Last update:
1-11-2024

CHEM 1061 Chemical Principles (Sections 001 and 004)
Syllabus

Spring 2024, 3 credits
Tues. 1/16/24 - Mon. 4/29/24
Lectures MWF 8:00 - 8:50 AM, Smith 100 (Section 001)
and TTh 9:45 - 11:00 AM, Smith 100 (Section 004)

Instructor Information:

Prof. Doreen Geller Leopold
211 Smith Hall dleopold@umn.edu (612) 626-2047
Q&A Sessions: MWF at 9:00 - 9:30 am in Smith 111 and
T Th at 9:00 - 9:30 am in Smith 100
I am also happy to meet with students at other times in person or by Zoom.
Please email me so we can set up a mutually convenient time.

General Course Information: Chemistry 1061 and 1062 (each 3 credits) are introductory lecture courses accompanied by separate lab courses (Chem 1065 and 1066, each 1 credit). These courses are designed to help prepare students for science and engineering majors, including chemistry. Each lecture/lab pair also fulfills the U of M's Diversified Core requirement in Physical Science.

Prerequisites: To register/remain registered in 1061, two criteria must be met:
- Placement exam passed with a score of 80% or better, *or*
  Chem 1015 (or an equivalent course) passed with a grade of C- or better
- *and* Registration in the Chem 1065 lab class this semester

Students who do not meet these requirements should report their situation immediately to the staff in Smith 115 (624-0026, chemfaq@umn.edu), who handle all registration issues.

Textbook: "Chemistry: The Molecular Nature of Matter and Change,"
by Martin Silberberg and Patricia Amateis (McGraw-Hill, 9th Ed., 2021)

- "Inclusive Access" to the interactive eBook and the online Homework for 136 days (19.4 weeks) after students register into ALEKS will be charged to students' accounts ($65.50) after the two-week drop deadline (Mon. Jan. 29, 2024). Students wishing to opt out should contact the Bookstore before that date.

- A printed text in loose leaf format can also be ordered from the Bookstore for students who purchase the "Inclusive Access" package. The additional cost is $30.75 for the 9th edition (or $40.00 for the 10th edition). Since access to the ebook is only provided for one semester, purchasing the loose leaf version at this discounted price is a good option for students who want to keep a copy for future use, e.g., in later courses or to study for the MCAT or other professional or graduate school entrance exams.

- Students in our two sections (001 and 004) will not need a mirror, whiteboard, equation sheet, or webcam (which are required for the other Chem 1061 sections this semester), since our exams will be given in class on paper and will include an equation sheet.

Quizzes and Final Exam Times:

For the MWF 8:00 AM class (Section 001):

- 5 Quizzes **Wednesdays at 8:00 - 8:50 AM in Smith 100**
  Feb. 7, Feb. 21, Mar. 13, Mar. 27, Apr. 10
- Final Exam **Sat. May 4, 2024 at 4:00 - 6:00 PM in Smith 100**

For the T Th 9:45 AM class (Section 004):

- 5 Quizzes **Thursdays at 9:45 - 10:35 AM in Smith 100**
  Feb. 8, Feb. 22, Mar. 14, Mar. 28, Apr. 11
- Final Exam **Mon. May 6, 2024 at 1:30 - 3:30 PM**
  in Smith 100 a second room for the final (to be announced)

Table of Contents

Useful Web Sites: There are two helpful websites associated with this course.

• ***Lecture Canvas Site*** https://canvas.umn.edu/courses/412527
CHEM 1061 Chemical Principles I (001 and 004) Spring 2024

Our Canvas site will include the following resources (many in the "Modules" section):
- Link to our ALEKS site for online homework and ebook access
- Announcements (you may want to turn on your notifications for these announcements)
- Lecture slides (with some blanks to be filled in during lectures)
- Videos of lecture material (in "My Gallery") recorded *after* lectures
- Study Guides, including reading and end-of-chapter problems for each chapter covered
- Review Sheets for each Quiz and the Final
- Answer Keys to our Quizzes and the Final Exam
- Previous (Spring 2023) Quizzes and Final Exam for practice, with detailed answer keys
- Students' scores on Quizzes and the Final (under "Grades").

This will also include the total number of questions answered correctly on the online homework; divide by 10 to obtain the score in points out of a maximum of 15 points)

To access Canvas:

1. Connect to myu.umn.edu, log in, click the "My Courses" tab, select the appropriate class link, and follow this to our class Canvas site. ***OR…***
2. Go directly to https://Canvas.umn.edu , login, and select the appropriate class.

• ***General Chemistry Website*** https://sites.google.com/umn.edu/general-chemistry/
This website has general information about Chem 1061 and other general chemistry courses, including times for walk-in tutorial hours in Smith 124 and Zoom options.

Chem 1065 Lab: You will also have access to another Canvas site for the lab, which is a separate 1-cr. course whose instructor is Prof. Michelle Driessen. The lab must, in general, be taken during the same semester as Chem 1061.

Calculators: A general policy for the general chemistry courses is that programmable or graphing calculators may not be used on Quizzes or exams. The presence or use of an unacceptable calculator will be considered as scholastic dishonesty, even if the calculator is not actually programmed.

It is necessary for the calculator to have exponential functions and to be able to display numbers in scientific notation (e.g., 6.02×10^{23}). One good model is the two-line display TI-30X IIS, which costs $15 at the U of M Bookstore (shown here).

Another calculator preferred by some students is the TI-36X Pro. It has a four-line display and can show multiple calculations at the same time.

If you have a different non-programmable, non-graphing calculator you would like to use, please obtain the instructor's approval prior to the exam.

eBook and ALEKS – "Inclusive Access":

Your online textbook (eBook) can be accessed within the ALEKS system, once you have added our course. The period of "inclusive access" is 136 days (19 weeks and 3 days) starting when the student first logs into ALEKS for our class (for example, Tues. Jan. 2 through Thurs. May 16).

The student's account will be charged **$65.50** for inclusive access to the eBook plus ALEKS. Students who drop the course in the first two weeks of the semester will be automatically refunded.

Students who register for the course will receive an e-mail from verbasoftware.com with the subject line "Course Materials Charged on Your Student Account". (This email sometimes goes to the spam folder since it links to an external site, so be on the lookout for it.) It also includes opt-out instructions. Students who opt out can be refunded after the 2-week drop/add period.

Students who have purchased the inclusive access package can purchase a printed copy of the Silberberg & Amateis text in loose leaf format from the Bookstore for an additional $30.75 for the 9th edition (or $40.00 for the 10th edition).

If you have additional questions, you can contact the U of M Bookstores directly at inclusiveaccess@umn.edu

Instructions to Access the eBook and ALEKS:

To access ALEKS, to click on the "ALEKS" link at the left of our Canvas site. It will take you directly to the ALEKS site associated with our two sections of Chem 1061 (Sections 001 and 004). ALEKS opens in a separate window. Our ALEKS site opened on Jan 2.

You will have automatic access to the ALEKS Homework and the e-text without entering payment, as this will be charged to your student account after the second week of classes.

When you register in ALEKS through our course Canvas site, you will not need to use an ALEKS Course Code.

Click on Login (if you have used ALEKS at the U of M before, you have an existing account) or SIGN UP.

Fill out student information if you are creating a new account.
For ALEKS to keep track of your Homework score, you'll need to
enter your U of M email address in both the email AND "Student ID" field.

To contact ALEKS directly for help, see the contact information at the top of p. 10.

Online Homework Assignments *(see p. 4 for access instructions)*:

We will use the ALEKS online Homework system in a "responsive" (rather than "responsive/adaptive") format. The former option, which was recently incorporated into ALEKS, gives each student essentially the same end-of-chapter problems (selected by the instructor), with different numerical values or sample molecules. There are 6 online homeworks with a total of 200 questions worth 0.1 point each. *The maximum score that can be earned is 15.0 points.* (You can ignore the ALEKS pie.) That is, if you have completed 150 out of the 200 questions by their due dates, then you have earned the maximum possible points. (It is useful to do the other questions too, for additional practice and to prepare for Quizzes and the Final.)

The "Initial Knowledge Check" (IKC) and the Math Review (48 topics), *which do not earn any points*, are based on 48 math topics chosen to help students review aspects of their high school math that may be useful when solving problems this semester. If a student answers the first 10 or so of the IKC questions correctly, ALEKS may decide that further review is not needed. If a student's incorrect answers indicate that more math review would be useful, then more questions will be presented. Thus, it is most efficient to answer the initial questions carefully, after working them out on paper. ALEKS estimates that the average student will spend 2 ½ hours on this IKC.

Our online Homework assignments (A through F) will generally be due on alternate Fridays (by 11:59 pm) on non-Quiz weeks; see the class schedules on pp. 19 - 20..
(An exception is Homework F, which is due the last day of classes, Mon. April 29.)
Each Homework (except the last one) can be submitted a week after its due date, with a 20% point penalty.

Homeworks B through F include some material covered on a Quiz given *before* that Homework's due date. For example, Homework A, due *Fri. Feb. 2*, covers material in the first chapter we will cover, Chapter 5, on the history, interpretation and applications of the ideal gas law. Homework B, due *Fri. Feb. 16*, covers Chapter 6 on thermo-chemistry. Our first test, *Quiz 1 on Wed. Feb. 7 or Thurs. Feb. 8*, will cover the material in Chapters 5 and 6 (although Homework B on Chapter 6 is due later). So, it is a good idea to do the relevant Homework problems *before* taking the Quiz covering those topics.

On the ALEKS Homeworks, students have 2 "question attempts" (which may have different numerical values or sample molecules), and 3 tries per question attempt. A second "assignment attempt" is also available, in which questions previously answered incorrectly can be tried (3 times) again, and the better score counts. *After submitting* each Homework, the problems can be redone for practice an unlimited number of times.

Schedule of Homeworks A - F

A	(Chap. 5)	opens 1/8	due 2/2
B	(Chap. 6)	opens 1/22	due 2/16
C	(Chap. 7, 8)	opens 2/5	due 3/1
D	(Chap. 9)	opens 2/19	due 3/22
E	(Chap. 10,11)	opens 3/11	due 4/5
F	(Chap. 12, 13, 15)	opens 3/25	due 4/29

Study Guides: A Study Guide is posted for each of the 10 chapters we will cover. These provide recommendations for readings and end-of-chapter problems. Many of these problems are also included in the online Homeworks (numbers in parentheses). The additional Study Guide problems have red numbers, indicating that the answer is given in Appendix E, with a more detailed answer in the Student Solutions Manual.

Grading Methods: Course grades will be determined based on scores on the online Homework, the Quiz scores and the Final Exam, as follows:

	Points	%
6 Online Homeworks (A through F) (150 out of 200 problems, 0.1 point each)	15	15 %
5 Quizzes (13 points each)	65	65 %
Final Exam (2.0 hours, 40 problems, 20 points)	20	20 %
Total	100 points	100%

Course grades will be determined by a "hybrid" method which combines the absolute grading scale shown below with an adjustment applied at the end of the semester (if needed) to *lower* some of the thresholds. That is, if your total scores give the following total percentages (out of the maximum possible 100 points), then your course grade is guaranteed to be *at least* as high as is listed below. Grades may be adjusted in a *favorable* direction at the end of the semester, but the thresholds will *not* be raised.

	Percentages		
		B+	75.0 - 79.9 %
A	85.0 - 100 %	B	70.0 - 74.9 %
A-	80.0 - 84.9 %	B-	65.0 - 69.9 %
C+	60.0 - 64.9 %	D+	45.0 - 49.9 %
C	55.0 - 59.9 %	D	40.0 - 44.9 %
C-	50.0 - 54.9 %	F	≤ 39.9%

For example, say a student gets a total of 50 out of 65 points on their 5 quizzes (which are worth 13 points each), 13 out of 15 points on the online Homework, and 14 out of 20 points on the Final exam. The total score is then 77 out of 100 points, or 77%. According to the grading scale above, this corresponds to a course grade of (at least) B+.

Sample calculation for a student with an excused absence from one Quiz (see p. 8):
Say the total score on the remaining 4 quizzes is 40 points out of 52 (i.e., 13 x 4) points. If, as before, the student got 13 out of 15 points on the Homework and 14 out of 20 points on the Final exam, then the total score is 67 out of 87 points (i.e., 100 – 13), or 77.0%. This again corresponds to a course grade of (at least) B+.

S/N Grading: For students registered on an S/N basis, a grade equivalent to C- or above on the A-F scale will receive an "S", and a grade of D+ or below will receive an "N".

Quiz and Final Exam Formats:

Our 5 Quizzes and the Final Exam will be taken in person on paper.
Many of the questions on our tests will be closely based on the class notes provided in the PowerPoint lecture slides posted on Canvas and notes written on the board in class, or will be very similar (but not identical) to problems in the Homeworks and Study Guides. Therefore, carefully reviewing the lecture notes, and studying the problems in the Homeworks and Study Guides, is an efficient and effective way to study for our tests.

Questions will all be multiple choice, and answers will be recorded on scantrons ("bubble" sheets) which have up to 10 answers per question. Only the answers recorded on the bubble sheet will be graded. Work done on the exam itself will not be graded.

Only one answer should be selected per question.
No credit will be given if 2 or more answers are bubbled in for a given question.
There will be no penalty for incorrect answers, so students should answer every question.

Equation Sheet: Relevant portions of the equations, constants, conversions, etc. shown on pp. 17-18 of this syllabus will be provided with our Quizzes and the Final. It is a good idea to familiarize yourself with their contents (e.g., while doing the online Homeworks and the end-of-chapter problems in the Study Guides) so you can access the required information quickly during a test.

Notes: No additional notes are allowed while taking the Quizzes or the Final Exam.

Pencils: Be sure to bring a couple of pencils with good erasers to each test.
Since the Quizzes and the Final will be automatically graded, answers must be clearly selected on the bubble sheets (and clearly erased if changed).

ID Cards (U Cards): Students should bring their ID card (U Card) to each Quiz and to the Final, since the proctors may check or spot-check these.

Cell phones or other electronic communication devices may not be used (and may not be present within easy reach) during Quizzes or the Final Exam.

Calculators must be non-programmable and non-graphing (also see p. 3).
They may not be shared with another student during tests. If you are concerned about battery failure, it is a good idea to bring a second calculator and/or extra batteries with you. (The proctor will also bring a few extra calculators and pencils.)

Collecting Exams: For the MWF class, we will collect both the bubble sheet and the question portions of Quizzes 1 - 5 and the Final, since students in the TTh class take their exams later and may have some similar questions. Quizzes will be returned in the MWF class on Friday (but the bubble sheets will not be returned). Students should write their names (or another identifying word) on the first page so they can easily retrieve them. Finals collected on Sat. May 4 can be picked up in Smith 115 on Tues. May 7 or later.

Regrade Requests: These should be made as soon as possible after the grades are posted. If you find a discrepancy between the posted score and the score you expected based on the answer key, we can look at your bubble sheet to identify the problem.

Excused Absences from Quizzes:
Students who are unable to take a Quiz due to illness, a family emergency, a university-sponsored activity, etc., can request an excused absence from the instructor, who should be contacted before the start of the Quiz if possible. It is not necessary to provide a doctor's note for one-time illnesses for which one would not ordinarily be seen by a doctor. See p. 6 for a sample calculation of the overall percentage (out of 87 points) for a student with an excused absence from one Quiz.

If circumstances require a student to request an excused absence from *more than one* of our 5 Quizzes, they should meet with the instructor to discuss the available options.

Excused Absences from the Final Exam:
If the Final Exam is not taken at the scheduled time, a score of zero will be given, unless the student obtains an excused absence (see "Incompletes" below).

Incompletes:
Students who have an excused absence from the Final Exam, and are passing the course based on their Quiz scores, may be eligible to receive a grade of "I" (Incomplete).
The instructor should be notified before the Final Exam begins, if possible.
Use of the "I" option in our Department is rare.
An "Incomplete" form signed by the student (when able to do so) and by the instructor is required. This form will describe the arrangements to make up the Incomplete, which must be done by the end of the following semester.

Withdrawals:
The last day to drop the class without a "W" appearing on the transcript is **Monday, Jan. 29, 2024**.

The last day to withdraw from Chem 1061 (without obtaining College approval) and receive a "W" is **Monday, April 1, 2024**.

If a student is considering withdrawing from the class for academic reasons, it is a good idea to discuss this first with the instructor. The situation is often not as dire as the student thinks it is. Students who do decide to drop the class should officially withdraw following the rules for their College. Students who withdraw will not have any records retained for use upon retaking the class.

Students who drop Chem 1061 *before* **Mon., March 25, 2024** (?? date to be confirmed) are required to withdraw from Chem 1065 (lab) as well. Students who withdraw from Chem 1065 on or after that date can finish up the lab class and, if it is passed, can retake Chem 1061 without the lab.

Retaking the Course: Students who wish to retake Chem 1061 after having already passed the Chem 1065 lab course should see the staff in Smith 115.

See Section 4(a) at this link: https://policy.umn.edu/education/gradingtranscripts

> "**Repeating courses.** An undergraduate student may repeat a course only once, except as noted in section 4(c). The college offering the course may grant an exception to this provision."

Exam Retakes and Extra Credit Options:
In some courses, the option to retake exams to earn extra points is provided, or there are options to earn extra credit. However, these options will ***not*** be available for our two Chem 1061 classes (Sections 001 and 004) this semester.

Study Support: Asking questions at Doreen's Q&A sessions and/or in the TA tutorial room, organizing and participating in study groups, etc., can help students overcome potential difficulties and excel in this course.

Tutorial Hours: https://sites.google.com/umn.edu/general-chemistry/
Smith 124 is the site of (free) drop-in tutorial sessions conducted by general chemistry TAs during weekdays. Tutorial hours via Zoom are also available.

Q&A Sessions: On Mon. – Fri. mornings at 9:00 – 9:30 in Smith 111 (MWF) or Smith 100 (T Th), Doreen will be available to answer questions in a small group setting. Many students feel uncomfortable asking questions in a large class, so these smaller groups can provide an opportunity to get your questions answered and to benefit from hearing other students' questions too. If there are no more questions, we can work through some in the online Homeworks or the practice exams. Students who participate in these meetings may also find that they can help catalyze the formation of study groups.

Study Groups: Organizing study groups and scheduling regular meetings to do the online Homework and prepare for tests is a good way to keep up with the material and to identify and clarify possible points of confusion. Since the conceptual (non-quantitative) test questions will be closely related to material on the posted lecture slides, students may wish to create "flash cards" or similar mnemonic devices and to quiz each other on this material. Since everyone will get essentially the same online Homework problems (with different numerical values or sample molecules), working together can be a productive and enjoyable way to learn the material and to share your knowledge with others.

Student Solutions Manual: The Student Solutions Manual (SSM) includes detailed solutions to the red-numbered end-of-chapter problems, for which brief answers are also provided in Appendix E of the text and under those problems in the e-Book. Nearly all of the problems selected for inclusion in the Study Guides for which answers are not available in the ALEKS Homeworks are red-numbered problems. Several copies of the SSM are available to be borrowed for 3 hours at a time Walter Library, and Smith 115 has additional copies that can be borrowed by TAs tutoring in Smith 124. (Note that the end-of-chapter question numbers in the 9th and 10th editions of our text may differ.)

ALEKS Support Team:

If needed initially or during the semester, you can contact the ***ALEKS support team***:

Phone: (800) 258-2374
Email: https://www.aleks.com/support/form

Hours (Eastern Standard Time)	Sunday, 4:00 PM to 1:00 AM
	Monday - Thursday, 7:00 AM to 1:00 AM
	Friday, 7:00 AM to 9:00 PM

Access and Disability Accommodations (DRC):

Students needing accommodations for access to class activities and materials should contact the Disability Resource Center (DRC) at 626-1333

https://diversity.umn.edu/

They will provide a letter for the student to share with the instructor describing how to facilitate an inclusive learning environment.

If the DRC recommends that extended Quiz and Final Exam times (and/or a private room) are required, students are responsible for making arrangements with the DRC to take these tests under their supervision at the McNamara Alumni Center. They should be taken at times that overlap the usual times that the other students in our class will be taking that Quiz or the Final. The DRC requires at least one week advanced scheduling of exams in their testing center. Students can make all of their reservations for the 5 Quizzes and the Final Exam early (e.g., when making the first reservation).

Issues with Your Instructor:

On occasion a student may have a concern or problem regarding this course. In general, the instructor will be quite willing to discuss this. If, however, a student wishes to discuss the issue with someone else as well, they should contact Prof. Michelle Driessen, Director of General Chemistry (mdd@umn.edu). She will serve as a mediator in helping to resolve the issue.

Credits and Workload Expectations:

One credit is defined as equivalent to an average (over a full semester) of three hours of learning effort per week necessary for an average student to achieve an average grade. For example, a Chem 1061 student with an average level of preparation should expect to spend a total of 3 cr. x 3 hours/cr. = 9 hours per week on the class.

Subtracting 150 minutes/week (2.5 hours) for lectures, this corresponds to an additional 6.5 hours per week spent reading and doing the online Homework problems and other problems in the Study Guides to achieve an average grade (which is typically B- in large, introductory chemistry lecture classes).

Liberal Education Statement for Chem 1061:

Chem 1061, combined with the lab course, Chem 1065, satisfies the U of M's Liberal Education Physical Science Core requirement. Core courses are intended to provide an in-depth look at how knowledge is created in a particular discipline. Naturally, they provide content knowledge, but just as importantly, they teach "modes of inquiry":

How do workers in a particular field think?
How do they collect and process information?
How do they create/discover new knowledge?

By taking a distribution of core courses during your time at the U of M, you gain an appreciation for the similarities and differences among disciplines. Much as learning a foreign language helps you to better understand your own language, a distribution of core courses provides the perspective needed to understand a broad range of complex issues and can ultimately make you a better practitioner of your own chosen field. You learn different approaches to finding credible information, analyzing information, solving problems, and drawing reasonable conclusions based on facts. In doing so, you develop skills needed to be an informed citizen and a life-long learner.

In Chem 1061, we learn to understand chemical bonding and its basis in quantum mechanics, thermochemistry and bond strengths, the behaviors of gases, and the attractions among molecules that affect the properties of liquids, solids and solutions. We describe how these topics fit together to form a coherent picture, allowing us to understand and make useful predictions about the world. To accomplish this, we do what scientists do all the time: we create ideas and then test their validities by applying them to new situations. Moreover, using the language of math, we translate these ideas into quantitatively testable predictions. We will pose and solve many problems in this course and, by working through them, you are, in effect, doing what scientists do – you are taking concepts and their mathematical expressions and using them to enhance your understanding and to make predictions. You are doing the work of the field.

This aspect of Chem 1061 is particularly emphasized in the co-requisite laboratory course (Chem 1065). In the lab, you do experiments, test hypotheses, and record data. You manipulate the data so as to allow it to provide the clearest possible picture of the phenomenon you are studying. In some cases, you will also use the understanding obtained to offer workable solutions to practical problems. This is how scientists and engineers approach the world and, in following suit, you experience the core of these important aspects of human endeavor.

Student Learning Outcomes:
https://provost.umn.edu/academic-oversight/assessment-student-learning

Succeeding in Chem 1061 (lecture) and 1065 (lab) will help you come closer to achieving 6 of the 7 *Student Learning Outcomes* that together describe the anticipated capabilities of students who have earned their bachelor's degrees at the U of M:

• *Can identify, define, and solve problems:* These courses provide a vehicle for practicing quantitative problem solving and for learning to transcend merely algorithmic thinking. Many of the problems we will encounter in class discussions, homework and tests require the synthesis of both mathematical and conceptual modes of understanding.

• *Can locate and critically evaluate information:* With the abundant new chemical information introduced in these courses, much of the challenge in solving a particular problem is often figuring out what information is most pertinent. How can we distinguish between reliable factual information and mere conjecture? These skills will be further exercised in lab, where students work on extended, open-ended assignments.

• *Have mastered a body of knowledge and a mode of inquiry:* We will cover many useful principles of chemistry which are tied together by common threads, and together form part of a "body of knowledge". For example, you will gain a better understanding of how the attractive forces between invisible, individual molecules affect the observable properties of matter such as the melting points of solids, boiling points of liquids, and whether a substance is a gas, liquid or solid at room temperature. Learning how to approach and apply this knowledge involves practicing some of the "modes of inquiry" used routinely by chemists and, indeed, by all scientists and engineers.

• *Can communicate effectively:* In the Chem 1065 lab, you will develop your scientific writing skills through keeping laboratory notebooks and writing formal lab reports. You will also hone your oral communication skills through interactions with your lab team members, and by presenting reports on your experimental results.

• *Understand the role of creativity, innovation, discovery, and expression across disciplines:* Scientists' efforts to explain the world in new ways often require real creativity, and the discipline to pursue and effectively communicate original ideas despite their initial derision by others. For example, we will study the history of the development of quantum mechanics in the early 1900's, when inexplicable experimental results demanded new theoretical explanations that seemed then (and now) to be highly counter-intuitive. Yet, these models now form the basis of our understanding of chemical bonding. We will see how physics and math blend seamlessly with chemistry, and how chemistry permeates many other disciplines.

• *Have acquired skills for effective citizenship and life-long learning:* Chemistry plays a central role in many societal issues. The knowledge and critical thinking skills developed in these courses as well as in their second semester counterparts, Chem 1062 and 1066, can help you form a foundation for effective decision making and informed citizenship.

Additional Links to Recommended U of M Syllabus Policy Statements

WEBPAGE: https://policy.umn.edu/education/syllabusrequirements-appa

1. Academic freedom and responsibility: Students are encouraged to develop the capacity for critical judgment and to engage in a sustained and independent search for truth. For more on academic freedom, see: https://regents.umn.edu/sites/regents.umn.edu/files/2019-09/policy_academic_freedom_and_responsibility.pdf

2. Student conduct code: https://regents.umn.edu/sites/regents.umn.edu/files/2020-01/policy_student_conduct_code.pdf

3. Avoiding scholastic dishonesty: https://communitystandards.umn.edu/avoid-violations/avoiding-scholastic-dishonesty
Scholastic Dishonesty is discussed under CSE's scholastic policies and is defined in the University Student Conduct Code as follows:

"Scholastic Dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis."

Academic dishonesty in any portion of the academic work for a course shall be grounds for assigning the student a grade of F (or N) for the entire course.

4. Use of personal electronic devices: https://policy.umn.edu/education/studentresp

5. Respecting Intellectual property:

> "Students may not distribute instructor-provided notes or other course materials, except to other members of the same class or with the express (written) consent of the instructor. Instructors have the right to impose additional restrictions on course materials in accordance with copyright and intellectual property law and policy. Students may not engage in the widespread distribution or sale of transcript-like notes or notes that are close to verbatim records of a lecture or presentation."

Additional Links to Recommended U of M Syllabus Policy Statements

6. Grading: (also see page 6 of this syllabus)
http://policy.umn.edu/education/gradingtranscripts

7. Makeup work for legitimate absences: (also see page 8 of this syllabus)
http://policy.umn.edu/education/makeupwork

8. Access and disability accommodations (also see page 10 of this syllabus)
https://disability.umn.edu/
https://disability.umn.edu/student-access

9. Student mental health and stress management:
To learn more about the range of confidential mental health services available on campus, see: http://www.mentalhealth.umn.edu/

10. Sexual harassment and related topics: The Chemistry Department strives to provide a safe and positive environment for everyone. Please review the policies regarding sexual harassment and related topics:
https://policy.umn.edu/hr/sexharassassault
For support and help please contact the Aurora Center: http://aurora.umn.edu

11. Diversity, equity, inclusion: We welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability, and other visible and nonvisible differences to this course. Instructors, teaching assistants, and peer students are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class. This is in agreement with university policy:
http://regents.umn.edu/sites/regents.umn.edu/files/policies/Equity_Diversity_EO_AA.pdf

12. Department of Chemistry Diversity, Equity and Inclusion (DEI) Committee:
Collaboration among people of all cultures and backgrounds enhances our experiences and contributes to excellence in teaching, learning, and research. We strive for a climate that celebrates our differences and strengthens our Department by embracing and working to increase diversity, equity, and inclusion. For more information about our departmental efforts and upcoming activities, see:
https://cse.umn.edu/chem/diversity-inclusion

For a list of diversity-related resources, see:
https://sites.google.com/umn.edu/chemintranet/diversity-inclusion/department-initiatives

Topics to be Covered in Chem 1061

Chapter headings and page numbers listed below are from Silberberg & Amateis' "Chemistry," 9th Ed., 2021. See the Study Guides (one for each chapter) posted on our class website for recommended reading and problems.

On average, we will spend about 3 ½ 50-minute class meetings, or about 2 1/3 75-minute class meetings, on each chapter. With this limited class time, some of the important material for each topic may not be completely covered in class. To do well on Quizzes and on the Final Exam, students should supplement the lectures by reading the text and doing the end-of-chapter problems in the online Homeworks and the Study Guides.

The contents of Chapters 1 - 4 are considered to be prerequisite topics and will only be briefly reviewed as we cover associated topics in the later chapters.

Chapter 1, "Keys to Studying Chemistry: Definitions, Units and Problem Solving"
Chapter 2, "The Components of Matter"
Chapter 3, "Stoichiometry of Formulas and Equations"
Chapter 4, "Three Major Classes of Chemical Reactions"
(Precipitation, Acid-Base, and Oxidation-Reduction Reactions)

Chapter 5, "Gases and the Kinetic-Molecular Theory"

5.2 Gas pressure and measurement
5.3 Gas laws and their experimental foundations
5.4 Rearrangements of the Ideal Gas Law
5.5 Kinetic Molecular Theory: a model for gas behavior
5.6 Real Gases: deviations from ideal behavior (to the middle of p. 241 only)

Chapter 6, "Thermochemistry: Energy Flow and Chemical Change"

6.1 Forms of energy and their interconversion
6.2 Enthalpy: changes at constant pressure
6.3 Calorimetry: measuring the heat of a chemical or physical change
6.4 Stoichiometry of chemical equations
6.5 Hess' Law: finding ΔH of any reaction
6.6 Standard enthalpies of reaction: ΔH°_{rxn}

Chapter 7, "Quantum Theory and Atomic Structure"

7.1 Nature of light
7.2 Atomic spectra
7.3 Wave-particle duality of matter and energy
7.4 Quantum-mechanical model of the atom

Chapter 8, "Electron Configuration and Chemical Periodicity"

8.1 Characteristics of many-electron atoms
8.2 Quantum-mechanical model and the periodic table
8.3 Trends in 3 atomic properties (size, ionization energy, electron affinity)
8.4 Atomic properties and chemical reactivity

Topics to be covered, continued

Chapter 9, "Models of Chemical Bonding"

9.1 Atomic properties and chemical bonds
9.2 Ionic bonding model
9.3 Covalent bonding model
9.4 Bond energy and chemical change
9.5 Between the extremes: electronegativity and bond polarity
9.6 Introduction to metallic bonding

Chapter 10, "The Shapes of Molecules"

10.1 Depicting molecules and ions with Lewis structures
10.2 Valence-shell electron-pair repulsion theory (VSEPR)
10.3 Molecular shape and molecular polarity

Chapter 11, "Theories of Covalent Bonding"

11.1 Valence-bond (VB) theory and orbital hybridization
11.2 Modes of orbital overlap and the types of covalent bonds
11.3 Molecular orbital (MO) theory and electron delocalization
(to be covered briefly if time allows)

Chapter 12, "Intermolecular Forces: Liquids, Solids, and Phase Changes"

12.1 Overview of physical states and phase changes
12.2 Quantitative aspects of phase changes
12.3 Types of intermolecular forces
12.4 Properties of liquids
12.5 Uniqueness of water
12.6 Solid state: structure, properties and bonding (pp. 497 - 498, 505 - 506)
12.7 Advanced materials (pp. 517-518 on polymers, pp. 522 - 523 on nanotechnology)

Chapter 13, "The Properties of Mixtures: Solutions and Colloids"

13.1 Types of solutions: intermolecular forces and solubility
13.3 Why substances dissolve: breaking down the solution process
13.4 Solubility as an equilibrium process
13.5 Concentration terms
13.6 Colligative properties of solutions
13.7 Structure and properties of colloids

Chapter 15, "Organic Compounds and the Atomic Properties of Carbon"

15.1 Special nature of carbon and the characteristics of organic molecules
15.2 Structures and classes of hydrocarbons
15.4 Properties and reactivities of common functional groups
15.5 Synthetic Macromolecules (pp. 673 - 674)

Equation Sheet for Chem 1061 (2 pages)

1 1A												13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1 H 1.00794	2 2A																2 He 4.00260
3 Li 6.941	4 Be 9.01218						Transition elements					5 B 10.811	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.1797
11 Na 22.9898	12 Mg 24.3050	3 3B	4 4B	5 5B	6 6B	7 7B	8	9 8B	10	11 1B	12 2B	13 Al 26.9815	14 Si 28.0855	15 P 30.9738	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.9559	22 Ti 47.88	23 V 50.9415	24 Cr 51.9961	25 Mn 54.9381	26 Fe 55.847	27 Co 58.9332	28 Ni 58.693	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.9059	40 Zr 91.224	41 Nb 92.9064	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.906	46 Pd 106.42	47 Ag 107.868	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.76	52 Te 127.60	53 I 126.904	54 Xe 131.29
55 Cs 132.905	56 Ba 137.327	57 *La 138.906	72 Hf 178.49	73 Ta 180.948	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.967	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.980	84 Po (209)	85 At (210)	86 Rn (222)

R = 8.314 J/(mol·K) = 0.0821 (atm·L)/(mol·K)

1 atm·L = 101.3 J

$N_A = 6.022 \times 10^{23}$ /mol

1. amu (also called just "u") = 1.661×10^{-27} kg

mass of electron $m_e = 9.11 \times 10^{-31}$ kg

mass of proton $m_p = 1.67 \times 10^{-27}$ kg

Planck's constant $h = 6.63 \times 10^{-34}$ J·s

speed of light in vacuum $c = 3.00 \times 10^{8}$ m/s

0° C = 273.15 K

1. atm = 760 torr = 1.013×10^{5} Pa = 14.7 lb/in^2 (psi)

1 m^3 = 1,000 L 1. cm^3 = 1 cc = 1. mL

density 1.00 g / mL for liquid water

Units:

Energy	Joule	J = kg m^2 / s^2
Force	Newton	N = kg m / s^2
Pressure	Pascal	Pa = N / m^2

SI Unit Prefixes:

kilo	10^{3}	e.g., 1 kg = 1×10^{3} g
centi	10^{-2}	e.g., 1 cm = 1×10^{-2} m
milli	10^{-3}	e.g., 1 mL = 1×10^{-3} L
nano	10^{-9}	e.g., 1 nm = 1×10^{-9} m
pico	10^{-12}	e.g., 1 pm = 1×10^{-12} m

Angstrom (Å) 10^{-10} m

Chapter 13 (Solutions)

Molarity (M) = mol solute / L solution molality (m) = mol solute / kg solvent

Henry's Law $S_{gas} = k_H P_{gas}$

k_H = 3.7×10^{-2} mol / L·atm for CO_2 in H_2O (at 20° C)

k_H = 1.3×10^{-3} mol / L·atm for O_2 in H_2O (at 20° C)

k_H = 7×10^{-4} mol / L·atm for N_2 in H_2O (at 25° C)

Raoult's Law $P_{solvent} = X_{solvent} P^{o}_{solvent}$ where $X_{solvent}$ = mol solvent / (mol solvent + mol solute)

Freezing Point Depression $\Delta T_f = i K_f m$ For water, K_f = 1.86 °C kg/mol

Boiling Point Elevation $\Delta T_b = i K_b m$ For water, K_b = 0.51 °C kg/mol

Chapter 5 (Gases)

density $d = m / V$ $\quad d = P\mathcal{M} / (R\,T)$

ideal gas law $P\,V = n\,R\,T$

STP $0\ ^{\circ}C$, 1. atm standard molar volume 22.41 L

molar mass $\mathcal{M}$ (g/mol) $= m\ (g)\ R\,T / (P\,V)$

mole fraction $X_A = n_A / n_{TOTAL}$

kinetic energy: $E_K = \frac{1}{2}\ m\,u^2$ $\quad \overline{E}_K = (3/2)\ (R / N_A)\ T$

$u_{rms} = (\overline{u^2})^{1/2}$ $\quad u_{rms} = (3\,R\,T / \mathcal{M})^{1/2}$

$$\frac{\text{rate of effusion of A}}{\text{rate of effusion of B}} = (\mathcal{M}_B / \mathcal{M}_A)^{1/2} \qquad \frac{\text{rate of diffusion of A}}{\text{rate of diffusion of B}} = (\mathcal{M}_B / \mathcal{M}_A)^{1/2}$$

Chapter 6 (Thermochemistry)

work due to expansion or compression $w = -P\Delta V$

specific heat capacity $c\ (J/g\,K) = q / (m\,\Delta T)$ for liquid water, $c = 4.184\ J / (g\,K)$

Chapter 7 (Quantum Theory)

$E_{photon} = h\,\nu = h\,c / \lambda$ $\quad \nu = c / \lambda$ (λ = wavelength of light, ν = frequency of light)

photoelectric effect $E_{photon} = h\nu = \Phi + \frac{1}{2}\ m_e u^2$ where Φ is the work function of the metal

de Broglie wavelength $\lambda = h / p = h / (m\,u)$

Hydrogen (H) atom emission lines $1 / \lambda = R_H\ (1 / n_1^2 - 1 / n_2^2)$ where $R_H = 1.097 \times 10^7\ m^{-1}$

Bohr formula for H atom energy levels $E = -2.18 \times 10^{-18}\ J / n^2$

uncertainty principle $\Delta x\ \Delta p \geq h / (4\,\pi)$ where we assume $\Delta p = m\ \Delta u$
(where p is the particle's momentum, m is its mass and u is its velocity)

Chapter 9 (Chemical Bonding)

A Few Electronegativity Values:

H	2.1	Cl	3.0
F	4.0	Br	2.8
O	3.5	S	2.5
N	3.0	P	2.1
C	2.5	Si	1.8
B	2.0	Al	1.5
Be	1.5	Mg	1.2
Li	1.0	Na	0.9

Spring 2024 Section 001 (MWF) **Chem 1061 Class Schedule** Doreen Leopold

See pp. 15-16 of this syllabus for information about the contents of each chapter.

Study Guides 1 - 10 on our Canvas class website list pages to read in our text, Silberberg & Amateis' "Chemistry", and selected end-of-chapter problems for each chapter. Most of these problems are also included in the online Homeworks or are "paired" with Homework problems.

Quizzes will be given in class (on paper) every other Wed. at 8:00 – 8:50 am starting Feb. 7. They will cover material discussed in class through the previous week, the review material discussed during the Mon. class before the Quiz, Homework problems, and the reading and problems in the corresponding Study Guide(s). See the Review Sheet posted a week before each Quiz for a list of the topics that will potentially be covered.

The six online homeworks are due every other Friday (by 11:59 pm) on weeks without Quizzes, starting Feb. 2. An exception is the last one, Homework F, which is due the last day of classes (Monday April 29).

Introduction	W 1/17					
Chap. 5 Gases and Kinetic Molecular Theory (Study Guide 1)	F 1/19 *Chap. 5*	M 1/22 *Chap. 5*	W 1/24 *Chap. 5*	F 1/26 *Chap. 5 & 6*	M 1/29 *Chap. 6*	W 1/31 *Chap. 6*
Chaps. 6 & 7 Thermodynamics, Quantum & Atomic Structure (Study Guides 2 & 3)	F 2/2 *Chap. 6* ***(HW A on Chap. 5 due, 20 problems)***	M 2/5 *Review for Quiz 1*	W 2/7 **Quiz 1** Chap. 5 & Chap. 6	F 2/9 *Chap. 7*	M 2/12 *Chap. 7*	W 2/14 *Chap. 7*
Chap. 8 Atomic Electron Configurations (Study Guide 4)	F 2/16 *Chap. 7* ***(HW B on Chap. 6 due, 20 problems)***	M 2/19 *Review for Quiz 2*	W 2/21 **Quiz 2** Chap. 7	F 2/23 *Chap. 8*	M 2/26 *Chap. 8*	W 2/28 *Chap. 8*
Chap. 9 & 10 Chemical Bonds, Molecular Shapes (Study Guides 5 & 6)	F 3/1 *Chap. 9* ***(HW C on Chap. 7 & 8 due, 40 problems)***	M 3/11 *Chap. 9, Review for Quiz 3*	W 3/13 **Quiz 3** Chap. 8	F 3/15 *Chap. 9*	M 3/18 *Chap. 10*	W 3/20 *Chap. 10*
Chap. 11 Covalent Bonding (Study Guide 7)	F 3/22 *Chap. 10* ***(HW D on Chap. 9 due, 25 problems)***	M 3/25 *Review for Quiz 4*	W 3/27 **Quiz 4** Chapters 9 & 10	F 3/29 *Ch. 11*	M 4/1 *Ch. 12*	*W 4/3 Chap. 12*
Chap. 12 & 13 Liquids, Solutions (Study Guides 8 & 9)	F 4/5 *Chap. 12* ***(HW E on Chap. 10 & 11 due, 45 probs)***	M 4/8 *Review for Quiz 5*	W 4/10 **Quiz 5** Ch. 11 & 12	F 4/12 *Chap. 13*	M 4/15 *Chap. 13*	W 4/17 *Chap. 13*
Chap. 15 Organic Chemistry (Study Guide 10)	F 4/19 *Chap. 15*	M 4/22 *Chap. 15*	W 4/24 *Chap. 15*	F 4/26 *Review for Final*	M 4/29 *Review for Final*	***(HW F on Chap. 12, 13 + 15 due Mon. Apr 29, 50 problems)***

Final Exam MWF Class (Section 1): **Sat. May. 4, 2024** **4:00 - 6:00 PM** **Smith 100**

Spring 2024 Section 004 (T Th) **Chem 1061 Class Schedule** Doreen Leopold

See pp. 15-16 of this syllabus for information about the contents of each chapter.

Study Guides 1 - 10 on our Canvas class website list pages to read in our text, Silberberg & Amateis' "Chemistry", and selected end-of-chapter problems for each chapter. Most of these problems are also included in the online Homeworks or are "paired" with Homework problems.

Quizzes will be given in class (on paper) every other Thursday at 9:45 – 10:35 am (50 minutes), starting February 8. They will cover the material discussed in class through the previous Thursday, the review material discussed on Tuesday, online Homework questions, and the reading and problems in the Study Guide(s).

The six online homeworks are due every other Friday (by 11:59 pm) on weeks without Quizzes, starting Feb. 2. An exception is the last one, Homework F, which is due the last day of classes (Monday April 29).

The schedule below is only approximate and will be revised throughout the semester. See the Review Sheet posted a week before each Quiz for a list of the topics that may be covered.

Introduction Chap. 5 Gases and Kinetic Molecular Theory (Study Guide 1)	T 1/16 *Chap. 5*	Th 1/18 *Chap. 5*		T 1/23 *Chap. 5*	Th 1/25 *Chap. 6*
Chaps. 6 & 7 Thermodynamics, Quantum & Atomic Structure (Study Guides 2 & 3)	T 1/30 *Chap. 6*	Th 2/1 *Chap. 6*	*F 2/2* ***(HW A on Chap. 5 due, 20 problems)***	T 2/6 Chap. 7	Th 2/8 **Quiz 1** Chap. 5 & Chap. 6
Chap. 8 Atomic Electron Configurations (Study Guide 4)	T 2/13 *Chap. 7*	Th 2/15 *Chap. 7*	*F 2/16* ***(HW B on Chap. 6 due, 20 problems)***	T 2/20 *Chap. 8*	Th 2/22 **Quiz 2** Chap. 7
Chap. 9 Models of Chemical Bonding (Study Guide 5)	T 2/27 *Chap. 8*	Th 2/29 *Chap. 9*	*F 3/1* ***(HW C on Ch. 7 & 8 due, 40 problems)***	T 3/12 *Chap. 9*	Th 3/14 **Quiz 3** Chap. 8
Chap. 10 Molecular Shapes (Study Guide 6) Chap. 11 Covalent Bonding (Study Guide 7)	T 3/19 *Chap. 10*	Th 3/21 *Chap. 10*	*F 3/22* ***(HW D on Chap. 9 due, 25 problems)***	T 3/26 *Chap. 11*	Th 3/28 **Quiz 4** Chapters 9 & 10
Chap. 12 & 13 Liquids, Solutions (Study Guides 8 & 9)	T 4/2 *Chap. 12*	Th 4/4 *Chap. 12*	*F 4/5* ***(HW E on Chap. 10 & 11 due, 45 problems)***	T 4/9 *Chap. 13*	Th 4/11 **Quiz 5** Ch. 11 & 12
Chap. 15 Organic Chemistry (Study Guide 10)	T 4/16 *Chap. 13*	Th 4/18 *Chap. 15*	*Mon. 4/29* ***(HW F on Chap. 12, 13 + 15 due 50 problems)***	T 4/23 *Chap. 15*	Th 4/25 *Summary and Review*

Final Exam TTh Class (Section 4): **Mon. May. 6, 2024** **1:30 - 3:30 PM**
Smith 100 + another room