to talk with me about them *before* making your revisions.**
- be aware that I grade *at least as stringently* on revisions as on the originals -- on the revision, I assume that you understand my expectations, so I am less likely to give you the benefit of the doubt when your intent or procedure is not clear from your work.
- understand that your final grade for the assignment will be the average of your original and revised grades. With a substantial improvement over the original assignment, this can make a very meaningful difference in your overall grade.

Finally, it would be naive to think that simply copying down answers off of someone else's paper, or writing down what someone else tells you, constitutes learning from your mistakes. While *I* won't be able to judge whether a correctly revised answer shows that you've *really learned* the subject matter, *you* should be able to make that assessment. I strongly encourage you to ask yourself that question honestly every time that you hand in revised answers. If you are not honest with yourself about this, you could get

a rude surprise on the final exam, which is worth more points than all the other tests put together, and on which you only get one opportunity to show me what you truly have learned.

Laboratory:

The laboratory component of this course is an integral part of it. This is reflected in its large numerical weight in the overall grade scheme of the course. To pass this course, you MUST complete all assigned laboratory work. Period.

A schedule of the lab exercises appears later in this syllabook. As noted above, you'll receive the laboratory manual on the first day of lab.

Lab safety is of high importance. That's not to say that working in a chemistry/biochemistry lab is a dangerous business, per se, but rather that there are risks and it is critical that we all avoid those risks where possible by practicing good lab behavior.

General Safety Instructions

1. Know the locations of all safety equipment such as fire extinguishers, eye-wash fountains, safety showers, and fire blankets.
2. Never taste chemicals.
3. No smoking, eating, or drinking is allowed in the laboratory.
4. Extra clothing and books should be placed on the racks provided, out of aisles and off of work surfaces.
5. Report all injuries, no matter how trivial.
6. Never perform unauthorized experiments.
7. Handle chemicals with caution:
    - read labels carefully
    - use only what is needed
    - leave reagents in their proper location, *appropriately closed*
    - dispose of waste and excess materials in the proper manner
    - clean up spills immediately, *especially at balances*

Eye Protection

1. Approved eye protection must be worn at *all* times in the lab. For this class, you'll be provided with safety glasses, but you may always use your own safety glasses or goggles, provided you first get approval from your instructor.
2. For hygiene reasons, students are discouraged from sharing goggles.
3. It is each student's responsibility to know where the eyewashes are in each laboratory and how to use them.
4. Face shields will be available for experiments that involve unusual risk.
5. Students are strongly encouraged not to wear contact lenses in the laboratory. Those who feel they need to wear contacts should inform their instructor so that appropriate help can be given in case of an accident.

Proper laboratory Attire is a very important way to minimize the potential danger to you of accidents that can occur in any laboratory. Therefore, I will insist that you observe the following clothing guidelines AT ALL TIMES:

- no open-toed or open-top shoes are allowed in the laboratory

- no shirts that expose your midriff nor above-knee skirts, shorts, or dresses are allowed in the laboratory unless they are worn underneath a lab coat -- *your skin should be protected from shoulder to knee*.
- hair long enough to hang forward should be tied back.

If you cannot meet these requirements in the lab, I will send you back to your room to change your clothing. I don't do this to aggravate you or because I want to enforce a particular style of dress, but rather because I believe that it is far more important to be safe in lab than to be fashionably dressed in lab.

Due dates and deadlines

Let's face it. We're all busy, and we all find ourselves in the nasty situation from time to time where we have more things to do than we have time to get them done. It's a very real part of the modern lifestyle. With that in mind, and in an effort to avoid holding you to a standard that's higher than the one to which I hold myself, here's my policy on handing things in on time: if you hand any assignment in after the deadline but before I have time to grade it, there will be no cost for your tardiness. If you hand in an assignment after the due date, and up to one week *after I have graded* that assignment for your classmates, there will be an automatic 12% deduction in your score (that is, the max you can get for a late submission is 88% instead of 100%). I hope that you never find yourself turning things in later than that, but if you do, your score will drop an additional 12% for every additional week *after I grade* the assignment.

Scientific Writing

Several of the assignments for this course involve writing. In science, as in nearly all aspects of professional and personal life, clear and effective communication skills are a tremendous asset. I encourage each of you to take advantage of the campus Writing Center to improve your written communication skills. Although there is a widespread perception that writing in the sciences is somehow "different" from writing in other disciplines, I regard that as a myth. Styles certainly differ between fields, but the fundamentals of good communication are nearly universal. The Center is a free resource available to all Denison students. Student writing consultants from many majors help writers one-on-one in all phases of the writing process, from deciphering the assignment, to discussing ideas, to developing an argument, to finalizing a draft. Because proofreading is a last step in that process, writers should leave plenty of time for getting their ideas right before expecting proofreading help. Consultants also can help writers with personal documents, like job and internship applications. The Center is located on the fourth floor of Barney-Davis Hall; a satellite location is in the Reference section of the Library (the Entry level). Go to the Writing Center website at denison.edu/academics/support/writing-center to see their current hours or make an appointment to meet with a tutor.

Special Needs

Different students come to this class with different training, different backgrounds, and different abilities. If you feel that because of personal factors you would benefit from some modification of course procedures, such as special test-taking arrangements, I ask that you contact me privately *at your earliest convenience*. Also, please note that reading is the pre-eminent way of taking in information in science. If you have difficulty reading, please make an appointment to see me at your earliest opportunity.

I will work with you and with the Academic Support and Enrichment Center (Doane Hall, room 102) to optimize your learning experience. Certain accommodations will require verification of disability based on documentation on file in the Academic Support office.

Academic and personal honesty

My most fundamental assumption about this class is that you are here to learn. All feedback that I provide you and all the learning opportunities that I set up are predicated on that assumption. For you to effectively learn, and for me to effectively advise you on your learning, you must be honest with me and with yourself about what you do and do not know. I will attach no stigma to your admission that you don't understand something. Indeed, that admission is the first step down the road to mastery of this course.

In 2008, the DCGA and the Denison University faculty agreed to a set of policies envisioned and largely crafted by Denison students. This set of policies, known as the Code of Academic Integrity, "provides a means of assuring that values essential to learning—trust, responsibility, and ethics—are promoted and maintained by all members of the Denison community." (this quote is taken from the description of the Code at denison.edu/academics/curriculum/integrity) I encourage you to become well acquainted with the Code; it not only governs how Denison deals with academic dishonesty (more on that in a minute), but it also provides a call to take greater personal responsibility for creating the learning environment that you want to experience at Denison.

If the atmosphere of trust and learning that I try to create in this class is compromised by individuals behaving in an academically dishonest manner -- for instance, passing off someone else's work as their own -- I will be deeply disappointed and quite upset. Academic dishonesty is tantamount to intellectual theft. This standard applies to all work ranging from simple lab assignments to the final exam. I recommend that you carefully read the Denison University Code of Academic Integrity (at the URL listed above), the Academic Dishonesty Policy as printed in the student handbook, and the section in the Bedford Handbook entitled "Citing sources" on pages 592-608. Neither ignorance nor carelessness is an acceptable defense in cases of plagiarism.

The grade penalty associated with a confirmed case of dishonesty will ordinarily be a score of zero for that assignment. Furthermore, by Denison policy, I must refer every act of academic dishonesty to the Associate Provost, and violations may result in failure of the course, suspension, or expulsion.

Don't be foolish. Engaging in dishonest behavior in order to bring your grade up from a B to an A, or to save yourself some time, is simply not worth the cost. It saddens me every time that I catch a student cutting corners like this, because the cost is so disproportionate to the potential gain. And I'm sorry to say that I've had to turn in at least one student for academic dishonesty almost every semester for the past several years. Don't join their ranks. Be proud of what you've learned, not what you've gotten away with. Be honest.

How will your learning be assessed?

As I currently envision the course (and subject to feedback from you), there will be a variety of opportunities for you to demonstrate to me your mastery of course concepts; these will probably add up as follows:

Subjective evaluation of intellectual engagement and contribution to the class (including lab)		60 pts	10 % of total
Laboratory		170 pts	27 % of total
analysis of experiment #1	40 pts		
poster presentation on expt #2	50 pts		
lab notebook checks	30 pts		
take-home portion of final exam	50 pts		
Tests (50 pts x 4 =)		200 pts	32 % of total
Final exam (plus take-home portion noted above)		200 pts	32 % of total
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TOTAL		630 pts	

Please note:

- The four hour exams together account for about one-third of your grade in this course, the same amount as the in-class portion of the final exam. I've done this for three reasons. First, it makes each in-class exam significantly shorter; I want to test how well you understand the material, not how quickly you can write. Second, it allows you to learn from your mistakes -- you can do poorly on a test, but if you learn what you did wrong and you address your deficiencies, then you will have the chance to score well on the final and come out of the class with a grade that reflects *what you learned in the end*. Third, this scoring system reflects my belief that what you know at the end of the semester is really important -- I don't want to reward you for cramming for one test and then immediately forgetting the material. Rather, I want to reward you for truly learning the material and for integrating each new topic into your mental picture of how the world works.

- Because this class has both important classroom and laboratory components, the following two conditions ***must*** be met for you to receive a passing grade in the class:
  1. You must complete all assigned laboratory work (as noted above).
  2. Your average exam grade (over the four tests and the final) must be greater than 50%.

- Because I want you to gain an appreciation for how the theoretical aspects of biochemistry dovetail with experimental aspects, you should expect that both in-class and take-home tests will explore biochemical questions that you engage in the lab.

- Grades will be assigned *roughly* according to the scale on the next page. Note that I may change the scale so that it more accurately reflects what I feel to be the performance of members of the class. For instance, if everyone does poorly on the tests and if I conclude that it is because I did something wrong, then I will likely adjust all grades upward from the following distribution. On the other hand, if I think that the tests are sufficiently challenging but everyone does very well and is earning "A" marks, then I will be pleased as punch and am *un*likely to change the scale. For the most part, you may consider these to be the most demanding standards that I am apt to apply.

90% and up	flavors of A
80 to 89%	flavors of B
70 to 79%	flavors of C
60 to 69%	flavors of D
below 60%	F

- Finally, I wish to make clear my interpretation of letter grades.

  I recognize that the way we assign grades in American higher education is not perfect, or even wonderful. It is, however, a necessity of our education system, and a way to allow communication between student, faculty, and outside constituencies -- employers, med school admissions committees, etc -- about how well you met the goals of this class. I will try very hard to ensure that all grades that I give in this class are based on careful, principled evaluation. I also try to ensure that I apply fair standards to all students in my class. Again, however, I recognize that there are many desirable learning attributes -- persistence, creativity, and positive outlook, to name only a few -- that aren't well captured in a simple letter grade. If you ever ask me for a narrative evaluation or letter of recommendation, I'll be sure to comment at length on these other facets of learning.

  In the same vein, I want to acknowledge up front that I don't give grades for effort, per se. Hard work, diligence, and motivation are indispensable for good learning. But they don't, in themselves, *constitute* good learning or high achievement. And good learning and high achievement are the things that are primarily reflected in my grading. Let me give a few examples that may illustrate what I mean. Not everyone can play in the (W)NBA when they grow up, regardless of whether they've wanted to be a professional basketball player all their life or not -- most of us are simply not blessed with the build or the native athleticism that would require. Nor can everyone be a doctor, or a stand-up comic, or an opera singer. You must have aptitude AND attitude AND proper training AND a whole lot of focused effort.

  That said, I believe that every one of you *is* capable of getting an "A" in this class. You would not be here at Denison if you had not already demonstrated the ability to learn, the ability to rise above your peers in achievement. But for you to truly excel in this class, other things will have to be sacrificed along the way. Many of us decide that those sacrifices are not worth the goal. And that's OK; choosing not to devote yourself heavily to Biochemistry this term will not make you a failure in my eyes, and it shouldn't make *you* view yourself as a failure either. But if you *do* choose to strive for excellence and you choose to devote the resources of time and effort to get there, then I will be your caddy, your ball boy, and your coach.

  For two perspectives on the factors needed to achieve excellence (in any endeavor), I encourage you to read:
  www.nytimes.com/2006/05/07/magazine/07wwln_freak.html
  www.nytimes.com/2009/05/01/opinion/01brooks.html

  I view an "F" as a strong indication that the level of preparation and/or commitment brought to the class by a student are incompatible with the goals of this course. I hope not to give your class any "F"s.
  I view a "D" as an indication that a student is passing the class, but performing well below my standards and failing to achieve a substantial portion of the course goals. Usually, this means that

the student is performing well below her or his true abilities. In effect, a grade of D signifies that a student took this class, but didn't learn enough to be able to build on it in subsequent classes, so I strongly recommend any student who earns a D in this class to retake this class to solidify their learning before taking a class that lists this class as a prerequisite. I hope not to give your class any "D"s.

I view a "C" as notice that a student is doing a fair job. Frequently, this means that the student is present but not fully motivated or engaged. A "C" student is doing adequately but probably came to the class with insufficient preparation and/or has not committed the personal resources to learn most effectively.

I view a "B" as a very respectable grade. The student who earns a "B" may be trying very hard but still struggling with mastery of the material, or may be working less hard and stopping short of achieving excellence.

I view a "B+" as an indication that a student is doing a truly good job. This grade indicates to me that the student is expending significant care and effort to ensure that s/he is learning the material.

I view an "A-" as a very good grade. I do not give this grade lightly or without evidence that a student is nearly approaching mastery of the ideas and techniques of this class; this grade indicates that a student has met my expectations for the course.

I view an "A" as an indication of true excellence. In order to achieve an "A" in my course, a student must demonstrate to me that s/he has not only committed the necessary resources to master the material, but also that s/he is *aggressively engaging the questions that we explore*. This is a grade to be proud of, a grade to be earned by serious work and mental sharpness.

The single biggest difference that I have found between “A” and “B” students over the years is that students in the former group take a much more active role in the course and demonstrate a *personal commitment to excellence* in learning.

OVERALL COURSE CALENDAR

Topical Outline	When we'll be there	Recommended chapters in G&G 5e*	Important dates and Assignments
I. The Basics			
A. Introduction to the context of biochemistry	weeks 1~3	1	(master your base topics)
B. Introduction to the molecules	weeks 3, 4	2, 4 *	(memorize the Amino Acids)
			test #1, Feb. 12
C. Introduction to protein analysis			
i. proteins in their native habitat			
ii. protein architecture	weeks 4~6	5, 6	
iii. how proteins interact with themselves and other molecules	week 6		
iv. protein purification and characterization	week 6, 7	5.2 - 5.6	
v. testing hypotheses in protein biochemistry via the central dogma of molecular biology	7	(10~12)	***test #2, March 5***
II. Towards a predictive understanding of protein architecture, function, and regulation			
A. Case studies in protein S/F	weeks 8, 9	(15)	
B. Thermodynamic and kinetic tools in protein analysis	weeks 9~11	13 13, 14	***test #3, April 2***
C. Control of protein function by modification of protein structure	weeks 12, 13	15	***test #4, April 16***
III. Proteins in the wild: Function and regulation of proteins in complex biological systems	weeks 13, 14	17 (17~27)	***course eval Apr 28*** ***lab poster presentations,*** *tentatively* ***May 1, 6 p.m.*** ***FINAL EXAM In-class portion Saturday May 10, flexible scheduling 8 am till 6 pm*** ***take-home portion due May 12, 5 p.m.***

* Specific sections of chapters will be recommended in class, depending on the pace of our coverage and the abilities and interests of the members of the class.

LAB SCHEDULE

Date	Lab activities	Assignment *due this week*
Experiment #1: Purification of Cytochrome c		
Jan. 21	Introduction, aqueous equilibria involving acids, bases, and buffers; make buffers	
Jan. 28	"The Big Picture", protein quantitation	***hand in notes from week one***
Feb. 4	equilibria involving weak non-covalent interactions	***std curve, sample calculations***
Feb. 11	lysate prep, cation exchange	(test #1 this week)
Feb. 18	dialysis, purification table workshop	***lab notebook interviews this week***
Feb. 25	analysis of samples, plan SDS-PAGE	***dry run purification table***
Mar. 4	SDS-PAGE *and:* Back to the Big Picture: what does it mean?	(test #2 this week)
Experiment #2: Kinetic Characterization of Horseradish Peroxidase		
Mar. 11	Isolation of HRP	
Mar. 25	kinetic analysis of HRP	***cytochrome* c *purification analysis (40 pts)*** ***Hand in lab notes from first experiment (10 pts)***
Apr. 1	specific activity of isolated HRP	(test #3 this week)
Apr. 8	planning of independent projects	***HRP purification table and assay data*** ***lab plan for independent project***
Apr. 15	independent projects	(test #4 this week)
Apr. 22	independent projects poster planning and feedback	***hand in poster abstract and data tables for feedback***
Apr. 29	Chem/Biochem Core Assessment	
May 1, 6 PM (proposed)	Poster session	***Poster Presentation (50 pts)*** ***hand in lab notes for Experiment #2 (20 pts)***

"Base Topics" for Biochemistry 258:
concepts and techniques that we are *assuming* you are conversant with as you enter this class

General and organic chemical principles

- **fluency** with metric units of measurement and prefixes (pico-, nano-, micro-, milli-, centi-, kilo-)
- **fluency** with scientific notation
- stoichiometry (gram ←→ mole relationships)
- solution properties and solution stoichiometry (concentration, dilution, ionic strength)
- periodic trends in bonding and reactivity of non-metals
- types and magnitudes of intermolecular interactions/forces
- the structure of small molecules and the impact of structure on reactivity, intermolecular forces, etc.
- dynamic chemical equilibrium (Le Chatelier's principle, K_{eq})
- basic aqueous equilibrium calculations, especially acid/base equilibria using pH, K_a and pK_a
- the interaction of light with matter (i.e., spectroscopy; especially Beer's Law and standard curves)
- kinetics (reaction order, Arrhenius equation, catalysis, collision geometry)
- thermodynamics (reaction coordinate diagrams; S, H, G; relationship of kinetic properties to thermodynamic properties; relationship of thermodynamic properties to equilibrium constant and behavior)
- structure and reactivity of common organic functional groups
- organic reaction mechanisms and "electron pushing"
- identification of nucleophiles/electrophiles and rationalization of their chemical behavior
- stereochemistry

Lab Techniques/Skills

- stir/heat plate use
- balance use (top-load and analytical and *when to use each*)
- column chromatography -- basic principles
- micropipet use (if you have any questions about proper use of micropipetters, *please* ask in lab!)
- **basic solution preparation** (e.g., how would you make 1.00 L of a 0.3 M solution of NaCl?)
- spectrophotometer principles and use
- **dealing with uncertainty in measurements (averages, standard deviations, confidence intervals for collections of numbers *and for lines*)**

Computer/Technology Skills

- basic use of Microsoft Word, Excel (including linear regression), and PowerPoint
- Web searching of data bases
- Web/online searching of literature sources
- E-mail use
- Network file sharing and information exchange

In addition, you will be expected to gain full familiarity (immediate recall) with the structures, names, one-letter-codes, and physicochemical properties of the 20 amino acids most commonly found in proteins. This information can be found in detail in chapter 4 of your text; it is summarized on the next page. This is an ideal project to begin in your first week of the semester, and I hope you will be quite familiar with all of them by the middle of the third week. See the course webpage and the Sapling Learning course site for additional resources to help you master your amino acids.

Names and selected properties of the 20 amino acids commonly found in polypeptides **Spring 2014**

Chemistry 258

Name	one-letter ID	notable physicochemical properties
All of them	X	pK_a of the amino group is about 9 (an oversimplification, but…) pK_a of the carboxyl group is about 2
Alanine	A, as in **A**lanine	small; in many ways this is the generic amino acid is often interchangeable, biochemically and evolutionarily, with G, S, or T
Glycine	G, as in **G**lycine	very small; can fit in tight spots is often interchangeable, biochemically and evolutionarily, with A (and less often w/ S, T)
Proline	P, as in **P**roline	unusual and constrained cyclic backbone geometry
Serine	S, as in **S**erine	small and modestly hydrophilic -OH group is a target for some covalent modifications as we'll discuss later is often interchangeable, biochemically and evolutionarily, with A and T
Threonine	T, as in **T**hreonine	-OH group is a target for some covalent modifications is often interchangeable, biochemically and evolutionarily, with A and S
Cysteine	C, as in **C**ysteine	contains sulfur can form a (covalent) disulfide bond with another C is sometimes interchangeable, biochemically and evolutionarily, with S; less often with A, T (has a pKa around 8, but the ionization of cysteine is only significant in isolated circumstances)
Valine	V, as in **V**aline	bulky and hydrophobic is often interchangeable, biochemically and evolutionarily, w/ I, L, M; less often w/ F, Y (&W)
Isoleucine	I, as in **I**soleucine	bulky and hydrophobic is often interchangeable, biochemically and evolutionarily, w/ V, L, M; less often w/ F, Y (&W)
Leucine	L, as in **L**eucine	bulky and hydrophobic is often interchangeable, biochemically and evolutionarily, w/ V, I, M; less often w/ F, Y (&W)
Methionine	M, as in **M**ethionine	contains sulfur bulky and hydrophobic is often interchangeable, biochemically and evolutionarily, w/ V, I, L; less often w/ F, Y (&W)
Phenylalanine	F, as in **F**enylalanine	bulky and hydrophobic *weakly* absorbs UV light around 280 nm is often interchangeable, biochemically and evolutionarily, with Y; less often with I, V, L, M, W
Tyrosine	Y, as in t**Y**rosine	bulky and hydrophobic absorbs UV light around 280 nm -OH group is a target for some covalent modifications is often interchangeable, biochemically and evolutionarily, with F; less often with I, V, L, M, W (has a pKa around 10, but the ionization of tyrosine is only significant in isolated circumstances)
Tryptophan	W, as in t**W**yptophan (just say it with a lisp!)	bulky and hydrophobic absorbs UV light around 280 nm occurs only rarely, but is generally interchangeable, biochemically and evolutionarily, with F and Y
Asparagine	N, as in asparagi**N**e	hydrophilic releases ammonia by amide hydrolysis when treated with strong acid is often interchangeable, biochemically and evolutionarily, w/ Q; sometimes with D, E
Glutamine	Q, as in **Q**tamine	hydrophilic releases ammonia by amide hydrolysis when treated with strong acid is often interchangeable, biochemically and evolutionarily, w/ N; sometimes with D, E
Aspartic acid	D, as in aspar**D**ic acid	acidic pK_a, about 4 negative charge at pH above pK_a is often interchangeable, biochemically and evolutionarily, w/ E; sometimes with N, Q
Glutamic acid	E, as in glu**E**-tamic acid	acidic pK_a, about 4 negative charge at pH above pK_a is often interchangeable, biochemically and evolutionarily, w/ D; sometimes with N, Q
Histidine	H, as in **H**istidine	acidic pK_a, about 6 neutral charge at pH above pK_a, positive charge at pH < pK_a
Lysine	K, as in the letter before L for lysine	basic pK_a, about 11 *(note that your text gives a value of 10.5, but I will refer to the more commonly accepted value of 11)* positive charge at pH < pK_a is often interchangeable, biochemically and evolutionarily, w/ R
Arginine	R, as in **R**ginine	basic pK_a, about 12.5 positive charge at pH < pK_a is often interchangeable, biochemically and evolutionarily, w/ K