

# CHEM 1210 – Principles of Chemistry I

## Syllabus

Instructor: Dr. Shawn M. Miller

## Summer Term, 2021

Email: shawn.miller@usu.edu

Office Hours: T/R 12:00 PM – 1:00 PM and by appointment

Location: Online via Zoom – See Course

Communication section for details

## Prerequisite:

One of the following:

- Math ACT score of at least 25 or equivalent SAT Math score
- AP Calculus AB score of 3 or higher
- ALEKS Math score of 76 or higher
- MATH 1050 or higher (may be taken concurrently)

High school chemistry recommended

## Required Materials:

**Calculator:** A non-programmable scientific calculator is recommended for use on Exams. Other electronic devices, including phones, are not permitted during Exams.

**Homework:** Chem101 online homework system. Access is automatic upon paying of course fees, but you will need to create an account for the service. Follow the Chem101 Enrollment instructions document on Canvas under the “Chem101 Access” module.

## Optional Materials:

**Text:** Brown, LeMay, Bursten, Murphy, Woodward, Stoltzfus *Chemistry: The Central Science*, 13<sup>th</sup> ed.; Pearson Education, Inc. (ISBN: 978-0-321-91041-7)  
(earlier editions are fine)

## Course Overview

CHEM 1210 is the first semester in a two-semester series of general chemistry courses that is targeted towards science and engineering students. This section is structured in an online format where presentation of content and practice problems are delivered via recorded lectures that also contain simple reading check questions. There are online Chem101 homework assignment and online Canvas Post-week Quizzes, which are designed to prepare students for the Exams. There are three 90-minute Midterm Exams in addition to a 180-minute Final Exam all of which are administered on Canvas using Proctorio.

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

- ...describe science as a process for discovery.
- ...list key fundamental chemistry theories and principles.
- ...use fundamental chemistry theories and principles to explain or predict a result when presented with a chemistry scenario.
- ...identify and use the appropriate equation(s) and problem-solving tool(s) needed to solve a chemistry problem.
- ...calculate and correctly write scientific values using algebra and other fundamental mathematical skills.

A detailed set of Learning Objectives for each chapter is located at the end of this syllabus.

**You will prepare for and practice achieving these objectives by...**

- ...optionally reading the textbook prior to watching recorded lectures.
- ...watching, taking notes, and answer Reading Check Quiz questions during recorded lectures.
- ...completing Chem101 homework problems online.
- ...taking weekly graded online Canvas Post-week Quizzes.
- ...regularly reviewing your performance on the homework and Post-Week Quizzes.
- ...asking for help via Zoom Office Hours, Piazza, Canvas message, or e-mail.
- ...optionally attending UTF or SI sessions for problem solving and further assistance.

**You will be assessed on how you have achieved these objectives using...**

- ...one Getting Started Quiz on Canvas.
- ...the aforementioned Reading Check questions.
- ...the aforementioned Chem101 homework sets.
- ...the aforementioned Chapter Quizzes on Canvas.
- ...three Midterm Exams.
- ...one Final Exam.

## Course Communication

**Piazza** is the recommended venue for asking academic questions about the course. Piazza is a free online system that can be accessed directly through Canvas and is designed for students to have access to rapid help from classmates and the course instructor simultaneously. **Piazza is not to be used to convey personal information.** Contact the instructor directly if you wish to discuss personal information such as grades.

When a question is posted on Piazza, students and the course instructor can all answer the question. This makes a rapid response more likely compared to emailing one person and hoping they read it soon. Often, a student asks a question another student was going to ask and the second student finds their question already answered on Piazza! Students have the option of posting anonymously to each other, but the instructor will always be able to see user identity. **Enrollment in Piazza is mandatory and five points are assigned to Piazza enrollment. Usage of Piazza during the term is optional.** Enroll in the course by clicking on the “Piazza” link in the sidebar on Canvas and following the instructions there. The deadline for enrollment is 11:59 PM on the Wednesday of Week 1 of the term.

Due to how Piazza licenses its product, this term a “contribution-supported” license is used to keep the service free. Piazza will prompt users provide a financial contribution if they find the experience valuable. **Students are under no obligation to provide monetary support to Piazza and may use the service for free throughout the course by ignoring the donation prompts.**

Students are always welcome to message the instructor directly with questions. Canvas messages are preferred, but email is fine as well. When using email, please include a full name, A-Number, and the course name in the message. The course instructor teaches several courses each term and cannot answer questions if they do not know what course the questions correspond to. The instructor will attempt to respond to messages in a timely manner, but the instructor has responsibilities outside of the course that may prevent the instructor from doing so and asks student to exercise patience after sending your message.

The instructor will hold regular online office hours via Zoom and sessions can be accessed via the link in the Canvas course sidebar. Regular Office Hours will start on Thursday of Week 1 of this term.

Course announcements are made using the Canvas Announcements system. You are expected to keep up-to-date on all Canvas Announcements and are responsible for any information in the Announcements. “But I did not know” is not an acceptable excuse for being unaware of information in course Announcements.

## Getting started in the course

Read the course syllabus. Once that is done, the first assessment is a “Getting Started” quiz administered through Canvas that covers course policy as discussed in the course syllabus. This Quiz is due at 11:59 PM on the Wednesday of Week 1 of the term. The Getting Started quiz is graded immediately upon completion and may be attempted an unlimited number of times. Correct answers will not be shown upon completion of the Getting Started Quiz, but students will be able to view their responses. If multiple attempts are made, the **highest** score is accepted. **If no score is present in a student’s Grades, no attempt was submitted.** The Getting Started Quiz score cannot be dropped and cannot be made-up.

USU welcomes students with disabilities. If you have, or suspect you may have, a physical, mental health, or learning disability that may require accommodations in this course, please contact the

Disability Resource Center (DRC) as early in the semester as possible (University Inn #101, 435-797-2444, [drc@usu.edu](mailto:drc@usu.edu)). All disability related accommodations must be approved by the DRC. Once approved, the DRC will coordinate with faculty to provide accommodations.

## Lectures

Students with access to the optional textbook are strongly encouraged to read the relevant sections prior to watching the recorded lectures. Students are not expected to understand the material simply by reading the textbook but reading the text will build a foundation that is expanded and refined through the recorded lectures. Blank lecture PowerPoint slides are available on Canvas and can be printed. The online format of this course allows for some flexibility for when students watch recorded lectures. The danger of this flexibility is falling behind and trying to cram weeks' worth of material before an Exam. **Students are strongly encouraged to create and keep to a regular schedule to watch the recorded lectures and not fall behind on material.**

Recorded lectures will have a "Reading Check" question embedded in them. Reading Check questions are designed to be simple, and students may attempt them only once. At the end of the term, correctly answering Reading Check questions are worth 50 points. These points are awarded based on the **percentage** of Reading Check questions answered correctly. To provide some flexibility, only 80% of Reading Check questions must be answered correctly to earn the full 50 points. For example, if there are 100 Reading Check Questions, then answering 80 or more correctly will earn 50 points. Answer 40 Reading Check Questions correctly (50% of 80 questions) will earn 25 points (50% of 50 points). Reading Check questions are due at 11:59 PM two days after the final recorded lecture for the chapter section they are associated with is scheduled.

## Chem101

Chem101 is an online homework service used this term. Access is automatic upon paying of course fees, but you will need to create an account for the service. Follow the Chem101 Enrollment instructions document on Canvas in the "Chem101 Access" module. **You must access Chem101 through the Canvas link.** Each chapter section will have a Chem101 homework assignment that is worth 5 points. These assignments are designed to provide additional practice to help you prepare for the quizzes and exams. The assignments will typically be due at 11:59 PM two days after the chapter section is completed in Lecture. The lowest 2 homework assignment scores are dropped at the end of the course.

## Quizzes

An end-of-Chapter Quiz is assigned for each chapter section covered in the course. The Quizzes will typically close at 11:59 PM two days after the final recorded lecture for the chapter section they are associated with is scheduled. Check Canvas for specific due dates. Chapter Quizzes will be worth 20 points. You will have 60 minutes to complete the Chapter Quiz and you may use your textbook and notes, but you must work alone. You should treat Post-Chapter Quizzes as practice for the Exam in terms of both format and content and it is strongly recommended that you do not use external resources on your first Quiz attempt so as to more accurately gauge your understanding of the material. You may take each Post-Chapter Quiz twice to account for any technical difficulties you encounter such as losing power or logging out accidentally. The **highest** score will be accepted. Discussion of Quiz details with other students while the Quiz is open is a violation of USU's academic

integrity policy as detailed below. The lowest two Post-Chapter Quiz scores will be dropped at the end of the course.

### **Examinations**

There will be three 90-minute midterm Exams, worth 100 points each, administered on Canvas via Proctorio according to the following schedule:

First Exam:	Monday, May 24 to Wednesday, May 26
Second Exam:	Friday, June 4 to Sunday, June 6
Third Exam:	Tuesday, June 15 to Thursday, June 17

These Examinations will consist of 25 questions worth 4 points each. Question formats may include, but are not limited to, multiple choice, multiple answer, matching, short essay, and fill-in (dropdown and text). Students must complete Exams alone. As Exams are open over multiple days, discussion of Exam details with other students while the Exam is open is a violation of USU's academic integrity policy as detailed below.

Make-up Exams for missed Exams may be granted upon petitioning the instructor only in the following situations: 1) documented and acceptable excuses for illness when verified by a doctor's note; 2) a family emergency when verified by a note from your academic advisor; 3) a regularly scheduled university-sanctioned conflict, such as a sports competition the student is participating in, but only when the instructor is notified well in advance of the conflict and verified with a note from the person in charge of the activity containing the specific reasons for the absence. Absences due to reasons not considered by the university to be excused absences, such as weddings, are not eligible for make-up Exams.

The only student materials permitted during Exams are writing utensils, calculators, scratch paper, and Useful Information Sheets. To enforce a standard set of exam conditions, a service called Proctorio is used to administer all Exams. Information on how to install and use Proctorio can be found through this link: <https://cidi.usu.edu/student-support-resources/proctorio-overview>. Proctorio requires the use of a camera and microphone, which many modern laptops come built with, and a reliable Internet connection. **If personal circumstances preclude using Proctorio, please contact the instructor directly.** There is an ungraded Quiz on Canvas called "Proctorio Test Quiz" in the "Logistical Assignments and Extra Credit" module that can be used to test the ability to use Proctorio.

A 180-minute cumulative Final Examination will be administered on Canvas via Proctorio from Thursday, June 24 to Saturday, June 26.

### **Academic Integrity**

All Utah State University academic integrity policies are strictly enforced. All students at Utah State University agree to be bound by the following Honor Pledge "I pledge, on my honor, to conduct myself with the foremost level of academic integrity." See the following for further information: <https://studentconduct.usu.edu/studentcode/article5>. Students found guilty of academic misconduct on any assignment will, **at minimum, be given a zero for the assignment and have the full value of that assignment deducted from their final course grade.** Actions up to and including a failing grade for the course are options available to the instructor.

## Course Assessment

After the first Exam, the instructor will solicit feedback through optional midterm evaluations on Canvas. The purpose of these surveys will be to determine student opinions of the course up to that point and ask for suggestions on what could be done to improve the course for the rest of the term and in subsequent terms. The instructor will know who completed the survey, but will be unable to match survey responses to students. Each student who responds to the midterm evaluation will be granted a small quantity of extra credit points. At the end of the course, end-of-term IDEA evaluations administered through University will be sent to students via email. The instructor will know who completed the survey, but will be unable to match survey responses to students. Each student who responds to the end-of-term evaluation will be granted a small quantity of extra credit points.

A Pre-test/Post-test approach will be used to measure comprehension and teaching of important concepts. The Pre-test will be administered online through Canvas. The Pre-test will be comprised of 20 questions with a duration of 90 minutes. The questions of the Pre-test will reappear in the Final Exam, in some form, to assess teaching and learning progress during the semester. If weaknesses are observed in specific subject areas, teaching methods will be reevaluated. An all-or-nothing 10-point reward will be given for completing the Pre-test. The Pre-test is due at 11:59 PM on the Tuesday of Week 1 of the term.

## Grading

The total score for each type of assignment represent totals after appropriate lowest scores have been dropped.

Getting Started Quiz	20	Percentage of Points Earned	Grade
Piazza Enrollment	5	93-100	A
Pre-test	10	88-92	A-
Reading Check Questions	50	85-88	B+
Chem101 Homework	50	81-84	B
Chapter Quizzes	200	77-80	B-
First Exam	100	73-77	C+
Second Exam	100	66-72	C
Third Exam	100	60-65	C-
Final Exam	200	56-59	D+
Total points	835	50-55	D
		< 50	F

Letter grades are assigned by taking the total numerical score, rounding to the nearest whole number, finding the percentage of total points earned, and then assigning a letter grade according to the table above. A grade of 93 or higher is guarantee an "A". The grade thresholds may be lowered depending on course performance, but it will never be increased. The administration of CHEM 1210, including the issuing of grades of Incomplete, will adhere to the outlines in the USU General Catalog.

## Summer 2021 Schedule

**Please look carefully at the following schedule for the correct order of Lectures. This schedule is approximate and may adjust depending on course pace.**

**Purple text** denotes days set aside for studying for and/or taking Exams and have no assigned lectures. **Blue text** denotes school holidays and have no assigned lectures.

Week	Day	Date	Topics	Chapter	Assignment Due
1	M	5/10	Course intro, Matter, Classifying Matter	1	
	T	5/11	Properties of Matter, Measurements, Numerical Uncertainty	1	
	W	5/12	Calculating with Uncertainty, Dimensional Analysis, Atomic Theory	1/2	Getting Started Quiz/ Pre-Test
	R	5/13	More Atomic Theory, Atomic Characteristics, Molecules Intro	2	
	F	5/14	Ions Intro, Ionic Compounds, and Ionic and Acid Nomenclature	2	Chapter 1 Quiz/HW
2	M	5/17	Molecular/Organic Nomenclature, Chemical Reaction Balancing/Types	2/3	
	T	5/18	Mole, Molar Mass, Stoichiometry Limiting Reactants	3	
	W	5/19	Theoretical Yield, Solution Fundamentals, Electrolytes, Solubility	3/4	Chapter 2 Quiz/HW
	R	5/20	Net Ionic Equations, Acids and Bases	4	
	F	5/21	Redox Reactions, Solution Concentration, Dilutions	4	Chapter 3 Quiz/HW
3	M	5/24	<b>First Exam (Ch 1–4)</b>		Chapter 4 Quiz/HW
	T	5/25	Energy, First Law, Enthalpy	5	
	W	5/26	Enthalpy of Formation, Calorimetry	5	
	R	5/27	Hess' Law, Standard Enthalpies, Radiant Energy and Quantum Theory	5/6	
	F	5/28	Bohr Model, Particle-Wave Duality, Atomic Orbitals	6	
4	M	5/31	<b>Memorial Day (No Classes)</b>		
	T	6/1	Many Electron Systems, Electron Configurations, Orbital Diagrams	6	Chapter 5 Quiz/HW
	W	6/2	Effective Nuclear Charge, Atomic and Ionic Sizes, Ionization Energy	7	
	R	6/3	Electron Affinity, Metal and Nonmetal Properties	7	Chapter 6 Quiz/HW
	F	6/4	<b>Second Exam (Ch 5–7)</b>		
5	M	6/7	Lewis Dot Symbols, Ionic and Covalent Bonding, Bond Polarity	8	Chapter 7 Quiz/HW
	T	6/8	Lewis Structures, Formal Charges	8	
	W	6/9	Resonance Structures, Breaking Octet Rule, Molecule Shape Intro	8/9	
	R	6/10	VSEPR Theory, Molecular Polarity, Valence Bond Theory	9	
	F	6/11	Hybrid Orbitals, Multiple Bonds	9	Chapter 8 Quiz/HW
6	M	6/14	Molecular Orbitals	9	
	T	6/15	<b>Third Exam (Ch 8–9)</b>		
	W	6/16	Pressure, Gas Laws, Ideal Gas Equation, Gas Stoichiometry	10	Chapter 9 Quiz/HW
	R	6/17	Partial Pressures, Kinetic Molecular Theory, Particle Speed	10	
	F	6/18	Intermolecular Forces	11/12	
7	M	6/21	Heating Curves, Vapor Pressure, Boiling, Phase Diagrams, Solid Unit Cells	11/12	Chapter 10 Quiz/HW
	T	6/22	Solids Packing, Solution Descriptions, Solubility	12/13	
	W	6/23	Concentration, Colligative Properties	13	
	R	6/24	<b>Final Exam (Cumulative)</b>		Chapter 11/12 Quiz/HW
	F	6/25	<b>Final Exam (Cumulative)</b>		Chapter 13 Quiz/HW

## Chapter Learning Objectives

**Chapt 1:** Define matter and classify it from the level of mixtures and compounds to elements

Differentiate physical and chemical properties and changes and intensive and extensive properties.

List and define the base SI units of mass, length, time, temperature and amount of a substance, and manipulate the base units to give derived SI units

Use the principles of dimensional analysis and conversion factors to convert quantities expressed in one unit to another unit.

Express numbers in different units by using the prefix and exponential notation methods.

Explain the difference between precision and accuracy, and relate these terms to the concept and usage of significant figures in experimental measurements.

**Chapt 2:** Explain the atomic theory of matter, emphasizing the composition of the atom, and what defines the identity of a given element.

Explain the relative sizes, masses, and charges of the proton, neutron, and electron, and how they assemble to form an atom.

Define the term isotope, and be able to discern the subatomic composition of an atom given its atomic and mass numbers. Represent the atom using the element symbol with superscript and subscript denoting the composition.

Use the Periodic Table to rationalize similarities and differences of elements, including physical and chemical properties and reactivity. Predict common ion charges of group 1A, 2A, 3A, 6A, and 7A elements based on position in the periodic table.

Name and predict ions formed from the elements, and recognize and be able to name common polyatomic cations and anions.

Differentiate between ionic and molecular compounds, and empirical and molecular formulas

Given the chemical formula for an ionic compound or molecule, provide a proper unambiguous systematic name for the compound. Conversely, given the compound name, write the single chemical formula that matches the name.

**Chapt 3:** Given the reactants and products for a chemical equation, balance the equation using whole number coefficients.

Recognize the following common chemical reactions: combustion, decomposition, combination.

Given the atomic weights and relative abundances of naturally occurring isotopes, calculate the average atomic weight of an element.



Use average atomic weights from the Periodic Table to calculate formula weights and molecular weights for compounds.

Use the concepts of the mol, molar mass and Avogadro's number and conversion factors derived from their relationships to interconvert between mass, mols, and numbers of particles for atoms and molecules.

Explain the basis for the "mass defect" seen when an experimentally determined molar mass for an atom is compared to the sums of the masses of the subatomic particles in that atom.

Use the stoichiometric relationships between atoms in molecules, and the stoichiometric coefficients on reactants and products in chemical reactions, to interconvert between numbers of particles, mols, and masses within compounds and for chemical changes.

Given the molar mass of an unknown compound and its elemental composition in mass percent, determine the empirical and molecular formulas for the compound.

Given a chemical reaction and masses of reactants, determine the limiting reagent if the reaction goes to completion, and calculate the masses of products formed and excess reagent remaining at the conclusion of the reaction.

**Chapt 4:** Understand solution composition and the terms solvent and solute

Differentiate between weak and strong electrolytes and nonelectrolytes

Define and differentiate strong and weak acids and bases

Define "solubility" and "miscibility" and understand the factors that make a solute soluble in water

Define and write representative equations for aqueous reactions involving neutralization, precipitation, gas generation, and oxidation/reduction.

Define and write representative equations for molecular equations, complete ionic equations, net ionic equations.

Recognize spectator ions in aqueous reactions

Define solution concentration in units of molarity and use dimensional analysis to interconvert molarity, mass, mols, and volume.

**Chapt 5:** Define energy in terms of work and radiation (heat), and differentiate the following types of energy and the terms that relate to it: kinetic, potential, thermal, chemical energy; conservation of mass, system and surroundings, state function

Describe energies, energy changes and associated signs referenced relative to the system of interest  
Define enthalpy and exothermic and endothermic reactions

Determine the enthalpy for a reaction given information from a standard table of enthalpies of formation or using specific heat and calorimetry data

Apply Hess' law to determine enthalpies of reaction

**Chapt 6:** Describe the properties of electromagnetic radiation, and use the appropriate equations that interrelate energy, frequency, wavelength, Planck's constant, and the speed of light

Explain the concept of "photons" and "quanta" and the dual nature of radiant energy

Explain the Bohr model of the hydrogen atom and use the Rydberg equation to determine the energies associated with electronic transitions

Explain the dual nature of matter (wave and particle).

Explain how the Heisenberg uncertainty principle and Schrodinger models relate to electronic structure

Describe electronic structure in terms of orbitals, with associated quantum numbers  $n$ ,  $l$ ,  $m_l$ , and  $m_s$  and how these quantum numbers relate to the energies, shapes, orientations, and spins of electrons in atoms

Use the above principles of quantum chemistry together with the Pauli exclusion principle and Hund's rule to predict the electronic configurations of multielectron atoms

**Chapt 7:** Predict periodic properties, including relative sizes of atoms, ionization energies, and electron affinities using the principles outlined in class

**Chapt 8:** Understand and describe chemical bonding at the level presented in class, with particular emphasis on understanding and applying the following terms/concepts: Lewis symbols and atoms, Ionic bonding, Lattice energy, isoelectronic series, covalent bonding, electronegativity and bond polarity, Lewis structures, formal charges, resonance, octet violations, bond strengths, oxidation numbers

**Chapt 9:** Apply valence shell electron pair repulsion theory to properly-drawn Lewis structures to predict bond angles and geometries about atoms in molecules

Use valence bond theory to describe covalent bonding in terms of orbital overlaps and hybridizations

**Chapt 10:** Describe the properties of a gas in terms of the variables  $P$ ,  $V$ ,  $n$ , and  $T$

Use the Ideal gas law to interconvert between  $P$ ,  $V$ ,  $n$ , and  $T$  for a gas

Understand and explain Kinetic-molecular theory

Explain the factors that lead to non-ideal behavior for a gas

**Chapt 11:** Understand and identify the intermolecular forces important in different solids and liquids Describe the processes by which states of matter are changed

Define vapor pressure and boiling point

Interpret heating curves and phase diagrams for a compound

**Chapt 13:** Understand the solution process in terms of thermodynamics

Explain the factors that affect solubility of a solute

Understand and explain the different colligative properties and use the proper mathematical equations to quantitatively describe these effects