Chemistry 131-01 -- Atoms and Molecules: structure and dynamics Fall 2014

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Welcome to the first semester of Chemistry at Denison! This fall we'll explore the fundamentals of the way chemists look at the world, and the language they speak. Along the way, I hope that the language and tools of chemistry become *your* language and *your* tools -- things that help you better understand the world in which you live.

This syllabus is intended to help you prepare for what I hope will be an exciting and challenging exploration. Please view it both as an introduction to the course and as an explanation of why I have designed this course this way. I'll be frank -- it's long (a "syllabook", almost), and probably more long-winded than necessary, but I feel that it's very important that you understand my educational philosophy in order to get the most out of this class. So please read the whole thing in order to have a good sense for what's 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'll be in the best position to learn Chemistry 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:

- Science and chemistry are processes of inquiry, not static collections of facts. While I certainly want to facilitate your understanding of chemical concepts and the "language" chemists speak, I also want you to come to see chemistry as a *way of learning*. A significant portion of this class will therefore be aimed at helping you to improve your skill in applying chemical logic to the investigation and analysis of your world.
- In the same vein, I want to share with you, and hopefully pass on to you, my passion for the explanatory power of chemistry and its relevance to our daily lives. To experience the excitement of delving beneath the observable, everyday landscape to the fascinating molecular world that forms its fabric, you need to see differently, to apply a *mental microscope* to the world around you. Many of the exercises in this course revolve around the goal of helping you calibrate your mental microscope.
- 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 chemistry. 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 names, reactions, and chemical phenomena 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 spectroscopy. 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://www.aacu.org/about/statements/documents/academicfreedom.pdf

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 and 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.

Course material:

Text:	*Chemistry: Atoms First*, by Burdge and Overby (McGraw-Hill)
Laboratory Manual:	Lab materials will be handed out prior to each investigation. (A Laboratory Notebook and Goggles are also required; goggles will be available for purchase during the first few lab periods.)
Online learning:	McGraw-Hill's *Connect*, course URL: http://connect.mheducation.com/class/denison_131-01-2014 If you have any problems using the online learning platform, please contact the McGraw-Hill Help Desk at 1-800-331-5094 or go to www.mhhe.com/support or create.mcgraw-hill.com/wordpress-mu/success-academy/

Course meeting time:
We will meet on Mondays, Wednesdays, and Fridays from 8:30 a.m. until 9:20 p.m. in Ebaugh room 202. In consultation with the class, I will also schedule an hour-long supplementary meeting at a regular time most weeks 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 for three hours each Thursday from 1:30 until 4:20 p.m. The lab will be closed at 4:30 whether everyone is done or not, so failure to properly prepare for lab may mean that you have to finish the exercise at another time. Let's not let that happen!

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 Chemistry 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 will provide you with a detailed course calendar and always encourage you to read ahead in your textbook, but I view the texts as a complement to the material that I present in class and I will therefore *not* simply re-phrase them. *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 (more on this below), 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'll provide you with resources and opportunities, knowing that if you are serious about learning, you'll 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 chemistry, 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 chemistry. 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 required 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 are 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 have 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 chemical 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 is 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 every day and penalize you for absences? No -- in fact I'll never take role *per se*. However, **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 Chemistry course *your* Chemistry 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.

The demands of this course During this semester, we will be exploring a large body of material, and I will be asking you to gain more than a surface understanding of chemical concepts. While many of you will find the list of topics looks quite familiar from your high school training, most students in this class will encounter some subject matter that they were not introduced to in high school. More importantly, nearly all of your classmates will find that the college approach to chemistry puts a new and challenging stress on explanation and application of concepts rather than knowledge of details. I tell you this not to *warn* you that it will be a hard semester, but rather to *encourage* you to be honest with yourself about how well you are understanding the material, *from the very first week onwards*. This is one of my reasons for having a quiz after just two weeks of class and a test after three weeks -- I want to give you early feedback on your progress towards understanding. If you feel that you are struggling to master any aspect of the course material, I ask you *in the strongest terms* to make an appointment to see me to discuss strategies for improving what you get out of this class. There will be a wide range of opportunities for you to better master the subject matter -- personal meetings with me, weekly group help sessions, help room sessions led by experienced students, one-on-one tutoring sessions, and workshops offered by the office of academic support. Please take full advantage of these opportunities.

Other ways to demonstrate your mastery of chemical concepts There is far more to chemistry than what you will encounter in Chem 131. I want to encourage you to experience some of the greater world of chemistry, and I also recognize that tests are not an effective way for many people to either be motivated to learn or to demonstrate what they *have* learned. If you know from experience that this is the case for you, I will be happy to explore alternatives to the course point breakdown laid out below. To take advantage of this opportunity, you must meet with me early enough to conclude our 'negotiations' about an alternate evaluation scheme before September 15th. Although I'm ready to explore lots of creative approaches to evaluating your learning, there are a few aspects of student evaluation that I feel pretty strongly about, so in all cases, the percentage of course points coming from lab evaluation and the final exam are non-negotiable.

Ten percent of your grade for this course (essentially one letter grade-worth) will come from a diverse set of opportunities to demonstrate what you've learned and how that learning fits together with other aspects of your intellectual life. I'll say more about these "supplemental exercises" in class, but briefly they include in-class predictions of chemical phenomena, challenge questions posed at intervals throughout the semester, and short papers (1 page long), relating scientific events (like seminars, or books you've read, or...) to topics from this course. If you realize at some point in the semester that you've missed some of these opportunities, you are always welcome to come discuss alternate supplemental exercises with me. If you were to take advantage of every opportunity, this would total more than the available number of points. On the one hand, this mirrors life -- there are always more things to do than we have time and energy to do them all. On the other hand, it means that if you work at it hard enough, you can guarantee that you receive all of the available points in this category. I believe that thinking about chemistry in lots of different ways will help you learn chemistry -- and science-as-a-way-of-life -- more deeply. This is my way of rewarding you for doing that.

I also 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.

[Speaking of rewards, I'm glad that you're reading this syllabus -- it really is intended to help you get the most out of the class. And to reward you directly for having read this carefully, I'll make it worth your while to remember this phrase: "lower energy means higher stability". Got that? Good! Now, for less tangible (but no less real) rewards, keep reading!]

Sample problems:

I will recommend homework problems from your textbook and from other sources following many class and lab periods. These problems will be designed to help you apply the material that you have read or that we have covered in class, and/or to encourage you to think beyond what you have encountered thus far in the course. I'll use a variety of formats for these problems -- some will be utilize our online learning platform ("*Connect*"; see the URL back on the second page of this syllabook), some will be posted on the Denison website, some will come to your email box, and some will be handed out in hardcopy. In all cases, these recommended problems are just that: *recommended, not required*. I encourage you to try your hand at them because I believe this will accelerate your learning of chemistry and your exposure to more examples of chemical analysis. And in many cases (such as follow-up exercises to our lab experiences), these homework problems will explicitly prepare you for similar exam questions. The *Connect* exercises have the added benefits that (a) they'll provide you with immediate feedback on your answers, and (b) they can generate an almost infinite supply of similar problems, so you can practice until you're really comfortable solving problems of any particular type. I hope that these diverse sample problems will give you

plenty to sink your mental teeth into, but if at any point you want additional practice problems, please don't hesitate to ask!

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. This approach to learning is built into the grading structure of this class in two ways:

- most graded assignments in this class will be preceded by (optional) non-graded opportunities to try your hand at the same sort of skill or analysis
- for all graded assignments except the final lab poster and final exam, you may revise an assignment and submit it for reconsideration; your final grade for that assignment will be the average of your original and revised scores. (For an 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.
- as indicated above, 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. It is your chance to explore with your hands and your senses some of the things you will be exploring with your mind in the classroom. Moreover, the laboratory periods will be an opportunity for you to learn how to test ideas through the design and critical analysis of experiments. As such, the lab is in many ways more important to my goals for the course than is the classroom. And as a result, to pass this course, you MUST complete all laboratory work. Period.

Before you come to lab each week To make the most of lab, especially given how little time we have to play with these experiments each week, you must prime your mental pump -- you must read and think about the experimental situation.

Based on what's in the description of the week's investigation, you should write a brief title and objective in your notebook before each meeting. Some people also like to write a thumbnail overview of the procedure in their notebook, to follow as they go through the exercise in lab, while others prefer to write down the procedure and their observations as they go along. The choice is yours, so long as you have a good mental image of what you will do *before* you come into lab, and you have a written procedure in your notebook at the end of the day.

If you don't understand the background information in the materials I hand out prior to each lab, please ask for help. I will sometimes send out corrections or comments on the lab in the days leading up to our weekly lab sessions. Although I will try to remember to mention these in class, I will usually distribute them by email, so please be in the habit of checking your email regularly.

Your laboratory notebook is your record of what you did and what you observed in lab. Good lab notebook entries will allow you to go back and reconstruct what happened during each experiment hours, days, or even years later. This permits you, as a scientist, to do two fundamental things -- to *reflect* on your experiments, and to *repeat* them should the need arise. Although most of us develop a personal style in our notebooks with practice, I recommend the following organization to get you started:

a) leave a few blank pages for a table of contents
b) for each lab,

- put your name, the date, and the name(s) of your lab partner(s) on the top of *every* page
- begin the description of the week's lab with a title and a few lines describing the purpose of the experiment(s) -- as noted above, to receive maximum benefit from thinking about why you are conducting the experiment, you must do this *before* coming to lab each week
- as mentioned above, before you come to lab you may wish to write out a summary of the procedure in your own words so that it will be easier for you to move quickly through the experiment. Again, this is up to you -- what matters is that you have a written procedure in your notebook by the time you are actually doing the experiment. Many people find that it is useful to diagram key portions of the lab procedure in their notebooks -- for instance, to indicate a particular apparatus configuration, or to sketch out the flow of a complex experimental procedure

- as I go through the lab procedure during the pre-lab discussion, you should enter a "Notes On Procedure" section in your notebook. I ask you to do this to ensure that you are following along and taking note of what are often key points in the experimental protocol. Your alertness and accurate recording of these points should reduce your frustration with the particulars of the experiment and enhance everyone's safety in the laboratory.
- record the procedure you are following and *your observations as you follow it* in **enough detail for a complete stranger to reconstruct what you did**. You do not need to include painstaking detail, as long as you make reference to the step you are following from the lab manual. Remember, this is the fundamental purpose of your laboratory notebook: to document what you did and what you experienced in a manner that will be intelligible days, months, or years from now. If you find that it is illegible, you may certainly re-write it, but *never throw out the original data*; simply add the prettier version to the original.
- All descriptions of laboratory observations and data should be recorded *directly* into your lab notebook *IN PEN*. Mistakes should be lined out with a single line, rather than obliterated or whited-out.

Lab reports

There won't be any traditional lab reports for this class. Rather, I'll provide a variety of opportunities for you to reflect on what you did in lab and what your results mean. Typically, I will ask you to focus on only one or two questions, and I'll usually send you each follow-up exercise by email.

Lab safety is of high importance. That's not to say that working in a chemistry 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 when we are actually in the lab. For students in this class, that means goggles that wrap around and fit snugly to the face.
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 when we are in the laboratory:

- 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'll 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.

Finally, let me repeat: the laboratory component of this course is an integral part of it. Although they are spatially and temporally separated, "classroom chemistry" and "laboratory chemistry" are inseparable in my mind. To reinforce this notion, I will make every effort to stress ways in which the concepts you are learning in lab apply to what you are learning in class, and vice versa. I encourage you to ask me questions about lab exercises during classroom meetings, and ask about concepts explored in class during lab meetings. And I will ask you to apply lessons from class in lab and to answer questions from lab on classroom tests.

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 http://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 104) 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 http://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 (which includes posting class materials to websites like CourseHero) -- 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". 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)		50 pts	10 % of total
Supplemental exercises (see description above)		50 pts	10 % of total
Laboratory poster presentation		50 pts	10% of total
Tests	50 pts x 3 =	150 pts	30 % of total
Final exam (including take-home portion)		200 pts	40 % of total
		---	
	TOTAL	500 pts	

Please note:

- The hour exams 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 encourage you to cram for one test and then immediately forget 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 laboratory exercises (as noted above).
  2. Your average exam grade (over the three tests and the final) must be greater than 50%.

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

- Grades will be assigned *roughly* according to the scale below. 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 communicate 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 how many hours they practice or whether they've wanted to be a professional basketball player all their life -- 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 may 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 chemistry 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. I will work by your side -- for long hours if necessary. That's a promise.

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

Approximate course calendar, Chemistry 131-01, Fall 2014

WEEK	DAY	DATE	TOPIC	READ THIS BEFORE CLASS
"0"	R	Aug. 28	Introduction to chemical science and to this class	
	F	29	Talking about atoms and molecules	2.1 - 2.5, read the syllabook *(Chapter 1, sections 1.1 - 1.4, 1.6)*
1	M	Sep. 01	Chemical properties are predictable; introduction to the Periodic Table	2.5, 4.1
	W		Counting atoms and molecules (and more!)	2.6, 5.8 (5.10)
	R	*lab*	*Introduction to the laboratory; measuring stuff and talking about it*	1.4, 1.5
	F		Speaking the language of chemistry: words and sentences	*(handout, 5.4, p. 155-156, 8.1)*
2	M	Sep. 08	Atoms, light, and energy	3.1 - 3.4
	W		The quantum mechanical view of the atom	3.5 - 3.8
	R	*lab*	*The absorbance of visble light by dye molecules*	
	F		Electron Configurations	3.9, 3.10, 4.2
3	M	Sep. 15	Periodic trends in atomic properties	4.3 - 4.6
	W		review and application	
	R	*lab*	*Using the absorbance of visible light to investigate the quantity of dye molecules in beverages*	
	F		Exam #1	
4	M	Sep. 22	Ionic bonds and covalent bonds	5.1-5.3, 5.5, 6.1-6.2
	W		Covalent bonds and covalent molecules	6.1 - 6.4
	R	*lab*	*Mass spectrometry*	
	F		...more fun with models of covalent bonding	6.3 - 6.6
5	M	Sep. 29	Prediction of molecular shape by VSEPR	7.1, 7.2
	W		review and application to organic molecules	(24.1 - 24.4)
	R	*lab*	*Molecular Shape*	
	F		Reconciling VSEPR, the reality of bond geometry, and the QM reality: Valence bond theory and hybrid orbitals	7.3 - 7.5
6	M	Oct. 06	review and application	
	W		Why and how bonds form: MO theory	7.6
	R	*lab*	*Introduction to Infrared Spectrophotometry*	
	F		Bonding theories: application and extension	7.7
7	M	Oct. 13	"Seeing" gas particles: the Kinetic Molecular Theory	11.1 - 11.3
	W		The ideal gas law (and why real gases are NOT ideal…)	11.3 - 11.7, especially 11.5 & 11.6
	RF	Oct 16-17	****Fall Study Break****	
8	M	Oct. 20	review and application	
	W		Exam #2	
	R	*lab*	*Infrared Spectrophotometry II: using IR to identify an unknown compound*	
	F		Intermolecular forces	12.1
9	M	Oct. 27	…and more intermolecular forces…	12.2 - 12.5
	W		When molecules get sticky: liquids and solids, the structures of solids, and...phase transitions	
	R	*lab*	*Introduction to Nuclear Magnetic Resonance Spectrometry*	
	F		To understand physical and chemical changes, we need to understand more about energy…	10.1 - 10.3
10	M	Nov. 03	…more thermodynamics…	
	W		Entropy	18.1 - 18.4
	R	*lab*	*Nuclear Magnetic Resonance Spectrometry II*	
	F		Spontaneity in chemical processes: Gibbs Free Energy	18.5

11	M	Nov. 10	The thermodynamics of phases and phase transitions	12.6
	W		Phase transitions seen through the lens and language of dynamic equilibrium	
	R	*lab*	*Putting it all together: using multiple instruments to identify an unknown compound*	
	F		Phase diagrams	12.7
12	M	Nov. 17	review and application	
	W		Exam #3	
	R	*lab*	*Week 2 of identifying unknowns*	
	F		Sprinkle some salt into a glass of water...Solubility and solvation	13.1 - 13.3
			THANKSGIVING BREAK	
13	M	Dec. 01	Solvation and molecular structure	9.1
	W		Thermodynamics of solvation and dissociation	
	R	*lab*	*Exploring Energy*	
			Submit ***full draft version*** of poster for feedback	
	F		Putting it all together: predicting and explaining solution properties on the basis of atomic and molecular structure	
14	M	Dec. 08	course evaluations; review and application	
			(Take-home portion of final exam handed out; due at time of in-class final)	
	W		More fun with IMFs, solvation, electrolytes, and molecular structure	
	R	*lab*	*Poster Presentations on identification of unknowns*	
	F		And even more fun with IMFs, solvation, electrolytes, and molecular structure	
	R	Dec. 18	9:00 am (...until you finish) **In-class portion of Final Exam**	