SCI 220: Chemistry
Fall 2022–Spring 2023
Maine School of Science and Mathematics

Class Times and Locations

Class MTWF 8:30–9:25 AM **Lab** R 8:30–10:25 AM

All class meetings are in room B210.

Instructor

Richard Barrans, Ph.D., M.Ed.; barransr@mssm.org
Office Hours: Sun 6:30–7:30 PM; MTR 11:30 AM –12:25 PM, W 9:30–10:25 AM

Objectives

After completion of this course, the successful student will be able to:

- Describe the composition and structure of material substances.
- Explain and describe fundamental reactions and interactions of atoms and molecules.
- Safely and accurately carry out manipulations and measurements in the chemistry laboratory.

Course Content and Approach

Chemistry is the science of the substances composing the world around us. This course is a two-semester introductory sequence. In the first semester, it addresses measurements and uncertainty, atomic structure, periodic properties, chemical bonding, the mole, stoichiometry, and thermodynamics. In the second semester, it addresses molecular geometry, gas laws, intermolecular forces, colligative properties, acid-base and redox reactions. Laboratory activities, in which students can directly observe chemical transformations and analyze products, are a critical component of the class.

Textbook

Introductory Chemistry: A Foundation, Seventh Edition, by Steven S. Zumdahl and Donald J. DeCoste, published by Brooks/Cole, Cengage Learning, 2011.

Grading

Two in-term examinations	20%
End-of-semester examination	20%
Quizzes	10%
Labs	30%
Homework	15%
Class work	5%

Course Components

Class

Attendance is expected in class. Class work receives full credit if it shows evidence of earnest effort in good faith.

Quizzes

Quizzes may be administered in class or on-line on Canvas. Quizzes must be completed in one sitting during the allotted time period. Online quizzes are open-note and open-book. Calculators are permitted. You are also permitted to access information published to the internet during on-line quizzes.

Any means of communication, consultation, or collaboration with any person (other than the instructor) while taking a quiz is not allowed. Forbidden means of communication include speech, writing, any visible sign or symbol, vocal utterances, overheard speech, sound generated by any means, gestures including sign language, Morse code, e-mail, text-messages, postings to message boards, or any other means of transferring information to another mind, whether or not known to the instructor or available at the time of publication of this syllabus. Posting any quiz questions to the internet, whether to a public or private audience, is not permitted. If you finish a quiz before a classmate, you may not communicate about the quiz with the classmate until they also finish.

Sharing of any materials, including textbooks, calculators, and computers, with classmates during quizzes and exams is prohibited.

Homework

Homework problems are assigned to reinforce the covered material. Each homework is graded in two parts: the rough draft and the final draft. The rough draft, worth one third of the total, is graded on whether you have made an earnest effort to tackle the problem. You will receive feedback on your work, including the grade each problem would receive as a final draft. The final draft is worth two thirds of the total. For full credit, you must explain how to approach and answer the question. Merely giving an answer, even if it is correct, will not earn full credit.

Laboratories

Weekly laboratory participation is an essential component of the course.

Lab Groups

It is expected that you will work in groups in lab. Many of the experiments require several people just to take the data. Groups may contain four or fewer students; obtain instructor permission *each time* for larger groups. All group members are responsible for completing all data tables, graphs, and analyses. Your instructor may check the data sheet of any group member to evaluate the group's work and data collection. The instructor may assign lab groups.

Lab Grades

Present your data to your instructor for approval when you leave. If your data is not signed by your instructor, you will not receive credit for any part of the lab.

Lab Reports

Written lab reports, if required, are due at the beginning of the next lab.

Final Exam

The final exam is in two parts, each worth as much as an in-term exam. The first section is the last exam in the semester sequence, and the second section is cumulative, covering the entire semester.

Year Grade

Your year grade is calculated form the average of the two semester grades.

Resources

Instructor

If office hours are inconvenient, the very best way to contact me is by e-mail. I can pretty much guarantee that I will forget any conversation during or right around class. If I have my wits about me when you speak to me in class, I will ask you to send me an e-mail to remind me of what we discussed. If I forget, please send the e-mail anyway.

Textbook

The textbook is your first source of information. The assigned sections of the text are best read by each student before class.

Internet

Current scores will be posted on Infinite Campus. Quizzes and assignments are accessed through Canvas.

Absences

Quizzes missed due to an excused absence may be made up. Arrangements for make-up quizzes must be made within seven calendar days of your return to class. If you are unable to attend a lab due to an excused absence, contact me. I may either schedule a make-up at another time or pro-rate your missed lab.

Remote learning during extended medical absences

If you are unable to be on campus due to a medical absence, you may participate in the class remotely. However, it is not technically possible for me to deliver the full classroom experience to students attending remotely; when I attend to students physically in lab or lecture, I am not able to optimize cameras, microphones, and narration. Students attending labs remotely may use data gathered from the group in which they synchronously participated, and which they record in

their own data tables. Students taking quizzes or exams remotely are subject to the same conditions, including time limits, as if they were physically present.

Academic Integrity

2022-2023 Community Handbook

At MSSM, students and staff take great pride in academic honesty and a supportive academic environment. All are expected to maintain habits of rigorous debate, healthy inquiry, and the vigorous pursuit of truth. Academic dishonesty, in any of its forms, disrupts the learning process and tarnishes the integrity of our community. As a result, MSSM will treat instances of academic dishonesty very seriously.

If an instructor grants permission, students may collaborate in completing assignments and homework. Any unauthorized collaboration, copying, using of notes on exams/major assessments, storing of non-permitted information on calculators or on computers, or any other unacceptable activity that gives a student or a group of students advantages over others is cheating and will not be tolerated.

While the assimilation of ideas from many sources is basic to academic research and intellectual development, students must always reference the use of any non-original materials. Failure to do so is plagiarism and this dishonesty impairs an instructor's ability to accurately evaluate a student's performance. Plagiarism is using someone else's ideas, wording, or data without proper or complete acknowledgment. Credit must be given for ideas and information that belong to someone else, whether it is quoted, summarized, or paraphrased. Faculty members may require that notes, drafts, and a list of sources be submitted along with the finished project. Failure to provide evidence of the work process may constitute an admission of plagiarism.

This class

Students are expected to respect others' opinions and abilities. Those who disrupt the class or interfere with other students' opportunity to learn will be asked to leave the class. If you have a mobile phone or any other distracting equipment, turn it off or silence it and refrain from non-class use during class.

Students are expected to work together on group work and labs, and encouraged to study together. However, all submissions must represent your OWN work. Copying, collaborating, and sharing of materials during quizzes is not permitted, as described in detail above. Other prohibited practices include, but are not limited to, signing an absent student's name to a sign-in sheet, submitting material for grading that is also submitted to another class without clearance by both instructors, and "dry-labbing" or recording data in lab that you did not actually observe.

Notice of Non-Discrimination

MSSM does not discriminate on the basis of race, color, national origin, sex, disability, or age in its programs and activities. The following person has been designated to handle inquiries regarding the non-discrimination policies:

Dr Greg Hamlin (he/him/his), Title IX Coordinator, Affirmative Action Officer
Email: hamling@mssm.org
Cell: 607-301-3922

For further information on notice of non-discrimination you may contact the U.S. Department of Health and Human Services, Office for Civil Rights. Web: https://www.hhs.gov/ocr/index.html, Phone: 1-800-368-1019, Email: OCRMail@hhs.gov, TDD: 1-800-537-7697

Disclaimer

Information in the syllabus was, to the best of the instructor's knowledge, correct when distributed at the beginning of the term. However, the instructor reserves the right to correct errors and to make changes in the course content or instructional techniques during the term. The instructor will make every effort to ensure that any such changes benefit the students. Before any changes to the syllabus take effect, students will be notified and given the opportunity to comment, object, and propose alternatives.

Tentative Schedule for the Fall Semester

Day	Topic	Reading	Homework*	Quiz
8/22	Syllabus, course overview			
8/23	SI units and prefixes, scientific notation	2.1–2.3		
8/24	Uncertainty, significant figures	2.4–2.5	HW 1 ↑	
8/25	*Lab 1: Density of Solids*			
8/26	Math with units	2.6–2.8	HW 1 R ↓	
8/29	Unit conversions			
8/30	Conversion factors			1
8/31	Temperature conversions		HW 2 ↑, HW 1 F ↓	
9/1	*Lab 2: Microscale Density Determination*			
9/2	Practice		HW 2 R ↓	
9/5	Elements, compounds, and mixtures	3.1–3.4		
9/6	Physical and chemical properties			2
9/7	Separation methods	3.5	HW 3↑, HW 2 F ↓	
9/8	*Lab 3: Relative Mass*			
9/9	Element names and symbols	4.1–4.2	HW 3 R ↓	
9/12	Idea of the atom	4.3–4.7		
9/13	Periodic table	4.8		3
9/14	Standard states of elements, ions	4.9–4.11	HW 4↑, HW 3 F ↓	
9/15	*Lab 4: Empirical Formula*			
9/16	Naming binary compounds	5.2–5.4	HW 4 R ↓ (Compressed schedule)	
9/19–9/20	**break** (4-day weekend)			

Day	Topic	Reading	Homework*	Quiz
9/21	Polyatomic ion names, ionic formulas	5.2–5.11		
9/22	*Lab 5: Types of chemical reactions*			
9/23	**Exam 1**			
9/26	Exam review		HW 4 F ↓	
9/27	Equation interpretation and balancing	Ch. 6		
9/28	Practice		HW 5↑	
9/29	*Lab 6: Preparation of alum*			
9/30	Practice		HW 5 R ↓	
10/3	Driving force; aqueous solubility rules	7.1–7.2		
10/4	Ions in aqueous solution	7.3		4
10/5	Types of reaction	7.6–7.7	HW6 ↑, HW5 F ↓	
10/6	*Lab 7: Molar ratios*			
10/7	Atomic mass unit	8.1–8.2	HW6 R ↓	
10/10	Moles, molar mass	8.3–8.5		
10/11	Percent composition, empirical formula	8.6–8.9	HW7 ↑	5
10/12	PSAT Day—no class			
10/13	*Lab 8: $Cu(NH_3)_4SO_4$*		HW7 R ↓, HW 6 F ↓	
10/14	Parent conferences—no class			
10/17–10/18	**break** (4-day weekend)			
10/19	Stoichiometry: moles to moles	9.1–9.2		
10/20	*Lab 9: Molar volume of a gas*			
10/21	Stoichiometry: mass to mass	9.3	HW7 F ↓	
10/24	Limiting reactant, theoretical yield	9.4–9.6		
10/25	**Exam 2**			
10/26	Exam 2 review		HW8 ↑	
10/27	*Lab 10*			
10/28	Percent yield, stoichiometry practice		HW8 R ↓	
10/31	Work and energy, conservation of energy	10.1		
11/1	Temperature and heat, heat of reaction	10.2–10.3		6
11/2	First law, specific heat capacity	10.4_10.5	HW9 ↑, HW8 F ↓	
11/3	*Lab 11*			
11/4	Enthalpy of reaction	10.6	HW9 R ↓	
11/7	Hess's law, calculating enthalpy	10.7		
11/8	Hess's law			7
11/9	Entropy: the quality of energy	10.8	HW10 ↑, HW9 F ↓	

Day	Topic	Reading	Homework*	Quiz
11/10	*Lab 12*			
11/11	Practice		HW10 R ↓	
11/14	Atomic line spectra, Bohr model	11.1–11.5		
11/15	Electron waves and orbitals	11.6		8
11/16	Hydrogen orbitals and shells	11.7–11.8	HW11 ↑, HW10 F ↓	
11/17	*Lab 13*			
11/18	Pauli principle, electron configuration	11.9	HW11 R ↓	
11/19–11/27 Thanksgiving break				
11/28	Orbital occupancy	11.10		
11/29	Periodic properties	11.11		9
11/30	Ionic and covalent bonds	12.1–12.3	HW12 ↑, HW11 F ↓	
12/1	*Lab 14*			
12/2	Electronegativity, bond polarity		HW12 R ↓	
12/5	Electron configuration and charges of ions	12.4		
12/6	Ionic lattices	12.5		10
12/7	Practice		HW12 F ↓	
12/8	*Lab 15*			
12/9	Review			
Midterm week			**Midterm parts 1 & 2**	

Tentative Schedule for the Spring Semester

Day	Topic	Reading	Homework*	Quiz
1/24	Lewis structures: single bonds	12.6		
1/25	Lewis structures: multiple bonds	12.7	HW13 ↑	
1/26	*Lab 16*			
1/27	Practice		HW13 R ↓	
1/30	VSEPR	12.8–12.10		
1/31	Expanded octets			11
2/1	Practice		HW14 ↑, HW13 F ↓	
2/2	*Lab 17*			
2/3	Named gas laws, absolute zero	13.1–13.4	HW14 R ↓	
2/6	Ideal gas law	13.5		
2/7	Dalton's law of partial pressures	13.6–13.7		12
2/8	Ideal gas law practice		HW15 ↑, HW14 F ↓	
2/9	*Lab 18*			
2/10	Ideal gas law practice		HW15 R ↓	

Day	Topic	Reading	Homework*	Quiz
2/13	Kinetic molecular theory	13.8–13.9		
2/14	Kinetic molecular theory			13
2/15	Gas stoichiometry	13.10	HW16 ↑, HW15 F ↓	
2/16	*Lab 19*			
2/17	Gases practice		HW16 R ↓	
2/18–2/26	**Break**			
2/27	Phase changes; enthalpies			
2/28	**Exam 5**			
3/1	Exam review			
3/2	*Lab 20*			
3/3	Intermolecular forces: liquids and solids	14.3–14.6	HW16 F ↓	
3/6	Solubility	15.1		
3/7	Concentration units; solution stoichiometry	15.2–15.4		14
3/8	Dilution and neutralization	15.5–15.7	HW17 ↑, HW16 F ↓	
3/9	*Lab 21 (titration?)*			
3/10	Practice		HW17 R ↓	
3/13	Normality	15.8		
3/14	Reaction rates and activation energy	17.1–17.2		15
3/15	Reaction rates and activation energy		HW18 ↑, HW17 F ↓	
3/16	*Lab 22*			
3/17	Elementary rate constants, catalysis		HW18 R ↓	
3/20–3/21	**break** (4-day weekend)			
3/22	Dynamic equilibrium			
3/23	*Lab 23*	17.3–17.5	HW19 ↑	
3/24	Heterogeneous equilibria	17.6	HW18 F ↓	
3/27	Practice		HW19 R ↓	
3/28	**Exam 6**			
3/29	Exam review			
3/30	*Lab 24*			
3/31	Le Chatelier's principle	17.7–17.8	HW19 F ↓	
4/3	Solubility product equilibria	17.9		16
4/4	Practice			
4/5	ICE tables		HW20 ↑	
4/6	*Lab 25*			
4/7	Practice		HW20 R ↓	

Day	Topic	Reading	Homework*	Quiz
4/10	Practice			
4/11	Strong acids and bases	16.1–16.2		17
4/12	Ionization of water	16.3	HW21 ↑, HW20 F ↓	
4/13	*Lab 26*			
4/14	pH and pOH	16.4	HW21 R ↓	
4/15–4/23	**Break**			
4/24	pH of strong acid solutions	16.5		
4/25	Buffers	16.6		18
4/26	pH of buffer solutions		HW22 ↑, HW21 F ↓	
4/27	*Lab 27*			
4/28	Practice		HW22 R ↓	
5/1	Redox reactions	18.1		
5/2	Assigning oxidation numbers	18.2–18.3		19
5/3	Half reactions	18.4	HW23 ↑, HW22 F ↓	
5/4	*Lab 28*			
5/5	Electrochemical cells	18.5	HW23 R ↓	
5/8	Batteries	18.6		
5/9	Corrosion	18.7		20
5/10	Electrolysis	18.8	HW24 ↑, HW23 F ↓	
5/11	*Lab 29*			
5/12	Practice		HW24 R ↓	
5/15	Alkane nomenclature	20.1–20.4		
5/16	Alkenes and alkynes	20.7		
5/17	Organic functional groups	20.10–20.15	HW24 F ↓	
5/18	*Lab 30*			
5/19	Review			
Finals week			**Final parts 1 & 2**	