Chemistry 101: Summer I 2021 Syllabus

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Office Hours: TBD after pre-course survey or by appointment

Lectures: Asynchronous; recorded and posted daily

Course overview: Welcome to General Chemistry I (Chem101)! This is the first course in a two-semester sequence in general chemistry, where we will develop a foundation in atomic and molecular structure, elementary chemical reactions, and states of matter. Our journey into chemistry will encompass stoichiometry, gas-phase chemistry, quantum theory, atomic structure, chemical bonding, noncovalent interactions, and coordination chemistry over the next 5.5 weeks. The topical coverage of the course is broad, and it is my aim that the content will gradually unfold such that you will confidently be able to take on the challenges that chemistry has to offer! Be sure to check our Canvas page **regularly** for Announcements, Homework, Exams, Lectures, Piazza discussions, etc.

Text: ***Chemical Principles* 8th Edition** by **Zumdahl & DeCoste** with **Owl V2 Access**. This "bundle" contains an electronic access code to Owl V2 (a learning tool with homework problems and many helpful tutorials) and an e-copy of the book. Prices vary according to duration of access code: 1 term (6 months; ISBN: 9781305864214) ~$105; 2 terms (12 months; ISBN: 9781305864184) ~$120. This is the same book and companion website as used in Chem102. Purchasing the Student Solutions Manual (8th Edition) is also **recommended**; the solutions to even-numbered book problems will be provided to you on Canvas.

Discussions: Science is itself a subject borne from discussing the world around us, generating testable hypotheses, and executing experiments to verify or refute those hypotheses. A critical aspect to the entire scientific process is asking questions (especially the *why*) to ourselves, peers, and mentors. Therefore, it is highly encouraged to participate in lecture, recitation, the Piazza discussion forum (located on Canvas), and in study groups outside of our regularly scheduled class times. I highly encourage to ask questions – if you are curious or confused, there is a strong possibility that your classmates are as well! Additionally, challenge the material by asking *why*! It is a more effective way of learning than listening to me *tell* you how chemistry works.

Office Hours: One of the major changes you will encounter in transitioning from high school to Penn are office hours. This is time I dedicate to meeting with anyone on a 'walk-in' basis. You are encouraged to attend my office hours to ask questions, receive additional support, discuss applications of our content to the real-world, or to get to know each other. Come by for any reason at all! If the times I have identified do not work for you, feel free to schedule an appointment or request that I hold an additional weekly office hour at a different time.

Academic Resources: Your instructor is here to help! Please take advantage of office hours, recitation, and appointments to succeed in the course! Assignments (homework and recitation, see below), the textbook, and

free online resources (e.g., Chemistry Libretexts, OpenStax Chemistry) are resources available to help prepare you for exams. For additional academic help, our university offers several additional resources:

- UPenn Tutoring Center (Remote and private tutoring)
- Weingarten Learning Center (Learning and study strategies)
- Chemistry Graduate Students (Not free, but offer one-on-one sessions from people working toward advanced degrees in chemistry and on the research frontlines)

Exams: Three midterm exams, each worth 150 points, will be scheduled at ~1/3 benchmarks over the semester. The midterm exams will be scheduled to take place outside of lecture with a 3-hour time limit and will consist of 6 – 7 comprehensive open-ended questions meant to test both your problem-solving skills and conceptual understanding of the material. Prior to each midterm exam, there will a practice exam (with solutions) posted to Canvas. These are meant to help you "test yourself" prior to the exam. If you miss Exams 1 – 3 **for any reason**, that exam score will be dropped. **No makeup exams will be given.**
A final cumulative exam worth a total of 150 points will be administered on the last day of classes. The exam will consist of 10 comprehensive, open-ended questions that will survey the main take-home points of the previous exams as well as new content that does not appear on Exam 3.

Expected Exam Schedule: Exams are expected to be administered during the following dates (all dates tentative and subject to change with adequate notice).
Exam 1: June 4th – 6th
Exam 2: June 16th – 18th
Exam 3: June 26th – 27th
Final Exam: June 30th

Homework: Weekly homework problems will be assigned from *Chemical Principles 8th Edition* on OWLv2, each worth 10 points. You are responsible for completing all assignments before their respective due dates. Homework assigned through OWLv2 is graded for completion, which means that you will have unlimited attempts to answer each question. Your highest score per attempt is recorded as the final grade for the assignment. **It is essential that you understand the assigned exercises as they help you develop the foundation necessary to succeed on the exams.**

Recitation and Recitation Problem Sets: Meets once a day for 1 hour, with dates and times TBD (based on class survey responses). During recitation, we will (1) review important concepts from lectures, (2) go over problem solving strategies, and (3) facilitate a cooperative learning environment.
Problem sets, worth 10 points each and consisting of 2 – 3 exam-level questions, will be distributed during via Canvas to stimulate a discussion amongst yourself and a small group of your peers during recitations. Problem sets are to be completed and turned in on Canvas by the same day the corresponding homework is due at 11:59 PM (EST). Problems are only graded for correct responses, and thus **only your final answers are required to be turned in**. We can discuss your work during recitation / office hours.

Grading Scheme and Final grades: Your course score is based on the cumulative sum of points acquired through exams, homework, and recitation problem sets. The total breakdown is given below:

Assessment	Total Point Value	% of total grade
Midterm exams (3 midterm exams; 1 drop allowed)	300	41.7%
Final Cumulative Exam	150	20.8%
Homework (12 assignments @ 10 points each)	120	16.7%
Recitation Problem Sets (12 assignments @ 10 points each)	120	16.7%
Regular participation in Piazza	15	2.1%
Class Survey (Due May 26th)	15	2.1%
TOTAL	720	100 %

The following grade cutoffs will be used to assign letter grades. The divisions may be slightly adjusted (to your advantage) such that the final overall mean is guaranteed to lie in the "B" letter grade range

Letter grade	Approximate Course Point Ranges
A	650 - 720
A-	610 - 649
B+	570 - 609
B	535 - 569
B-	500 – 534
C+	470 – 499
C	435 - 469
C-	400 – 434
D	365– 399
F	< 365

Course Outline:

(1) Introduction & Stoichiometry: **Chapters 2, 3, and 4**

Dimensional analysis; Atomic structure; Isotopes, Atomic & Molecular Masses; Nomenclature; The mole; Empirical & Molecular Formulas; Chemical reactions; Calculations involving chemical reactions; Limiting reagents; Percentage Yield; Chemical reactions and calculations involving aqueous solutions – precipitation, acid-base, and redox reactions.

(2) Gases and Energy: **Chapter 5 and Chapter 9 – Section 9.1**

Properties of gases; Definition of pressure; the Absolute and Centigrade temperature scales; Gas laws; Ideal gas equation; Kinetic Molecular Theory; Effusion; Non-ideal gases; Energy

(3) Atomic Theory & Quantum Mechanics: **Chapters 12 & 13 - Section 13.4**

Quantum theory, Bohr atom; Schrödinger wave mechanics, Atomic quantum mechanics of hydrogenic and polyelectronic atoms; Electronic configuration of neutral atoms; Electronic configuration of ions; Periodic

relationships of size (radius) and ionization energies of neutral atoms and of ions. [Electronic configuration and periodic properties of ions are contained in Section 13.4.]

(4) Chemical Bonding & Intermolecular Forces: Chapters 13, 14.1, and 16.1

Periodic relationship of electronegativity; Ionic, Polar covalent, and Covalent Bonding - and the connection with electronegativity difference; Lewis structures; Resonance; Formal Charge; Valence Bond-Hybridization Theory; Polarity, Intermolecular Forces/Hydrogen bonding.

(5) Molecular Quantum Mechanics: Chapter 14 (14.2 – 14.6)

Molecular Orbital Theory; Multiple Bonds; Delocalization; Bond Order; Paramagnetism and Diamagnetism.

(6) Coordination Chemistry: Chapter 19 (19.1, 19.5 – 19.6)

Coordination complexes, Oxidation numbers, Crystal field theory, Optical and Magnetic properties

Note: Due dates of Homework are also correlated with due dates of recitation problem sets!

Date	Subject	Reading	Homework & Exams
May 24th	Chemistry, Math in Science, Dimensional Analysis, States of matter	A1.5, A1.6, A2.1, A2.2	Homework 1
May 25th	Periodic Table, Atomic Structure, Isotopes, Average Atomic Mass, Nomenclature	Chapter 2, Sections 2.5 – 2.9	Homework 1 **Homework 1 Due by 11:59 PM**
May 26th	The Mole, % Composition, Balancing Chemical Equations, Stoichiometry	Chapter 3, Sections 3.1 – 3.9	Homework 2
May 27th	Combustion Analysis, Empirical and Molecular Formulae, Limiting Reagents	Chapter 3, Sections 3.8 – 3.10	Homework 2 **Homework 2 Due by 11:59 PM**
May 28th	Aqueous Chemistry, Solubility, Concentration, Precipitation, Ionic Equations	Chapter 4, Sections 4.1 – 4.8	Homework 3
June 1st	Acids and Bases, Titration, Redox Reactions, Oxidation Numbers, Balancing Redox Reactions	Chapter 4, Sections 4.9 – 4.12	Homework 3 **Homework 3 Due by 11:59 PM**
June 2nd	Ideal Gases, Charles/Boyle/Dalton's Laws	Chapter 5, Sections 5.1 – 5.4	Homework 4
June 3rd	PV = nRT, Density of gases, Stoichiometry	Chapter 5, Sections 5.3 – 5.5	Homework 4 **Homework 4 Due by 11:59 PM**
June 4th	Kinetic Molecular Theory (Derivation), root-mean-square speed, Temperature	Chapter 5, Section 5.6	Homework 5 **Exam 1: Available June 4th – 5th (48 hours)**
June 7th	Maxwell-Boltzmann distributions, Relative Rates of Effusion, Real Gases	Chapter 5, Section 5.6, 5.7, 5.10	Homework 5
June 8th	Energy, Intro to Quantum Mechanics, Wave nature of light	Chapter 9, Section 9.1; Chapter 12, Section 12.1	Homework 5 Note: Concept from 9.1 is needed, not thermochemistry ideas **Homework 5 Due by 11:59 PM**
June 9th	Particle nature of light, Quantization, Photoelectric Effect	Chapter 12, Section 12.2	Homework 6
June 10th	Wave-particle Duality and Bohr Model	Chapter 12, Section 12.2 – 12.4	Homework 6 **Homework 6 Due by 11:59 PM**

June 11th	Quantum Mechanical H-atom	Chapter 12, Sections 12.5, 12.7, 12.8	Homework 7
June 14th	Hydrogenic Orbitals and Sketching Orbitals	Chapter 12, Section 12.8 – 12.9	Homework 7 **Homework 7 Due by 11:59 PM**
June 15th	Particle in a box	Chapter 12, Section 12.6	Homework 8
June 16th	Effective Nuclear Charge, Electron Configurations	Chapter 12, Sections 12.10 – 12.13	Homework 9 **Homework 8 Due by 11:59 PM** **Exam 2: Available June 16th – 17th (48 hours)**
June 17th	Electron Configurations, Modified Bohr Equation	Chapter 12, Sections 12.13 – 12.14	Homework 9
June 18th	Periodic Trends and Chemical Bonding	Chapter 12, Sections 12.13 – 12.15 and Chapter 13, Section 13.4	Homework 9 **Homework 9 Due by 11:59 PM**
June 21st	Lewis structures, Octet Rule, Electronegativity, Bond Polarity	Chapter 13, Sections 13.1 – 13.3, 13.7, 13.9 – 13.10	Homework 10
June 22nd	Formal Charge, Resonance, and Hypervalency	Chapter 13, Sections 13.10 – 13.12	Homework 10 **Homework 10 Due by 11:59 PM**
June 23rd	VSEPR/Hybridization	Chapter 13, Section 13.3 and Chapter 14, Section 14.1	Homework 11
June 24th	Polarity / Intermolecular Forces	Chapter 13, Section 13.3 and Chapter 16, Section 16.1	Homework 11 **Homework 11 Due by 11:59 PM**
June 25th	Molecular Orbital Theory	Chapter 14, Sections 14.2 – 14.6	Homework 12 Part 1 **Homework 12 Part 1 Due by 11:59 PM** **Exam 3: Available June 26th – 27th (48 hours)**
June 28th	Coordination Chemistry (On Final Exam)	Chapter 19, Sections 19.1, 19.5, 19.6	Homework 12 Part 2
June 29th	Cumulative Final Exam	Final Exam: Available for ~48 hours (12:01 AM June 29h – 11:59 PM June 30th)	**Homework 12 Part 2 Due by 11:59 PM**
June 30th	Cumulative Final Exam		**Final Exam Due by 11:59 PM**

Course code of conduct, community, and respect

Community in the UPenn Chemistry Department: One of the goals of the course is to develop a community with a shared appreciation of chemistry, and where everyone has a sense of belonging. This can only happen if **all** members of the course community-- the instructor, TA(s), and students, work together to create a supportive, inclusive environment that welcomes all students, regardless of race, ethnicity, gender identity, sexuality, religious beliefs, physical or mental health status, or socioeconomic status. Diversity, inclusion, and belonging are all core values of this course and of Penn Chemistry. All participants in this course deserve and should expect to be treated with respect by all other members of the community. If you have any concerns in this area or are facing any special issues or challenges, you are encouraged to discuss the matter with me (set up a meeting by email), or with the Chemistry Undergraduate Office or the Undergraduate Biochemistry Program Office (see below).

Inclusion and Diversity: At Penn Chemistry, we value the backgrounds and identities of all students (including but not limited to country of origin, race, class, religion, ethnicity, gender, sexual orientation and identity, and disability status), and are committed to providing an inclusive climate across the Department. If there are elements of your experiences, culture, or identity that you would like to share with me as they relate to your success in this class, I am happy to meet with you to discuss. Likewise, if you have any concerns in this area or are facing any special issues or challenges, you are encouraged to discuss the matter with me (set up a meeting by email) with an assurance of full confidentiality, or with the Chemistry Undergraduate Office or the Undergraduate Biochemistry Program Office (see below). If you want to discuss your background with me and share anything that might help me to help you by adjusting my teaching to your style of learning, please let me know! Again, I am here to help and will do my best to make chemistry learning fun!

Mental Health Resources: The Chemistry Department is here to support you! At Penn Chemistry, we care about the holistic well-being of our undergraduates. While focusing on academics, it is important to attend to your physical and mental health as well. Anxiety and depression are all too common in high-stress environments. If you are concerned about yourself or a friend, please reach out to either the Chemistry Undergraduate Office or the Undergraduate Biochemistry Program (see below) who will direct you to the appropriate resources. If you, or anybody you know, needs mental health care, please refer to the following campus resources: (1) Counseling and Psychological Services, CAPS. 215-898-7021 (off hours and weekends 215-349-5490); (2) Department of Public Safety 215-898-7333, or 511 if imminent danger to themselves or others; (3) Finding Programs for Student Wellness through the VPUL; and (4) Student Health Services.

Formal and Informal Accommodations: The Chemistry Department at Penn is committed to assisting students requiring special accommodations for circumstances that are registered with the Office of Student Disability Services (SDS; https://www.vpul.upenn.edu/lrc/sds/). The University of Pennsylvania provides reasonable accommodations to students with disabilities who have self-identified and been approved by SDS. If you have not yet contacted SDS and would like to request accommodations or have questions, you can call SDS at 215-573-9235. All services are confidential. If you are not formally registered with SDS and experience anxiety, depression, learning disabilities or other issues that affect your ability to fully participate and learn in this class, you are encouraged to check-in with me or with the Chemistry Undergraduate Office or the Undergraduate Biochemistry Program Office (see below) so that we can help you to secure the resources to promote your success.

Contacts for help: For help with any of these issues, please feel free to reach out to me, as well as the Chemistry Undergraduate Office [Professor Jeffrey Winkler, Undergraduate Chair (winkler@upenn.edu) or [Ms. Candice Adams, Undergraduate Coordinator (chemugrad@sas.upenn.edu)] or the Biochemistry Undergraduate Office [Professors Ponzy Lu (ponzy@sas.upenn.edu) and Jeffery Saven (saven@sas.upenn.edu), Co-Chairs Undergraduate Biochemistry Program] or [Ms. Leslie Shinn, Undergraduate Biochemistry Program Coordinator (biochemistry@sas.upenn.edu)] who will direct you to the appropriate resources.

Academic Integrity: Penn's code of academic integrity can be found here**.** Your instructor and TAs consider it an honor to work with some of the best students in the world, and in turn we expect honorable behavior from you. While we encourage you to cooperate with and learn from your classmates in recitation, lecture, office hours, and your own study sessions, all exams must be completed independently. You may use any personal resources you wish (textbooks, notes, internet) on exams but you may not consult with any other person.

Specific examples of academic dishonesty in this course include, but are not limited to:

- Submitting someone else's written work as your own
- Representing yourself to be another person
- Allowing another person to represent you
- Having someone take an exam for you
- Allowing unauthorized persons to access lecture materials or exams
- Communicating with someone else during an exam, other than the instructors
- Receiving information from any person before or during an exam
- Sharing information about exam questions with other students
- Providing a false excuse for missed exams
- Attempting to do any of the above

The consequences of these infractions may range from a grade of "0" on the exam in question to receiving an F in the course. It is our obligation to enforce these rules and report infractions to the Office of Student Conduct.