

CHE 107: Principles of Chemistry (Syllabus subject to change by instructor)

Fall 2012

Lecture (section 3): M T W F 11:30 am – 12:20 pm, NHS 201

Lecture (section 4): M T W F 12:30 – 1:20 pm, NHS 222

Instructor

Dr. Steve Miller

Office: NHS 107B

Office Hours: M 10:30 – 11:20, T 1:30 – 2:30

I am also happy to meet with students outside of my office hours. You are always welcome to stop by my office, but be aware that I may be away or unable to see you due to other obligations. You may also contact me in advance to arrange another meeting time.

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Email: smiller3@gustavus.edu

Catalogue Description

The fundamental concepts of chemistry, including the atom; periodicity; stoichiometry; properties of gases, liquids, and solutions; acids and bases; chemical energetics; and bonding. Laboratory work is coordinated with lecture and is intended to illustrate principles and develop experimental skills.

Required Materials

- 1) Textbook: McQuarrie, Rock, and Gallogly, *General Chemistry (4th ed.)* 2011, University Science Books (paperback)
- 2) Access code for the Sapling Learning system (must be purchased at the Sapling website, <http://www.saplinglearning.com>)
- 3) Lab manual: Gustavus Adolphus College, *General Chemistry Laboratory Manual* (available only through the campus bookstore)

Course Goals

- 1) Learning the basic language and principles of chemistry
- 2) Understanding the prevalence of chemistry (and science in general) in modern society
- 3) Fostering critical thinking, and learning to apply it to problem solving

My Approach (aka Just So We Understand One Another)

The third course goal listed above is one which I take *very* seriously; I will pound on it throughout the semester, like a sledge hammer on an unlucky nail (I exaggerate—but only slightly). The most important thing to remember is that chemistry (and science in general) is a process for discovering the unknown, not just a collection of facts. A person can have an encyclopedic knowledge of chemical facts, but that does not automatically make him/her a good *chemist*. Conversely, a person with limited knowledge of chemical facts may be a very good chemist.

To help reinforce this philosophy, we will have in-class activities prior to exams (see the attached schedule). The purpose of these activities will be to take some of the chemical knowledge you have recently learned and apply it to a complex problem which you likely have not seen/thought about before. The point will be for you to take a scientific approach to the problem; that is, you will work with classmates, consult your book/notes, etc., and/or by any other (honest) means available try to come up with an answer to a previously unseen question. Hopefully, these problems will be challenging (but solvable), informative, and enjoyable, in much the same way a puzzle can be. Your answers will not be graded, but becoming comfortable with the *process* of problem solving will undoubtedly help you come exam time (and hopefully in your other courses and life as a whole).

Attendance

I do not take attendance for lecture, but attending every lecture is *strongly* encouraged. If you miss a lecture, **you** are responsible for getting the information and/or notes from a classmate—I will not provide them for you. Moreover, you will probably find that what is *said* during lecture is no less important than what is written in your notes, and there is no reliable way to hear what is said without being in class and paying attention. Laboratory attendance **IS** required every week. If you must miss a laboratory meeting, please inform your lab instructor as soon as possible to discuss make up options. Attendance at scheduled peer mentoring sessions (see below) is also mandatory.

Grading

Final grades will be assigned according to the following scheme:

HW	15%
Midterm Exams	45%
Lab	25%
Final Exam	15%

The maximum percentage for final grades will be 88% (A-), 76% (B-), 62% (C-), 55% (D), <55% (F). In other words, if you earn a grade of 91% for the semester, you are guaranteed an some flavor of A. If you earn 87%, you are guaranteed some sort of B; with the final cutoffs your grade may be bumped up to the A/A- range (the actual percentage cutoffs will be determined only after the final exam).

Note that different items may not be worth the same number of points (e.g. one exam may be worth 82 points and another 103 points). However, I base all grades on percentages, so specific point values do not matter. For example, 80% on an 82 point exam affects your overall grade exactly the same as 80% on a 103 point exam.

A closer examination of the grade contributions shows that nearly half of your grade is based on homework and lab. These are the parts of the course that will best teach you the *process* of chemistry and science. Doing the homework/lab work is the only way to learn their lessons; because they contribute so much to your overall grade, you will not succeed in this course without doing them. However, if you do the homework/lab work without

learning their lessons, you will not do well on the exams and will still have difficulty succeeding in the course. The only way to truly be successful in this course is by doing the work AND understanding what it means.

Exams

There will be five midterm exams given in class on the dates included in the attached schedule (note that there is an exam scheduled for the week before finals; despite common misconception, this in no way violates college policy, which essentially says that the final exam cannot be given the week before finals). The following policies will govern the midterm exams:

- 1) You are expected to take each exam in class on the day it is given. If you know in advance that you will miss an exam, you may arrange a make-up exam. If you miss an exam due to a last minute issue (e.g. illness), a make-up will be allowed only in exceptional circumstances (I do not consider routine illnesses, such as the common cold, to be exceptional).
- 2) Make up exams, when granted, may contain different questions than the exam given during normal class time.
- 3) Exams will be meant to require the full 50 minute class period, and I truly mean the *full* period. Good time management on exams is absolutely necessary for success; do not expect to finish in 35 minutes and have 15 minutes left over to check your answers...
- 4) Exams will contain some combination of multiple choice, true/false, matching, short answer and word problems.
- 5) I may elect not to allow the use of calculators on exams. Do not assume that any such exam would have no arithmetic and/or algebra on it.
- 6) You may write in either pen or pencil on exams. I will not regrade any question on an exam which is answered in pencil, erasable pen, or pen which has been whited out. If I make an adding mistake when totaling an exam grade, I will fix it whether the exam was written in pen or pencil.
- 7) You will be allowed to drop your lowest exam grade.

HW

Ten homework assignments will be given during the semester. They will be available through the Sapling Learning System, and you will have to go online to complete them.

There are several important things to remember about the homework:

- 1) An individual homework assignment may consist of several online assignments, and the total score for each homework will be the sum of the individual component scores; be sure to complete all necessary online assignments. The full complement of homework assignments is available on Sapling and on the attached list.
- 2) All assignments will be visible to you throughout the semester, but you will only be allowed to access them between 1:30 pm on the day we begin covering the appropriate material in class and 11:20 pm on the due date (note that the available and due dates for each assignment are listed in Sapling and on the attached list). For

example, the two assignments which make up HW 1 will be available between 1:30 pm on 9/4/12 and 11:20 am on 9/11/12.

- 3) Late assignments will not be accepted once the due date/time has passed for any reason.
- 4) You will be allowed to drop your lowest total homework score.
- 5) There is one extra credit assignment which is meant to familiarize you with Sapling. This assignment will only be available between 9/4/12 and 9/7/12.

Laboratory

Each student must attend every lab session and complete all of the required laboratory assignments in order to pass the course as a whole (see the lab manual and/or talk to your lab instructor for details). In other words, if you miss a lab and/or fail to turn in a lab assignment, you will automatically fail the *entire course* (lab also constitutes a full one-fourth of your course grade, so it provides a lot of points). The laboratory portion of the course is designed to

- 1) teach basic chemical laboratory techniques
- 2) apply chemical theory to real problems
- 3) provide a basic introduction to various chemical subdisciplines, namely analytical chemistry, physical chemistry, environmental chemistry, inorganic chemistry, and biochemistry

Details about lab grades, expectations, make up conditions, etc. will be presented during your first lab meeting (the week of September 10). Please note that your lab and lecture instructors may be different; if you ever have questions about the lab portion of the course, please direct them to your lab instructor as s/he will be better able to help you.

Final Exam

All students must take the final exam at the time/place (1:00 – 3:00 pm on Monday, Dec. 17 in the Nobel Auditorium) mandated by the college. The general policies for the two hour final exam will be the same as those used for the midterm exams.

Peer Mentoring

To help you develop stronger learning skills and to better understand the ethos of scientific inquiry you will be participating in a Peer Mentoring program during the semester. This program is funded by the college. The goal of this program is to help you be more successful in biology and chemistry, as well as other scientific courses.

Each week, you will meet with a small group of peers also enrolled in BIO101 and/or CHE107. The sessions are led by a junior or senior majoring in biology, chemistry, or biochemistry. The sessions involve activities where you will practice application and synthesis of concepts, and gain an enhanced understanding of the subjects. There are three main types of activities:

- Lecture and Laboratory content reinforcement and practice
- Skill building

- How to think and act like a scientist

You are required to **sign up** for a peer-mentoring group in **121 Nobel Hall** on **Wednesday, Sep. 5** or **Thursday, Sep. 6** between **5:00 - 9:00 pm**. If you are enrolled in either BIO 101 or CHE 107, you will sign up for a group that will focus solely on that class. If you are enrolled in both BIO 101 and CHE 107, you will sign up for a group that covers activities for both courses. Please bring your class and event schedule with you when you sign up for a Peer Mentoring group to help determine which time will work best for you. Peer Mentors will be available at that time to answer your questions.

You will meet with your group once a week in Nobel 121 or Nobel 106B. Bring a notebook and a pen or pencil to your session, and possibly a textbook. Unless specifically requested, you will not be allowed to use personal electronic devices during your peer mentoring session. Ten sessions are planned for the weeks of: Sep: 9, 16, 23; Oct: 7, 14, 28; Nov 4, 11, 25; and Dec. 4. There will be no sessions during Nobel Conference Week, Reading Week, or Thanksgiving week. A list of the Peer Mentoring activities for the semester is on Moodle. If you do not attend *and actively participate* in eight (8) of the ten (10) peer mentoring sessions, **you will lose 5%** of your final course points. If you have any questions, please contact Scott Bur or Aron Anderson, Peer Mentoring Coordinators at sbur@gustavus.edu or aander16@gustavus.edu.

General Expectations

- 1) I try to treat every student with respect. In return, I expect each student to treat me and all of his/her fellow students with respect. This includes not talking during class or when others are speaking.
- 2) My biggest pet peeve as a teacher is the improper use of digital devices. Phones, MP3 players/iPods, etc. should be *turned off*—not just set to silent or vibrate (the temptation to text your friend sitting next to you may simply be too great...)—and put away during class. If I see or hear it, I may just take it away so no one can be distracted by it again...
- 3) **Academic dishonesty will not be tolerated under any circumstances.** For details, see the academic honesty portion of the Additional Resources section of this syllabus (below). If you have any questions/concerns about the propriety of a particular aspect of working with your fellow students, please do not hesitate to discuss it with me.
- 4) If you ever have questions, ask! If I cannot answer them myself, I will try to point you to someone who can.

Tips for Success

- 1) **Introduce yourself**—to me and your fellow classmates. I like to get to know each and every student in my classes, and I hope that you will feel comfortable approaching me with any questions you may have. An initial introduction helps to achieve both ends. You would also do well to meet your fellow classmates, with whom you may want to form study groups.

- 2) **Do not wait until the night before an exam to study.** It won't work. Seriously, it won't.
- 3) **Do the homework.** The homework assignments are meant to help you keep pace with the lecture material and avoid falling behind. In addition, doing the homework should be a reliable way of boosting your course grade.
- 4) **When reading the textbook, re-read any passages which you do not understand.** If you see a word you do not know, look it up in a dictionary (it may help you with a concept, and there's no harm in expanding your vocabulary while you're at it...). It can also very helpful to write a summary of material you have just finished reading.
- 5) **Take good notes.** Chemistry is a difficult course to study for without the guidance of a good set of notes. I will help you in this regard by providing partially completed notes for your use.
- 6) **Be familiar with the math.** Math is a tool, and one with which you must be comfortable. Research and experience have demonstrated that one's comfort with math often tracks well with his/her grade in general chemistry—know it, and you're more likely to do well; know it not, and you're more likely to struggle. A math assessment and tutorial will be provided on the course website; you are *strongly* encouraged to look at them early in the semester, before unfamiliar math concepts hamper your ability to learn chemistry.
- 7) **Get help if/when you need to.** You have a number of people and resources at your disposal, including me, your lab instructor, TAs, tutors, and peer mentors. We are all here (and happy) to help! You may also seek help from classmates and materials available through Sapling.

Additional Resources

Course website

I will post lots of things on the course website (<http://homepages.gac.edu/~smiller3/courses/107-f12.htm>) during the semester. If you are ever looking for information check there first, and let me know if you cannot find what you need.

Sapling Learning

In addition to the required homework assignments, Sapling (<http://www.saplinglearning.com>) has many resources (tutorials, practice problems, etc.) for your use. You are required to purchase access, and you might as well get your money's worth!

Academic honesty

All students are expected and required to adhere to the Gustavus Honor Code, as embodied in the statement

“On my honor, I pledge that I have not given, received, or tolerated others' use of unauthorized aid in completing this work.”

As per this policy, cheating can take one of three forms:

- 1) Accepting unauthorized help (e.g. copying someone else's work)
- 2) Providing unauthorized help (e.g. letting someone copy your work)
- 3) Failing to report cheating by others (e.g. knowing someone else has cheated and not turning him/her/them in)

It will be assumed that the honor code is in effect on any graded item, whether or not signing it is actually required (e.g. there is no way to include signing the honor code as part of online homework submission, but you are expected to adhere to the honor code for homework). Any student caught violating any part of the honor code will receive an automatic, undroppable grade of zero for the assignment/lab/exam in question and will be reported to the Provost. A second offence will result in the student's immediate removal from the course (with an automatic F) and will be reported to the Provost a second time. Further information about the Honor Code can be obtained from the Provost's office (x6223).

Disability Services

Gustavus Adolphus College is committed to ensuring the full participation of all students in its programs. If you have a documented disability (or you think you may have a disability of any nature) and, as a result, need reasonable academic accommodation to participate in class, take tests or benefit from the College's services, then you should speak with the Disability Services Coordinator, for a confidential discussion of your needs and appropriate plans. Course requirements cannot be waived, but reasonable accommodations may be provided based on disability documentation and course outcomes. Accommodations cannot be made retroactively; therefore, to maximize your academic success at Gustavus, please contact Disability Services as early as possible. Disability Services (<https://gustavus.edu/advising/disability/>) is located in the Advising and Counseling Center. Disability Services Coordinator Laurie Bickett (lbickett@gustavus.edu or x6286) can provide further information.

ELL accommodations

Support for English Language Learners (ELL) and Multilingual students is available via the College's ELL Support staff person, Andrew Grace (agrace@gustavus.edu or x7395). He can meet individually with students to consult about academic tasks and to help students seek other means of support. The ELL Support person can also consult with faculty members who have ELL and multilingual students enrolled in their classes. The College's ELL staff person can provide students with a letter to a professor that explains and supports academic accommodations (i.e. additional time on tests, additional revisions for papers). Professors make decisions based on those recommendations at their own discretion. In addition, ELL and multilingual students can seek help from peer tutors in the Writing Center.

Tentative Lecture Schedule

Monday	Tuesday	Wednesday	Thursday	Friday
9/3 No class: Labor Day	9/4 Introduction	9/5 Introduction	9/6	9/7 Introduction
9/10 Introduction	9/11 HW 1 Due Atomic structure	9/12 Atomic structure	9/13	9/14 Periodicity
9/17 Periodicity	9/18 <i>Activity</i>	9/19 HW 2 Due Exam 1	9/20	9/21 Ionic bonding
9/24 Ionic bonding	9/25 Covalent bonding	9/26 Covalent bonding	9/27	9/28 Covalent bonding
10/1 HW 3 Due Molecules	10/2- 10/3 No class: Nobel Conference		10/4	10/5 Molecules
10/8 Molecules	10/9 <i>Activity</i>	10/10 HW 4 Due Exam 2	10/11	10/12 Chemical reactions
10/15 Chemical reactions	10/16 Chemical reactions	10/17 HW 5 Due Thermodynamics	10/18	10/19 Thermodynamics
10/22 - 10/23 No class: Reading days		10/24 Thermodynamics	10/25	10/26 Thermodynamics
10/29 Thermodynamics	10/30 Thermodynamics	10/31 <i>Activity</i>	11/1	11/2 HW 6 Due Exam 3
11/5 Stoichiometry	11/6 Stoichiometry	11/7 Stoichiometry	11/8	11/9 Stoichiometry
11/12 HW 7 Due Phases	11/13 Phases	11/14 Phases	11/15	11/16 Phases
11/19 <i>Activity</i>	11/20 HW 8 Due Exam 4	11/21 - 11/23 No class: Thanksgiving		
11/26 Equilibrium	11/27 Equilibrium	11/28 Equilibrium	11/29	11/30 Equilibrium
12/3 Equilibrium	12/4 HW 9 Due Kinetics	12/5 Kinetics	12/6	12/7 Kinetics
12/10 Kinetics	12/11 <i>Activity</i>	12/12 HW 10 Due Exam 5	12/13	12/14
12/17 Final Exam, 1-3 pm, NHS Auditorium (both sections)	12/18			

CHE 107 topics

Module 1: Introduction and atoms (9/4 – 9/19)

Part 1: Introduction (Ch. 1)

- Scientific method; measurements and significant figures; dimensional analysis; math background (logs/pH, algebra, graphs, etc.)

Part 2: Atomic structure (2-4, 2-5, 2-9, 2-10, Ch. 4, 5-1 through 5-11) and periodicity (2-11, 3-3 through 3-7, 5-12)

- Atomic structure; quantum mechanics and atomic orbitals; electron configurations
- Chemical periodicity; the periodic table; periodic properties; mass spectrometry

Module 2: Bonding and molecules (9/21 – 10/10)

Part 1: Ionic bonding (2-6 through 2-8, 2-12, Ch. 6, 10-2) and covalent bonding (2-6 through 2-8, Ch. 7, 14-2, 14-6)

- Ions; ionic bonding; ionic compounds
- Covalent bonds; Lewis structures; covalent compounds; resonance; bond polarity, enthalpy, and order

Part 2: Molecular geometries and properties (Ch. 8, Ch. 9)

- VSEPR/Molecular geometry; molecular polarity; valence bond theory; hybridization; molecular orbital theory

Module 3: Reactions and thermodynamics (10/12 – 11/2)

Part 1: Chemical reactions (3-1, 3-2, Ch. 10)

- Reaction types; writing chemical reactions; ionic and net ionic equations; solubility rules; exo/endothermicity

Part 2: Thermodynamics (14-1 through 14-9, 23-1 through 23-6, 23-10)

- First law: heat and work; conservation of energy; enthalpy; Hess's law
- Second and third laws: statistical basis of entropy; universal entropy; absolute entropy; spontaneity
- Gibbs free energy; calorimetry

Module 4: Mass relationships and phases (11/5 – 11/20)

Part 1: Stoichiometry (2-8, Ch. 11)

- Empirical and molecular formulas; the mole; molar mass; stoichiometry; limiting reactants

Part 2: Phases (Ch. 13, 15, 16)

- State properties; gas laws; kinetic molecular theory; stoichiometry involving gases; real gases
- Intermolecular forces; liquids; solids; phase changes; phase diagrams
- Solutions; colligative properties; stoichiometry involving solutions (including titrations)

Module 5: Equilibrium and kinetics (11/26 – 12/12)

Part 1: Equilibrium (Ch. 19, 20, 21, 22)

- Chemical equilibrium; equilibrium constants; equilibrium calculations; Le Chatelier's principle; equilibrium and free energy
- pH and pOH; polyprotic systems; strong vs. weak acids/bases; weak acid/base calculations; buffers; Lewis acid-base theory
- Equilibrium concentrations of insoluble salts; common ion effect

Part 2: Kinetics (Ch. 17, 18)

- Reaction rates; rate laws (differential and integrated); method of initial rates; Arrhenius equation; mechanisms