

CHEM 4845/5845 Molecular Modeling and Drug Design
Chemistry Department,
College of Liberal Arts and Sciences, University of Colorado Denver

COURSE SYLLABUS

Instructor:	Hai Lin	Term:	Spring 2024
Office:	Science Building 4126B, 3071E	Class Meeting Days:	Mon & Wed
Phone:	303-315-7656	Class Meeting Hours:	3:30–4:45 pm
E-Mail:	hai.lin@ucdenver.edu	Class Location:	NC 3207
Website:	https://clas.ucdenver.edu/chemistry/hai-lin	Lab Location:	n/a
Office Hours:	Mon & Wed 2:00–3:15 am and by appointments		

COURSE OVERVIEW

I. Welcome!

Welcome to Molecular Modeling and Drug Design! This is an introductory course that will bring you the basic ideas and hands-on experience of modern molecular modeling techniques and their applications to computer-aided drug design. You will learn how to describe the interactions between individual atoms and molecules and to predict how they change over time. You will learn how such information can be used to assist the design of drugs that cure diseases. The knowledge that you acquire in this course will deepen your insights in chemistry, biology, and pharmacology.

II. University Course Catalog Description

Advanced course in biochemistry. An introductory course on modern molecular modeling techniques and their applications to computer-aided rational drug design.

III. Course Overview

Materials covered: This course will introduce to you the principles of

- (1) Molecular modeling
- (2) Computer-aided drug design

For molecular modeling, we will cover molecular visualization, energy minimization, homology modeling, docking, and dynamics simulations. For computer-aided drug design, we will discuss basic concepts such as drug targets, lead discovery, lead optimization, ADME, etc.

Computer skills: You will spend a lot of time “playing” with various computer programs. Some of these programs will be installed locally (e.g., in your laptop) while others are accessed via Internet. You do not need to be a computer genius or do a lot of computer programming, but you must have basic knowledge of computer (e.g., what a directory is, how to access a file, how to run programs through command lines, how to use spreadsheet programs for data analysis, and how to give presentations using PowerPoint slides).

Knowledge in math: While this course does not require extensive math knowledge, it is essential to know basic statistics, because you will do a lot of data analysis. A good understanding in spherical coordinates, differential equations, and Fourier series will be helpful.

Knowledge in Physics: The molecular modeling techniques in this course are based on classical (Newtonian) physics. Basic knowledge in electrostatics (e. Coulomb's Law) and thermodynamics (e.g. temperature and kinetic energies) is needed.

Hands-on learning experience: Instead of surveying all molecule modeling and drug design topics, this course will emphasize illustrating fundamental concepts through examples. Homework assignments play a major role to this mission. You must do the homework in time as instructed, and you should actively participate in the discussion of homework assignments. Practice makes you perfect.

Emphasis on fundamental principles: As both molecular modeling and computer-aided drug design are rapidly developing fields, the specific algorithms and software used today may become obsolete tomorrow. Therefore, it is important that you have good understandings of the involved fundamental principles so that you can quickly adapt to new techniques when they emerge.

You do not need to memorize specific theoretical details or computational algorithms.

IV. **Course Goals and Learning Objectives (underlines show alignment with Chemistry Program Learning Outcomes)**

By the end of this course, students will be able to...

1. Demonstrate an adequate knowledge base in the molecular modeling and in how to apply the knowledge to computer-aided drug design, including
 - Understand the principles in molecular modeling and computer-aided rational drug design.
 - Possess an adequate knowledge of inter-atomic forces and drug-receptor interactions.
2. Evaluate, analyze, and interpret data to form conclusions, including
 - Perform basic calculations by applying appropriate modeling techniques.
 - Analyze and interpret the calculated data based on chemical and physical principles.
3. Effectively extract and construct scientific meaning from critical reading of primary and secondary literature (scientific research articles, reviews, and database)
4. Effectively communicate your ideas through audiovisual presentation

V. **Course Prerequisites**

CHEM 3411 (Organic Chemistry I), PHYS 2020 (Algebra-based Physics II) or PHYS 2331 (Calculus-based Physics II), or equivalents.

VI. **Course Credits**

3 credit hours. CHEM 4845 fulfills the biochemistry elective requirement for the BS biochemistry degree, and CHEM 5845 counts as elective for graduate programs in chemistry.

VII. **Required Texts and Materials**

Required Texts and Materials:

- A **computer** (laptop or desktop): Windows, Mac, or Linux with > 100 GB free space hard drive, Internet access, and **administrator privilege** to install programs. (Mac OS 10.15 Catalina or later has software compatibility issues – if you only have access to a Mac running macOS 10.15 or later, please join a group that has access to a Windows/Linux computer.)
- Computer programs to be downloaded for free and installed in your laptop: Avogadro, VMD, NAMD, MGLTools, and Autodock Vina.

- Computer programs to be accessed free via Internet: PDB2PQR, APBS, and Swiss-Model
- Online Database accessed free via Internet: Protein Data Bank and UniProt
- [Tutorials and associated computer files](#) for employed computer programs, free to download via Internet
- Handouts provided by instructor
- An external portable hard drive, memory card, or USB memory stick for [data backup](#). Please contact the instructor if you need helps in this regard.

Additional Materials, Equipment, or Skills:

- Your laptop should have an either VGA or HDMI port so that you can connect it to the overhead projector for presentation; if not, you may need a convertor.
- Proficient in using computers (see “Computer Skills” in Section II)
- Know how to use text editing programs (e.g., Notepad, TextEdit, or vim) and spread sheet programs (e.g., MS Excel)
- Know how to use Google (www.google.com)

VIII. Supplementary (Optional) Texts and Materials

- For molecular modeling applications: Andrew Leach, “*Molecular Modeling: Principles and Applications*,” 2nd Ed. by published by Wiley, ISBN 0582382106
- For molecular modeling theory: Christopher Cramer, “*Essentials of Computational Chemistry: Theories and Models*,” 2nd Ed. by published by Wiley, ISBN 0470091827
- For drug design: Richard B. Silverman and Mark W. Holladay, “*The Organic Chemistry of Drug Design and Drug Action*,” 3rd Ed. published by Academic Press, ISBN 978-0-12-382030-3
- For data analysis: John Taylor, “*An Introduction to Error Analysis: The Study of Uncertainties*,” 3rd Ed. published by University Science Books, ISBN 978-1940380087.
- For biochemistry: David L. Nelson and Michael M. Cox, “*Lehninger Principle of Biochemistry*,” published by W.H. Freeman, 6th Ed. ISBN 978-1429234146 (or later Ed.)
- For using computers: Steven H.D. Haddock and Casey W. Dunn, “*Practical Computing for Biologists*,” published by Oxford University Press, 4th Ed. ISBN 978-0878933914

IX. Course Schedule

The schedule is shown below. The dates for quizzes and homework presentations are fixed; if changes are necessary, the instructor will notify the students as early as possible in class and/or via Canvas announcement (e.g., school is closed due to severe weather – although quizzes are online and will not be affected by weather). Dates for topics and other activities are tentative.

Week	Date	Day	Topics	Assessments/Activities
1	1/15	M	Holiday, no class	
1	1/17	W	Syllabus, Computer 101	Practice: Know your computer
2	1/22	M	Protein structure	
2	1/24	W	Protein structure	Group finalized
3	1/29	M	Force fields	
3	1/31	W	Force fields	
4	2/5	M	Force fields	Quiz1: protein structure
4	2/7	W	Force fields	HW1: Small molecules
5	2/12	M	Dynamics	
5	2/14	W	Dynamics	
6	2/19	M	Dynamics	
6	2/21	W	Simulations	HW2: Biomolecular visualization
7	2/26	M	Simulations	
7	2/28	W	Simulations	
8	3/4	M	Homology model	
8	3/6	W	Docking	
9	3/11	M	Docking	
9	3/13	W	Implicit solvation	
10	3/18	M	Spring break, no class	
10	3/20	W	Spring break, no class	
11	3/25	M	Drug design	Quiz2: molecular modeling
11	3/27	W	Drug design	HW3: Dynamics simulations
12	4/1	M	Drug design	
12	4/3	W	Drug design	
13	4/8	M	Drug design	
13	4/10	W	Drug design	HW 4: Homology modeling
14	4/15	M	Drug design	
14	4/17	W	Drug design	
15	4/22	M	Drug design	
15	4/24	W	Drug design	HW5/6: Docking or PB calculations
16	4/29	M	Drug design	
16	5/1	W	Drug design	
17	5/6	M	Finals week	Quiz3: drug design
17	5/8	W	Finals week	

EVALUATION

X. Assignments

Assignments include homework and quizzes.

Working in a Group: Collaboration with people of various backgrounds is essential to modern scientific research, and you will have the chance to such experience in this course.

Students will work in small groups in homework (but **not in quizzes**). Each group is made of 3-5 people depending on the course enrollment. A student should get to know the classmates in the first 2 weeks and identify the partners to work with. Please inform the instructor by **4:45 pm, 1/24/2024** if you are unable to join a group, and the instructor will assign you to a random group. If you have justified reasons that prevent you from working in a group setting, you must let the instructor know by then, and the instructor may approve you working alone in homework.

Each group must elect/appoint a **group coordinator**, who will coordinate the group activities. After taking the position, the group leader should email the list of students in the group by **4:45 pm, 1/24/2024** to the instructor, with other group members copied.

The group coordinator will coordinate the homework activities and be the corresponding person between the group and the instructor (with other group members copied).

Each group member should collaborate with each other with courtesy and help the group leader in the group activities.

The grade of homework is group-based, i.e., all in the group will in principle receive the same grade. However, to be fair, if a student barely contributes to the group efforts, he/she will receive a lower grade than the other group members.

- Homework

There are 5 homework assignments that need submissions (HW1, HW2, HW3, HW4, and HW5/HW6, 20 points each assignment). For **HW5/HW6**, you only need to pick one of them.

Note that the optional **HW0** is for students who need practices to know computer better. No submission is required for this homework, nor does it contribute to your grade.

A homework assignment usually requires the group to practice given programs through tutorial and then use the programs to do similar things with 1-2 other proteins and/or molecules.

Each group will present the results of the homework as a short **(5-10 minutes) talk** in class on the due date. (See the schedule for specific dates). Please make sure that at least one group member's laptop can hook up with the overhead projector via HDMI/VGA connector.

The assessment of a homework assignment is based on **completion in time (15 points)** and **effectiveness in presentation (5 points)**. Effectiveness means that the presentation is given in a clear and organized manner and that you answer in a reasonable manner the questions from the audience. You may do the calculations incorrectly, but that is fine, as you will not lose points for that.

Students are strongly encouraged to participate in the discussion of the homework presentation. For example, you may:

- Ask specific questions (e.g., What assumptions have you made for XXX?)
- Answer questions.
- Point out mistakes, including typos.
- Suggest alternative solutions.

- Discuss what the results will be if certain parameter (e.g., temperature) changes
- Connect the problem with chemical principles.
- Connect the problem with your research experiences.
- Offer meaningful comments (rather than just saying "Nice work!").
- And many more...

- Quizzes

There are 3 **open-book, open-note, and open-resource quizzes in Canvas**. See the schedule above for the specific dates. The quizzes will cover recent materials. The quizzes will mostly be in the form of multiple-choice questions (other forms such as open-ended questions may also be used). The quizzes will assess if you understand the fundamental concepts. Elaborated numerical evaluations are typically not involved in the quiz problems.

The quizzes are **individual based**, i.e., you are not doing quizzes in a group setting, and you will receive your own score.

A quiz is **timed**. You have a 24-hour window to do a quiz. Once you start a quiz, you must complete it within the allocated time. You have only **one attempt** for each quiz.

Partial credit is not given for multiple-choice problems. For open-ended questions, the instructor has certain rules for giving partial credits, which will be followed strictly. **No makeup quiz will be given**. A missed quiz will be given zero.

XI. Extra Points for Making a Chemistry Video

Each student has a chance to earn **up to 6 extra points** for making and posting on YouTube a short (2-4 minutes) video on a specific scientific topic that is related to what we have covered in this course. The goal is to explain the scientific concept or knowledge to general public. The audience is assumed to be at the level of an undergraduate freshman or sophomore, who is taking or has taken general chemistry but not necessarily majored in chemistry.

Note that this is completely optional, so you do NOT have to do it. But if you want to earn the extra points, please post your video on YouTube and **email me the link to your video and a headshot of you** (so that I can verify that the person in the video is indeed you) before the last week of the semester (**before 5/4/2024 Saturday**).

Examples of previous videos (from other classes):

- <https://www.youtube.com/watch?v=ClO67x5Ktb0&feature=youtu.be>
- <https://www.youtube.com/watch?v=WmPo4bMkaV0&feature=youtu.be>
- https://www.youtube.com/watch?v=Oi_cC1utcpw
- <https://www.youtube.com/watch?v=GzIEC76zBjM&feature=youtu.be>
- https://www.youtube.com/watch?time_continue=4&v=tXUDqsFH81c&feature=emb_logo
- https://www.youtube.com/watch?v=-UxEeBKKpMA&feature=emb_logo
- <https://youtu.be/Z4qfFwHLg3E>
- https://www.youtube.com/watch?v=DZP3_Sxv2WU
- <https://www.youtube.com/watch?v=7ifywnHpT7M&feature=youtu.be>
- <https://youtu.be/jDz7QHh0r9s>
- https://www.youtube.com/watch?v=iprecPTFMbA&ab_channel=MinhLe
- <https://youtu.be/lHjWsYMjkc>

- https://www.youtube.com/watch?v=lr_vuxx8BnA
- https://www.youtube.com/watch?v=HKKo7_dHyVo
- <https://www.youtube.com/watch?v=Y1bsqizxHml>
- <https://www.youtube.com/watch?v=CWETA1-TKR0&t=15s>
- <https://www.youtube.com/watch?v=BWkK19z9IRQ>
- https://youtu.be/xLjwWiWhz_c
- <https://youtu.be/nD06dryoM3Y>
- <https://youtu.be/BGvhro2J4tQ>
- <https://youtu.be/X4SPxXmrQjc>
- <https://www.youtube.com/watch?v=1sc2BNZvtI8>
- <https://www.youtube.com/watch?v=l6qe7Xyy3Ng>
- https://youtu.be/9d7YkN_-dME
- <https://youtu.be/0zIX29z5lGA>
- <https://youtu.be/CZMBnARNgUA>
- <https://youtu.be/6tw5SaYcVs4>
- <https://youtu.be/LSD2o2FpRv8>
- <https://youtu.be/aKwpZtHzjSw>
- <https://youtu.be/Zg6fHw8Z-8M>
- <https://www.youtube.com/watch?v=3eFT-8u9A8M>
- <https://youtu.be/0nnx-9N91S8>
- https://youtu.be/ph1BUss_w4
- <https://www.youtube.com/watch?v=l3XmE13rJxk>
- https://www.youtube.com/watch?v=QXCz9z_m-AE
- <https://www.youtube.com/watch?v=9eA4m905R6g>

Suggested example topics are:

- Introduction of my favorite element (or molecule)
- What can you buy with one mole of US dollar?
- How much energy is needed to cook a patty for hamburger?
- Do you know the most spicy/bitter/sweet compound?
- How can you find out the volume of a single water molecule?
- What is ^{14}C and why is it useful?
- Which compounds are used as flame retardant and how do they work?
- What are the challenges to recycle solar panels?
- What are the challenges to recycle plastics?
- What are “high temperature” and “room temperature” in superconductor?
- What are the differences between baking soda and baking powder?
- How are cheeses made?
- What make our eyes tearful when chopping onions?
- What are there in a glass of wine (or beer or coffee or tea or Gatorade or other drinks)?
- Which molecules are used as cold and cough medicines?
- Which molecules are at work when we feel hungry/full?
- What is nylon and why is it useful?
- What molecules are there in swimwear?
- What molecules are there in contact lens?
- What molecules are there in sunscreen?
- Mosquitos! Please help!
- Why do some antiallergy pills make you sleepy?
- What are the challenges to use biofuel?
- What are the differences between windshield glass and the glass used to make a beaker?

- What might be the concentrations of greenhouse gases and the temperature of the earth right after the bolide that hit the earth 66 million years ago?
- What is glyphosate?
- What is insulin?
- What is vaccination?
- Why shouldn't we use antibiotics unless it is absolutely needed?
- How do snake/spider/scorpion venoms inspire new medicines?
- How does a battery work?
- What are insecticides, and how do they work?
- What are our skeletons made of?
- What is gel nail polish?
- What are food colors?
- What molecules are there in shampoo/soap/detergent?
- Which molecules make me feel happy?
- What materials are used for dental fillings?
- What fuels are used for spacecrafts?
- Which compounds can be used to treat acne?
- How has the population of polar bears changed over the last 100 years?
- Why is there coal in Greenland?
- What is personalized medicine/treatment?
- How many years and dollars does it typically take to develop a new therapy/drug?
- How does sewage is treated?
- What are there in mucus/tears/saliva?
- Is nuclear energy a green source of energy?
- Hey! Introducing last year's Ig Nobel Prizes (do not laugh) ...

You are welcome to discuss your topic choice with the instructor.

While there are no limits in the format or contents that you present in the video, please **restrict the stuff to science** in the video. Furthermore, please make sure that your video **does not violate the laws and does not contain immoral stuff**. Anyway, no one wants to get into troubles...

You may get some ideas on what and how to present in the video from various resources including online resources. However, make sure that you **use and cite those resources appropriately**. You do not want to be sued for plagiarism, do you?

If students **work in groups** for the video production, the 6 extra points will be divided and given to the involved students. For example, if two students work together to make a video, each student will receive 3 points.

I am happy to help you in this video production; however, to be fair to all students in the class, my role as the instructor must be limited to offering advice on topic selection.

You as the author of the video retain the **copyright** of the video (e.g., you post it on YouTube and other places like Facebook and invite family, friends, coworkers, and classmates to like it); but you agree that the instructor may use your video, with adaptations (e.g., to correct mistakes, if any), for educational purposes (e.g., showing your fantastic video to other students, faculty, or general public). The instructor will not use your video for commercial purposes.

XII. Basis for Final Grade

Grading will be based on the assignments.

Assessment	Points per Occurrence	Number of Occurrences	Total Points Possible	Percent of Final Grade
Quiz	TBA	3	100	50%
Homework	20	5	100	50%
			200	100%

Grading scale is based on percentage, which is shown below.

Grading Scale (S%)	
$92 \leq S$	A
$90 \leq S < 92$	A-
$88 \leq S < 80$	B+
$82 \leq S < 88$	B
$80 \leq S < 82$	B-
$78 \leq S < 80$	C+
$72 \leq S < 78$	C
$70 \leq S < 72$	C-
$68 \leq S < 70$	D+
$62 \leq S < 68$	D
$60 \leq S < 62$	D-
$S < 60$	F

The instructor may or may not curve the accumulated grades. If curving is applied, it may or may not improve your grade, but it will not lower your grade.

XIII. Grade Dissemination

Your grades of the assignments can be found via the course's Canvas course shell. You can access your scores at any time within the Canvas Gradebook. Final grades are posted via UCDAccess at the end of the semester.

According to the University's interpretation of the Family Education Rights and Privacy Act (FERPA), your instructors are not allowed to discuss grades via email, as it is not considered a secure means of communication. However, I am able to discuss your grades via email if you include the following disclaimer in your email to me: **"I understand that email is not a secure means of communication and give you permission to discuss my grade via email."**

Student Success

The secret of success in this course is very simple: **working hard**.

- **How many hours per week do I needed to spend on study for this course?** It depends on many things. This course has a lot of homework assignments, which can take a lot of time especially if you are not familiar with computer. However, as you practice more, you will get more and more proficient, and the time needed will hopefully reduce.
- **How to do the homework assignments?** Working in group, trial and error, and Google.
- **What will be in a quiz?** Materials covered in recent classes. “Recent” does not mean just the classes last week; we may cover the materials in even earlier classes.
- **How should I work in a group setting?** This is not an easy question to answer. It depends on many things and varies from case to case. My suggestions are:
 - Be courteous to everyone in the group.
 - Explicitly specify the task each person in the group will be responsible for and the corresponding due date & time.
 - Establish a procedure to resolve problems, delays, conflicts etc., should they come up.
 - Prepare yourself for the group meeting; or you are wasting everyone’s time.
 - When in doubt, discuss openly (and with respect) with other group members and the group coordinator who oversees the progress and takes actions when needed.

COURSE PROCEDURES**xiv. Course Policies: Grades**

If you have questions about your grades, please contact the instructor with a *written statement* within 7 calendar days after the grades are posted for the specific homework assignments or quizzes, include the following disclaimer in your email: **"I understand that email is not a secure means of communication and give you permission to discuss my grade via email."**

Attendance Policy

Students are expected to attend lectures and actively participate in the group-based homework activities. UC Denver Student Attendance and Absences Policy can be found at http://www.ucdenver.edu/faculty_staff/employees/policies/Policies%20Library/OAA/StudentAttendance.pdf

Late Work Policy

No late quiz will be accepted. They will be given zero.

Extra Credit Policy

Making a short YouTube video on chemistry earns you up to 6 extra points. In addition, sometimes a quiz may have extra problems, which offer the opportunity for you to earn extra points. Those extra problems are often related to the materials you learned in this course, and they may or may not require advanced understanding. Because of the extra points, you may earn more points than the listed possible points in a quiz; however, if you earn more than 180 total points in all assignments together, you will only receive 180 points. Also, please note that Canvas does not distinguish between regular and extra points in a quiz. For example, if you earn 19 regular and 1 extra points in a quiz that offers 20 regular and 1 extra points, your grade should be $20/20 = 100\%$; but Canvas will show it as $20/21 = 95\%$. This may cause some confusion, but I will make sure that your grade is properly calculated at the end of the semester.

Grades of "Incomplete"

The current university policy concerning incomplete grades will be followed in this course. Incomplete grades are given only in situations where unexpected emergencies prevent a student from completing the course and the remaining work can be completed the next semester. The instructor is the final authority on whether you qualify for an incomplete. Incomplete work must be finished by the end of the subsequent semester or the "I" will automatically be recorded as an "F" on your transcript.

Rewrite/Resubmit Policy

No rewrites or resubmission will be accepted.

Group Work Policy

See the group work described in Section "Assignment".

xv. Course Policies: Technology and Media**Email**

One of the requirements for this course is that you maintain an email address, check it regularly for messages, be sure it is working, and notify the instructor in time if you change your email address. Official university communication is only sent via a student's university email address. Normally, you are responsible for any messages the instructor sends to you via email 24 hours prior. You may contact the instructor via email, in addition to phone calls and seeing the instructor during office hours. The instructor will answer emails as quick as possible (usually within 24 hours), but delays may be expected during weekends and breaks, when

the instructor is traveling or on sick leave, and in other special situations (e.g. the university email server is down).

While email is a convenient tool, please do not abuse it. Please limit the contents to stuff related to this course and to academic purpose. **Please indicate explicitly your name, student ID, and the course title in the email**, which will help the instructor to quickly locate the necessary information when replying. The instructor may request you to meet in person if your questions cannot be answered via email (e.g. per the university's policy, no grades can be disseminated via email) or are difficult to answer via email (e.g. your question requires extensive discussion).

Canvas

This course will make use of the Canvas course management system. You should automatically be registered for access to the course site. You should check your Canvas account regularly. The syllabus for the course is listed there. Your grades will be posted to your personal page, so you will know your standing and can correct any clerical errors with ease. The instructor will also post notes on Canvas.

You can log into Canvas at <https://ucdenver.instructure.com/login>. If you have any problems with the online system, please contact the Help Desk immediately. The instructor does not have any authority in managing your account.

Laptop and Mobile Device Usage

Please make sure that you have Internet connection so that you can use the Canvas course shell and receive/send emails. You are required to have access to computers that can be used for the course (homework and online tests). Please ask the instructor for permission before using recording devices (e.g., to record a lecture or meeting). Note that laptops and mobile devices are used in the class only for this course and for academic purpose, and that the use of them must not cause disturbance to the instructor or other students.

Classroom Devices

A computer (laptop or desktop) is required. See the required text and materials section.

Library-supplied online databases and collections

If you need to use the library for further information (e.g., dictionaries and references), please contact the library staff. The Auraria library website is at <http://library.ucdenver.edu/>.

Classroom Response Clickers

This course does not use student response devices such as clickers. However, you are expected to actively participate in the discussion.

xvi. Course Policies: Student Expectations

Civility

Everyone must be treated with respect and courtesy both in class and after class. Everyone must commit to create a climate for learning characterized by respect for each other. As your instructor, I never discriminate students on the basis of race, color, national origin, pregnancy, sex, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation, or political philosophy. I hope that you do the same.

Professionalism:

Disruptive behavior is not tolerated; this includes using foul language, threatening others, talking about things irrelevant to the course in emails or during the Zoom meeting, etc. Anyone who disrupts the learning environment will be reported to the university.

Auraria Library

The Auraria Library offers many services, research databases, and collections. A list of specific librarian contact and/or library subject expert web page can be found at

<http://library.auraria.edu/services/researchhelp/specialists>.

Writing Center

The Writing Center website is

<http://www.ucdenver.edu/academics/colleges/CLAS/Centers/writing/Pages/TheWritingCenter.aspx>

Religious Observances

You must notify the instructor at least 24 hours in advance of conflicts between the normal class schedule (e.g., scheduled quizzes) and major religious observances if you intend to miss class to observe a holy day of your religious faith.

Student Grievances

Student complaints about this course or instructor should be communicated directly to the instructor. If the issues cannot be resolved, you should meet with the chairperson of the Chemistry Department. Contact 303-315-7650 to arrange a meeting. If meeting with chairperson does not resolve the issues, you may appeal to the Associate Dean of Student Success in the Office of the CLAS Dean (NC 5014, 303-315-7000). The decision of the Associate Dean is final. You may also meet with the CU Denver Ombudsman to ask for assistance. For additional information, please see the CLAS policy "Procedures for Student Grievances about Courses or Faculty" available from the Office of the CLAS Dean.

Link to University Policy on Service Animals

<http://equity.ucdenver.edu/wp-content/uploads/2017/02/Service-Animal-Policy-FINAL-DRAFT-2016-11-30.pdf>

University Requirements for Campus Safety

You should review the latest required safety protocols (<https://www.ucdenver.edu/coronavirus/>) and follow the recommendations of the CDC, Colorado Department of Public Health and Environment, and the University. I wish everyone safe and healthy, because otherwise you will not be able to learn chemistry!

UNIVERSITY POLICIES

The University of Colorado Denver is committed to maintaining a positive learning, working, and living environment. As such, the University does not discriminate on the basis of race, color, national origin, pregnancy, sex, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation, or political philosophy in admission and access to, and treatment and employment in, its educational programs and activities. (Regent Law, Article 10).

XVII. Access**Disability Access:**

The University of Colorado Denver is committed to ensuring the full participation of all students in its programs, including students with disabilities. If you have a disability or think you have a disability and need accommodations to succeed in this course, I encourage you to contact Disability Resources and Services (DRS) and/or speak with me as soon as you can. (DRS is located in Academic Building 1, Suite 2116, and at disabilityresources@ucdenver.edu.) I am committed to providing equal access as required by federal law, and I am interested in developing strategies for your success in this course.

DRS require students to provide current and adequate documentation of their disabilities. Once a student has registered with DRS, DRS will review the documentation and assess the student's request for academic accommodations in light of the documentation. DRS will then provide the student with a letter indicating which academic accommodations have been approved.

XVIII. Academic Dishonesty**Student Code of Conduct**

Students are expected to know, understand, and comply with the ethical standards of the university, including rules against plagiarism, cheating, fabrication and falsification, multiple submissions, misuse of academic materials, and complicity in academic dishonesty. For suggestions on ways to avoid academic dishonesty, please see the Academic Honesty Handbook at

http://www.ucdenver.edu/faculty_staff/faculty/center-for-faculty-development/Documents/academic_honesty.pdf

Plagiarism is the use of another person's ideas or words without acknowledgement. The incorporation of another person's work into yours requires appropriate identification and acknowledgement. Examples of plagiarism when the source is not noted include: word-for-word copying of another person's ideas or words; the "mosaic" (interspersing your own words here and there while, in essence, copying another's work); the paraphrase (the rewriting of another's work, while still using their basic ideas or theories); fabrication (inventing or counterfeiting sources); submission of another's work as your own; and neglecting quotation marks when including direct quotes, even on material that is otherwise acknowledge.

Cheating involves the possession, communication, or use of information, materials, notes, study aids, or other devices and rubrics not specifically authorized by the course instructor in any academic exercise, or unauthorized communication with any other person during an academic exercise. Examples of cheating include: copying from another's work or receiving unauthorized assistance from another; using a calculator, computer, or the internet when its use has been precluded; collaborating with another or others without the consent of the instructor; submitting another's work as one's own.

Fabrication involves inventing or counterfeiting information—creating results not properly obtained through study or laboratory experiment. Falsification involves deliberate alteration or changing of results to suit one's needs in an experiment or academic exercise.

Multiple submissions involves submitting academic work in a current course when academic credit for the work was previously earned in another course, when such submission is made without the current course instructor's authorization.

Misuse of academic materials includes: theft/destruction of library or reference materials or computer programs; theft/destruction of another student's notes or materials; unauthorized possession of another student's notes or materials; theft/destruction of examinations, papers, or assignments; unauthorized assistance in locating/using sources of information when forbidden or not authorized by the instructor; unauthorized possession, disposition, or use of examinations or answer keys; unauthorized alteration, forgery, fabrication, or falsification of academic records; unauthorized sale or purchase of examinations, papers, or assignments.

Complicity in academic dishonesty involves knowingly contributing to or cooperating with another's act(s) of academic dishonesty.

Academic integrity is fully expected. **An act of Academic Dishonesty may lead to sanctions including a reduction in grade (up to and including a permanent F for the course).**

Students Called for Military Duty

If you are a student in the military with the potential of being called to military service and /or training during the course of the semester, you are encouraged to contact your school/college Associate Dean or Advising Office immediately.

XIX. CLAS Policies and Deadlines

For relevant university deadlines and procedures (such as the last day to withdraw from a course) as well as academic support sites, please see this website

https://clas.ucdenver.edu/faculty-staff/sites/default/files/attached-files/student_services_and_calendar.pdf.

XX. Health and Wellness

The University of Colorado Denver is committed the health and well-being of all students. As a student, you may experience a range of challenges that can interfere with learning, such as strained relationships, traumas, increased anxiety, substance use, feeling down, difficulty concentrating, and/or lack of motivation. These mental health concerns or stressful events may diminish your academic performance and/or reduce your ability to participate in daily activities. If you or someone you know is struggling, you can find supportive campus and community resources at <https://www.ucdenver.edu/counseling-center> or by calling the CU Denver Counseling Center (303-315-7270) or the Health Center at Auraria (303-615-9999). On weekends, holidays, or after-hours, you can contact the 24/7 Mental Health Crisis and Victim Assistance Line at 303-615-9999 or text Talk to 38255.

XXI. Early Action Statement

Succeeding at college does not mean that you don't struggle in classes or during particular semesters. Our goal at CU Denver is to do all we can to support students and facilitate their success. Early Action (*Course Progress Report: CPR*) is one of the ways we support our students. It's a process by which individual courses can link you to campus supports and it's a time for your instructors to let you know what changes you can make toward success in the course and engage in a learning partnership with you. This is a way to open up the conversation between you and your instructor so that together you can work out how to achieve your goals in the course. Getting an Early Action is not an indication that you will not succeed in the course. It is a call to action. You might get an email or phone call. Please engage this process. Students who have taken advantage of resources offered them are able to move forward and succeed.

Appendix A: Academic Dishonesty and CLAS Academic Ethics Policy

Students are expected to know, understand, and comply with the ethical standards of the University. A university's reputation is built on a standing tradition of excellence and scholastic integrity. As members of the University of Colorado Denver academic community, faculty and students accept the responsibility to maintain the highest standards of intellectual honesty and ethical conduct.

Academic dishonesty is defined as a student's use of unauthorized assistance with intent to deceive an instructor or other such person who may be assigned to evaluate the student's work in meeting course and degree requirements.

Examples of academic dishonesty include, but are not limited to, the following:

A. Plagiarism: Plagiarism is the use of another person's distinctive words or ideas without acknowledgment. Examples include:

1. Word-for-word copying of another person's ideas or words;
2. The mosaic (the interspersing of one's own words here and there while, in essence, copying another's work);
3. The paraphrase (the rewriting of another's work, yet still using their fundamental idea or theory);
4. Fabrication of references (inventing or counterfeiting sources);
5. Submission of another's work as one's own;
6. Neglecting quotation marks on material that is otherwise acknowledged

Acknowledgment is not necessary when the material used is common knowledge.

B. Cheating: Cheating involves the possession, communication, or use of information, materials, notes, study aids or other devices not authorized by the instructor in an academic exercise, or communication with another person during such an exercise. Examples include:

1. Copying from another's paper or receiving unauthorized assistance from another during an academic exercise or in the submission of academic material;
2. Using a calculator when its use has been disallowed;
3. Collaborating with another student or students during an academic exercise without the consent of the instructor

C. Fabrication and Falsification: Fabrication involves inventing or counterfeiting information, i.e., creating results not obtained in a study or laboratory experiment. Falsification, on the other hand, involves the deliberate alteration of results to suit one's needs in an experiment or other academic exercise.

D. Multiple Submissions: This is the submission of academic work for which academic credit has already been earned, when such submission is made without instructor authorization.

E. Misuse of Academic Materials: The misuse of academic materials includes, but is not limited to, the following:

1. Stealing or destroying library or reference materials or computer programs;
2. Stealing or destroying another student's notes or materials, or having such materials in one's possession without the owner's permission;
3. Receiving assistance in locating or using sources of information in an assignment when such assistance has been forbidden by the instructor;

4. Illegitimate possession, disposition, or use of examinations or answer keys to examinations;
5. Unauthorized alteration, forgery, or falsification;
6. Unauthorized sale or purchase of examinations, papers, or assignments

F. Complicity in Academic Dishonesty: Complicity involves knowingly contributing to another's acts of academic dishonesty. Examples include:

1. Knowingly aiding another in any act of academic dishonesty;
2. Allowing another to copy from one's paper for an assignment or exam;
3. Distributing test questions or information about the materials to be tested before the scheduled exercise;
4. Taking an exam or test for someone else;
5. Signing another's name on attendance roster or on an academic exercise

Students who fail to comply with the UC Denver CLAS Academic Ethics Policy are subject to disciplinary action as set forth by the College policy. For more information regarding the Academic Ethics Committee policies and procedures, please refer to

<http://ucdenver.edu/academics/colleges/CLAS/faculty-staff/policies/Pages/HandlingAcademicDishonesty.aspx> .

Appendix B: CLAS and Chemistry Department Withdrawal Policy as Established in Fall 2017**CLAS Withdrawal Policy**

- From the first day of classes until the Sunday at the start of the 11th week of the semester, students may withdraw using the UCD Access student portal. No signatures or permissions are required. Courses that serve as a co-requisite for another course may not be dropped unless both courses are dropped. This co-requisite rule is now enforced campus-wide and the Registrar's office will not under any circumstance break a co-requisite prior to week 11.
- From Monday of the 11th week through Friday of the 14th week of the semester, students who wish to withdraw must follow the CLAS Late Withdrawal Policy. The CLAS Dean's office has indicated that the policy will:
 - Require signatures from the instructor and a CLAS advisor or dean.
 - Allow students to withdraw during this period for any reason, including poor performance.
 - Allow for co-requisites to be broken.
- After the Friday of the 14th week of the semester students must submit a retroactive withdrawal petition which requires detailed documentation. Poor or failing grades are not typically a valid reason for a retroactive withdrawal. Retroactive withdrawal requests will not be considered until the following term.

Chemistry Department Policy for Withdrawals

- Students who wish to withdraw from a chemistry course beginning Monday of the 11th week through Friday of the 14th week of the semester will be allowed to do so. Students must follow the CLAS Late Withdrawal Policy which requires the signature of the instructor and a CLAS advisor or dean.
- Beginning Monday of the 11th week through Friday of the 14th week of the semester, students can drop a course that serves as a co-requisite for another course without having to drop both courses. That is, *the Chemistry Department will allow co-requisites to be broken after the 10th week of the semester is completed.* This applies to all co-requisite courses (listed below) in the chemistry department.

Chemistry Courses requiring a co-requisite course:

- Course CHEM 2038 has the co-req CHEM 2031 or CHEM 2081
- Course CHEM 2068 has the co-req CHEM 2061 or CHEM 2091
- Course CHEM 2088 has the co-req CHEM 2031 or CHEM 2081
- Course CHEM 2098 has the co-req CHEM 2061 or CHEM 2091
- Course CHEM 3011 has the pre-req/co-req CHEM 3421 or CHEM 3491
- Course CHEM 3018 has the pre-req/co-req CHEM 3011
- Course CHEM 3118 has the co-req CHEM 3111 or CHEM 3481
- Course CHEM 3418 has the co-req CHEM 3411 or CHEM 3481
- Course CHEM 3428 has the co-req CHEM 3421 or CHEM 3491
- Course CHEM 3481 has the co-req CHEM 3418 or CHEM 3488
- Course CHEM 3488 has the co-req CHEM 3411 or CHEM 3481
- Course CHEM 3498 has the co-req CHEM 3421 or CHEM 3491
- Course CHEM 4121 has the co-req CHEM 4128 for chem majors
- Course CHEM 4128 has the co-req CHEM 4121
- Course CHEM 4511 has the pre-req/co-req MATH 3511 or CHEM 4500 (effective Spring 2018)
- Course CHEM 4518 has the co-req CHEM 4511
- Course CHEM 4521 has the pre-req/co-req MATH 3511 or CHEM 4500 (effective Spring 2018)
- Course CHEM 4538 has the co-req CHEM 4521
- Course CHEM 4548 has the pre-req/co-req CHEM 4511 and CHEM 4521
- Course CHEM 4810 has the pre-req/co-req CHEM 3421 or CHEM 3491 (effective Spring 2018)
- Course CHEM 4815 has the co-req PHYS 2020 or PHYS 2331

Appendix C: Diversity and Inclusion Statement by the Chemistry Department

As a unit that teaches and explores, arguably, one of the most diverse topics within the sciences, the Department of Chemistry at CU Denver affirms the importance of reaching out to involve every person in the scientific and science education enterprises. As our campus' population reflects more the diversity that makes the city of Denver rich and prosperous, there is much work that needs to be done to achieve this quality in most STEM fields, not only within our campus but also beyond.

We want to emphasize that the Chemistry department values diversity and inclusion as qualities that make us stronger, wiser, and more impactful. By sticking to these core values, we believe that we can better address and solve the most pressing problems of our society while sharing our knowledge with our student population and beyond. By actively considering the voices of all people, regardless of their nationality, sexual orientation, gender, religious beliefs, cultural background, veteran status, disability, race, or skin color, we are sure that our decisions in the types of problems we decide to tackle, and how they are addressed, can result in a positive impact on our communities.

Since the early days of our campus in the 1960s, our department has worked with students considered as 'not traditional'; such as first-generation students, students holding jobs to support themselves and their families, students interested in re-starting their careers after years of involvement in other activities, students starting families, and much more. Six decades later, and with a much different campus, we continue to serve these populations, understand their challenges, and are proud to see them leave CU Denver with more tools to be successful in their next academic/professional step. As the campus population evolves, we are eager to continue working with traditional and non-traditional college students of all backgrounds.

We believe that the scientific enterprise and the concepts of diversity and inclusion are not separate. On the contrary, working with these values to understand and solve the scientific challenges that we are pursuing, will ensure our success. Just as important, their application in the classroom setting (virtual or in-person) will result in a positive and welcoming environment for everyone involved (student, TA, LA, instructor, etc.).

Our department extends an invitation for everyone to contribute to learning and doing chemistry, whether in the classroom or in the laboratory, everyone is welcome in chemistry spaces. We strongly believe that these values will positively influence the future leaders arising from CU Denver.