Welcome to Chemistry 1072H! This syllabus and the accompanying class schedule will answer many of your questions about the course. Please read them carefully and keep them for future reference.

The Course: Chemistry 1072H is the continuation of CHEM1071H, courses that together with the accompanying labs are designed to prepare a student for a major in science, including chemistry and engineering, and the health sciences. Because this course sequence is a survey of chemical principles, it covers many different topics. The major concepts of Chemistry 1072H include rates and mechanisms of chemical reactions, nuclear reactions, equilibrium reactions, acid-base equilibria, precipitation and complexation reactions, thermodynamics, electrochemistry, transition metal compounds and coordination compounds. Each lecture/lab pair fulfills the core physical science requirement. A student may ask, “Why is this course considered an important component of my liberal education?” A liberally educated person is one who can understand complex issues, find credible information, analyze that information, problem-solve, and draw reasonable conclusions based on facts. This course will develop these skills and prepare you to be an informed citizen and life-long learner.

Prerequisites: CHEM 1071H; Honors student or Honors Office permission; concurrent registration in the laboratory course, CHEM 1076H. Registration for CHEM 1076H must precede registration for CHEM 1072H. The lecture material will begin with Chapter 16 of the text by Silberberg and Amateis. You should be familiar with the material covered in Chapters 1–13 and 15.

Instructor: Professor Andreas Stein (219 Smith Hall, 612-624-1802, a-stein@umn.edu)
Office hours: Tuesdays noon–1 p.m., Wednesdays 4:30–5:30 p.m. or by appointment.

Required Text: “Chemistry: The Molecular Nature of Matter and Change” by Martin S. Silberberg and Patricia G. Amateis (McGraw Hill, 8th Edition, 2018), packaged with CONNECT. This is the same text that you used in CHEM 1071H. Note that the publisher’s online homework system, CONNECT is required and is provided in the package sold at the University Bookstore in Coffman Union. The Student Solutions Manual is available on reserve in Walter Library.

Course Web Page: The course Moodle site can be accessed by going to your “my page” at https://www.myu.umn.edu/. After you login, click on the “My Courses” tab and then on the appropriate link for the course Moodle site (CHEM 1072H section 001). This site will be used for posting the syllabus, lecture notes, grades, and other course-related material.

Clickers: Clickers will be used for in-class responses. The required device is the iClicker2, and it is sold at the campus bookstore. At the end of the semester, if your clicker is in good condition, the bookstore will buy back your used iClicker.

Registering Your Clicker: You must properly register your clicker to receive credit. Registration is done through the course Moodle site. On the Moodle page for CHEM 1072H, if you look on the left side there should be a small block with the title "i>clicker", and it will have a link for "Remote Registration" that you can click on.
**Online Homework (Connect):** Homework will be given using the publisher’s online homework system, Connect, and will count 10% toward your course grade. Each homework assignment will cover recently completed material, by chapter. The homework assignments are generally due on Fridays by 11 pm. You must complete 80% of the questions in each homework assignment correctly to receive full credit for homework at the end of the semester. Any score below this mark will earn a prorated portion of credit. You must set up your Connect account correctly to get credit for your online homework. If you had access to the Connect system last semester, that access will continue this semester and you will not need to make any further purchases. However, you will need to register on the Connect system for access to materials pertinent to our section.

To set up your Connect account:
2. Choose “register now”.
3. Enter your U of M email address. You will only receive credit if you use your U of M email address that ends with …@umn.edu. DO NOT USE AN ALTERNATE EMAIL ACCOUNT.
4. Select one of the following:
   (a) Enter the access/registration code that came packaged with your textbook
   (b) Choose “free trial” (3 weeks) if you want to test out the course or are waiting for financial aid.
   (c) Choose “buy online” to purchase
      i. Connect – online homework system only – use as a companion for your used textbook.
      ii. Connect PLUS – online homework system AND the e-book – use this option if you don’t want to purchase a hard copy of the textbook.
5. Fill in your correct contact information, click “I agree”, and then click “submit”.
6. You should get a message that tells you your registration was successful.

**Additional Practice Problems:** If you need more practice than the online homework problems give you, please see the list of problems from the end of each text chapter listed in the class schedule.

**Attendance:** Your attendance is expected and assumed at all lectures. YOU ARE RESPONSIBLE for all announcements made and for all material presented in class (whether or not it is in the text). It is your responsibility to obtain missed lecture notes, copies of handouts, etc. Note that 5% of your grade will depend on in-class participation via the clickers.

**Examinations and Grading:** Three 50-minute midterm examinations and one comprehensive 2-hour final examination will be administered in CHEM 1072H. Note that the midterm exams will take place during class time. Exams will cover the material discussed in class or assigned as homework (including assigned readings of chapters). The exams will consist of multiple-choice questions. You must bring a picture ID to each midterm exam and to the final exam. There may be a spot check of IDs. The exam schedule and important information on exam policy are given below.

- **First Midterm Examination:** Monday, February 18, 9:05–9:55 a.m. (Smith 231)
- **Second Midterm Examination:** Monday, March 25, 9:05–9:55 a.m. (Smith 231)
- **Third Midterm Examination:** Monday, April 22, 9:05–9:55 a.m. (Smith 231)
- **Final Examination:** Monday, May 13, 1:30 p.m.–3:30 p.m. (location tba)
Grades will be calculated from scores on the three midterm exams, the final exam, online homework and in-class participation (via the clickers). The overall course grade will be determined as follows:

- Midterm exams 1–3: 19% each
- Final exam: 28%
- Online homework: 10% (using Connect, typically due on Fridays before 11 pm)
- In-class participation (clickers): 5%

*Final letter grades* will be assigned based on the overall cumulative score, with the B+/B borderline set close to the 40th percentile. No grade lower than the following will be given for the total percentage-based letter grade:

- 90% and higher → A-
- 80% and higher → B-
- 70% and higher → C-
- 60% and higher → D

However, the grades may be curved upward if warranted by the course distribution.

If you are registered for this course on an S/N basis, a grade equivalent to C- on the A–F scale will be required to receive an “S”. A D+ or below will receive an “N”. Many programs or transfer courses do not like S/N grades or will assume that they are the minimum possible grade. Requests to change grading basis after the University deadline will not be approved.

**No exam, including the final exam, may be taken at any time other than that which has been scheduled.** If you have conflicts with any of the scheduled times, you should resolve them now or drop the course. The only exception is if you are registered in another UM course that conflicts with the exam time. If you have a course conflict of this type *see me during the first week of classes*. No make-up exams will be given. In the case of a true emergency (documentation within 1 week is required), a student may be excused from one midterm exam and have a substitute score recorded based on the corresponding section in the final exam. If the unforeseen need to miss more than one midterm exam comes up, you need to discuss the situation with the instructor as soon as possible. In the case of University-sponsored activities that require the student to be out of town, it may be possible to take the exam with the coach or another instructor as the proctor. Please see the instructor about such conflicts *as soon as possible* so arrangements can be made.

**Exam Regrades:** Exam regrade requests must be submitted to the instructor by the end of the class period after that at which the exams were returned (i.e., if exams were returned on Wednesday, the regrade request must be submitted by the end of the class on the following Friday). It is possible, although very unlikely, that the machine-scored exam was misread. Note that you are responsible to properly record answers (and fully erase unwanted marks) on the answer form when taking the exam.

**Incompletes:** An I (incomplete) grade is only possible if a student is doing satisfactory work (C- level or better) and cannot take the final exam due to extreme, documented circumstances. A signed agreement involving the instructor, student, and third party is required and must be completed before final grades are submitted. Provisions for making up the final exam will be arranged on a case-by-case basis. Incompletes will not be granted if a student has missed earlier exams, or is not passing based on the work up to the final.

**Withdrawals:** It is hoped that every student will successfully complete this course. If, however, it becomes necessary to drop the course, you must officially withdraw from the course following the rules for your college (CSE, CLA, CBS, etc.). Before withdrawing, I urge you to come and speak with me. Your situation may not be as bad as you think it is.
**Calculators:** Every student should have a calculator that calculates all arithmetic and trigonometric functions, logarithms, and exponentiation. The calculator must also be capable of displaying numbers in scientific notation (e.g. 6.02 x 10\(^{23}\) or 6.02E+23), because many of the numbers we deal with in this course will be too small or too large to input or display any other way.

**Overlapping & Back-to-Back Courses:** Enrolling in overlapping or back-to-back courses that do not allow enough travel time to arrive at our class meetings on time is prohibited. For more information, please see: [http://policy.umn.edu/Policies/Education/Education/OVERLAPPINGCLASSES.html](http://policy.umn.edu/Policies/Education/Education/OVERLAPPINGCLASSES.html)

**Teaching & Learning:** The materials provided in this course are intended only for the students officially enrolled in this section and are to be used to learn and practice the course material. Disseminating class notes, videos, exams, etc. beyond the classroom community or accepting compensation (in the form of cash or in trade, such as access to a study website) undermines instructor interests in their intellectual property while not substantially furthering instructor and student interests in effective learning. Such actions violate shared norms and standards of the academic community and are not allowed. For additional information, please see: [http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html](http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html)

**Student Conduct Code:** As a student at the University you are expected to adhere to Board of Regents Policy: Student Conduct Code. To review the Student Conduct Code, please see: [http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf](http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf).

**Scholastic Dishonesty:** The Board of Regents Student Conduct Code states that, “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.” The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: [http://www1.umn.edu/oscai/integrity/student/index.html](http://www1.umn.edu/oscai/integrity/student/index.html). The policy in this course is **zero tolerance**. The minimum action taken in a case of scholastic dishonesty in any portion of the work in this course will be a grade of F for the course.

**For University-wide policies, please see the following webpage:** [https://policy.umn.edu/education/syllabusrequirements-appa](https://policy.umn.edu/education/syllabusrequirements-appa)

This webpage covers eleven policies related to: Student Conduct Code; Use of Personal Electronic Devices in the Classroom; Scholastic Dishonesty; Makeup Work for Legitimate Absences; Appropriate Student Use of Class Notes and Course Materials; Grading and Transcripts; Sexual Harassment; Equity, Diversity, Equal Opportunity, and Affirmative Action; Disability Accommodations; Mental Health and Stress Management; Academic Freedom and Responsibility.
HELP IS AVAILABLE

Instructor: Asking questions during office hours is a first line of defense toward overcoming conceptual problems with the course material. Get help early on so that problems do not compound. I hope to see you in person so that I can help you if you are having any difficulty.

Tutoring: Your lab TA will have one or more office hours per week at a time and location to be announced. For students in the honors program, there will be weekly hours for chemistry-specific tutoring available in in Middlebrook Hall. Specific hours and tutors will be posted on the Honors web site at the start of the semester. You are also welcome to use the General Chemistry tutoring facilities in Smith 124. Additional tutoring services are available at the Smart Learning Commons (http://smart.umn.edu/index.html). Please Note: The walk-in tutorial is not intended as a routine means of getting your homework problems solved. Many students fall into the trap of seeking help too soon, before they have put sufficient thought into a problem by themselves. The result is that they never learn to solve problems on their own, and the consequences are disastrous on exams. Thus, while you are not discouraged from using the tutor room, you are discouraged from over-using it. Tutors are instructed NOT to simply do problems for students, but rather to ask questions that will help them see how to do the problems themselves. They may also ask to see evidence that you have tried a particular problem yourself. Generally, then, it’s a good idea to bring along the work you have done on a problem. Seeing this will help the tutor figure out how best to help you. If you have any questions about this, please feel free to ask me.

Study Groups and Homework: One of the best ways to learn chemistry is to answer questions and work problems with other students. You will probably find other classmates who are interested in being a part of a study group.

Special Needs: Students with disabilities that affect their ability to participate fully in class or to meet all course requirements are encouraged to bring this to the attention of the instructor so that appropriate accommodation can be arranged. Further information is available from the Disability Resource Center at 612-626-1333 (https://diversity.umn.edu/disability/).

Student Mental Health and Stress Management: As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student’s ability to participate in daily activities. University of Minnesota services are available to assist you with addressing these and other concerns you may be experiencing. You can learn more about the broad range of confidential mental health services available on campus via http://www.mentalhealth.umn.edu/.

General Chemistry Director: If you have concerns or problems regarding the lecture portion of this course that you would like to discuss with someone other than your lecturer, contact Dr. Michelle Driessen, the General Chemistry Director, in 113 Smith Hall (mdd@umn.edu, 612-624-0062).
STUDY HINTS

Step 1: READ THE TEXT BEFORE THE LECTURE. No matter how clear the lecture, if it is your first encounter with the material, you will probably not retain much of the content of the lecture. On the other hand, if you have read the relevant material in advance, at your own pace, the lecture will make a lot more sense, and it will deepen your understanding.

Step 2: COPY OVER YOUR LECTURE NOTES ON THE SAME DAY. Your notes will probably not be written in complete, coherent sentences and equations. Try to rewrite them in your own words. Any step or concept that isn't clear will stand out when you rewrite it yourself.

Step 3: WORK PROBLEMS WITHOUT LOOKING AT THE ANSWER. Be playful. Mistakes at this point can be very helpful. Try several approaches. If you need to look at an answer, come back later and do the same problem without looking it up. Working problems is one of the two best ways to test your comprehension of the material. The other is to explain a concept to others, or explain to them how to work a problem.

Problems with Examinations ("I studied 20 hours and really knew the material. Why didn't I get an A?) One of the most common student complaints concerning exams is that the exams do not resemble, or are harder than the homework problems. There are many types of problems in chemistry, such as the calculation of the molarity of a solution, that are important, straight forward and are commonly encountered stated in a familiar way. However, to try to determine whether a student understands a concept or is relying on memorization, your lecturer needs to ask the problem in a different way - and one which may confuse you. To help avoid confusion, treat the numerical problems you work in the following way:

1. Work the problem as written and determine the answer if possible. Note whether this is one of several very similar problems that were assigned.

2. Think about the problem and your answer
   • in your own words, what does the problem ask?
   • in your own words, what does the answer mean?
   • try to restate the problem at least two different ways.
   • can you make-up a similar problem? (This is not always easy or realistic to do.)
   • can this problem be worked backwards? (Knowing the answer, can you calculate any of the given pieces of data?)
   • can you think of a use for the information contained in the problem?
   • finally, can you help another student to understand and work this problem? Study in a small group is helpful in this regard.

3. DANGER! If the working of a problem by the professor, a tutor, a friend or the solutions manual "makes sense", this does not necessarily mean that you have a good understanding of the problem and that you can readily work other problems which involve these concepts. The most reliable way to understand a problem is to work it completely and correctly yourself and to then take the time to reflect on what you have done as described above.

4. Rereading the text several times may not be as useful in chemistry as in other subjects. When study time is limited, it may not leave time to answer questions and work problems at the end of the chapter. You might try:
   • reading the text thoughtfully once (before it is discussed in lecture)
   • reviewing the notes after each lecture
   • working problems at the end of the chapters and rereading the text as needed to help understand the problems

5. When working problems on a multiple choice test, it is useful to eliminate answers you know are incorrect as quickly as possible. This increases your chances of making a correct "educated" guess, if you are not sure of the correct answer.
I will try to adhere to this schedule as closely as possible, but some changes may be necessary. Remember, you are responsible for any announcements made in class. Specific information for each exam will be announced in class. The problems listed are suggested practice problems. For extra practice, find related problems at the end of each chapter. Note that many adjacent problems are provided as similar sets.

Chapter 16 (Kinetics: Rates and Mechanisms of Chemical Reactions)

Dates: W 1/23 – F 2/1 (Lectures 1–5)
Read: 16.1–8
Problems: 4, 7, 9, 12, 13a, 14, 17, 18, 21, 25, 26, 28, 30, 32, 34, 35, 37, 45, 46, 61, 62, 63, 65, 75, 78, 83, 86, 96, 97, 101, 105, 108, 118, 120, 125, 126

Chemical Content: Reaction rates, rate laws, reaction order, first and second order reactions, half-life, temperature dependence of reaction rates, activation energy, collision theory, transition states, chemical reaction mechanisms, rate determining step, relation between mechanism and rate law, catalysis, homogeneous vs. heterogeneous reactions, steady state approximation, enzyme kinetics.

Chapter 24 (Nuclear Reactions and Their Applications)

Dates: F 2/1 – M 2/4 (Lectures 5–6)
Read: 24.1–2, 4–5

Chemical Content: Radioactive decay, nuclear stability, balancing nuclear equations, mode of decay, kinetics of radioactive decay, radioisotopic dating, effects of nuclear radiation on matter, effects of ionizing radiation on living matter, applications of radioisotopes, radioactive tracers.

Chapter 17 (Equilibrium: The Extent of Chemical Reactions)

Dates: W 2/6 – W 2/13 (Lectures 7–10)
Read: 17.1–6
Problems: 2, 3, 4, 6, 10, 11, 12, 15, 16, 19, 21, 23, 25, 27, 30, 31, 33, 35, 39, 40, 42, 45, 47, 50, 51, 54, 56, 58, 60, 63, 66, 67, 69, 71, 74, 76, 78a, 84, 86, 88, 90ab, 95a, 97ac, 102, 103, 109a

Chemical Content: The equilibrium condition, reaction quotient, equilibrium constant expressions, expressions involving pressures, heterogeneous equilibria, applications of the equilibrium constant, solving equilibrium problems, Le Châtelier's principle.

Date: F 2/15 (Lecture 11): Review and problem solving
Date: M 2/18 (Lecture 12): Exam 1 (Covers chapters 16, 24, 17, associated reading, homework problems).
Chapter 18 (Acid-Base Equilibria)

Dates: W 2/20 – F 3/1 (Lectures 13–17)
Read: 18.1–9
Problems: 2, 5, 8, 9, 11, 13, 16acd, 17abd, 19(for H₂O), 21ab, 22, 23, 25, 27, 29, 31, 36, 37, 38, 39, 40, 41, 42, 43, 45, 47, 49, 55, 63, 65, 66, 69, 100, 103, 105, 107, 110, 111, 112b, 118, 122ab, 143, 149, 167, 168, 174, 186

Chemical Content: Nature of acids and bases, Brønsted-Lowry definition of acids and bases, household acids and bases, conjugate acid-base pairs, strong acids vs. weak acids, acid dissociation constant, ion product of water, pH and pOH of strong and weak acids, percent dissociation, acid-base properties of salts, the Lewis model.

Chapter 19 (Ionic Equilibria in Aqueous Systems)

Dates: M 3/4 – M 3/11 (Lectures 18–21)
Read: 19.1–5
Problems: 1, 4, 5, 6, 7, 8, 10, 14, 20, 22, 25, 27, 28, 31, 32a, 34, 39, 41, 42, 43, 44, 48, 49, 50, 51, 52b, 53, 55, 67, 71, 74, 75, 77, 80, 113, 117, 119, 120ab, 126, 127, 128, 130, 138, 141, 142

Chemical Content: Common ion acid-base equilibria, buffered solutions, Henderson-Hasselbalch equation, titration and pH curves, indicators, solubility equilibria, common ion effect, complex ion equilibria, selective precipitation and qualitative analysis.

Date: W 3/13 (Lecture 22): Review and problem solving
Date: M 3/25 (Lecture 24): Exam 2 (Covers chapters 18, 19, associated reading, homework problems).

Spring Break 3/18 – 3/22

Chapter 20 (Thermodynamics: Entropy, Free Energy, and the Direction of Chemical Reactions)

Read: 20.1–4

Chemical Content: Spontaneous processes and entropy, 2nd law of thermodynamics, effect of temperature on spontaneity, free energy, entropy changes in chemical reactions, 3rd law of thermodynamics, standard free energies, predicting the sign of ΔS°, dependence of free energy on pressure, free energy and the equilibrium constant, free energy and work.

Chapter 4.5, 4.6 and 21 (Electrochemistry: Chemical Change and Electrical Work)

Read: 21.1–7 (and review 4.5, 4.6)
**Chemical Content:** Basic definitions, oxidation numbers, balancing equations, galvanic cells, half reactions and half cells, cell potential, standard reduction potentials, Nernst equation, dependence on concentration, concentration cells, electrical work, batteries, corrosion, electrolysis.

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**Date:** F 4/19 (Lecture 35) – Review and problem solving  
**Date:** M 4/22 (Lecture 36) **Exam 3** (Covers chapters 20, 4.5, 4.6, 21, associated reading, homework problems).

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**Chapter 23 (The Transition Elements and Their Coordination Compounds)**

**Dates:** W 4/24 – F 5/3 (Lectures 37–41)  
**Read:** 23.1–5 (Also review 4.5 and 4.6)  
**Problems:** 4, 9, 12, 14, 16, 27, 29, 45, 47, 50, 52, 53, 55, 58, 62, 66, 74, 80, 82, 86, 92, 95, 97, 98, 114, 121, 122

**Chemical Content:** Survey of transition metals, electron configurations and oxidation states, coordination compounds, isomerism, bonding in complex ions, valence-bond theory, crystal field theory, octahedral complexes and other geometries, biological importance of coordination complexes.

**Date:** F 5/6 (Lecture 42): General review

**Date:** Monday 5/13: **Comprehensive Final Exam** from 1:30 p.m. – 3:30 p.m. (location tba)