

# CHEM 1210 – Principles of Chemistry I

## Syllabus

Instructor: Dr. Shawn M. Miller

## Spring Term, 2022

Email: shawn.miller@usu.edu

Office Hours: Monday/Wednesday

9:15 AM – 10:15 AM in Widtsoe 339 or by  
scheduled appointment

## Course Lecture Times & Locations:

Section (CRN)	Time	Day	Location
Lecture 001 (10432)	10:30 AM to 11:20 PM	M/W/F	LSB 133
	N/A	R	Online

## 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)

## Supplementary Course Assistance:

SI Information: Alex Hill (contact: A02278175@aggies.usu.edu or Canvas)  
Session Times: TBA

UTF Information: Kaden Christensen (contact: A02142745@usu.edu or Canvas)  
Session Times: TBA

## **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. In-person lectures will be held three times a week and will include both presentation of content and practice problems. Additionally, there will be an online fourth “lecture” contact hour each week scheduled for Thursdays where students will watch recorded lectures outside of the lecture room. There will be assigned online Chem101 homework sets for each chapter. There will be an online Post-Week Quiz on Canvas at the end of most weeks designed to help prepare students for the Exams. There will be four 90-minute Midterm Exams in addition to a 180-minute Final exam all of which will be proctored through Canvas via the Testing Center.

### **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 optional textbook prior to attending in-person lectures/watching recorded lectures.
- ...taking notes and working through practice problems when attending in-person lecture periods and when watching recorded lectures.
- ...completing online Chem101 homework problems.
- ...taking weekly graded online Canvas Post-week Quizzes.
- ...regularly reviewing your performance on the homework and Post-Week Quizzes.
- ...asking for help via Office Hours, Piazza, Canvas message, or e-mail.
- ...optionally attending UTF or SI sessions for problem solving and other course assistance.

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

- ...one Getting Started Quiz on Canvas.
- ...the aforementioned Chem101 homework sets.
- ...the aforementioned Post-week Quizzes on Canvas.
- ...four 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 designed for students to have access to rapid and efficient help from classmates, the course teaching team (UTF and SI), and the instructor simultaneously. **Piazza is not to be used to convey personal information.** Contact the instructor directly if you need to discuss personal information such as grades.

When you post a question on Piazza, the instructor, the UTF, the SI, and your fellow students can all answer the question making it more likely for you to receive a rapid response compared to emailing one person and hoping they read it soon. Maybe someone will have already asked the question you were going to ask and got it answered! You have the option of posting anonymously to each other, but the instructor will always be able to see your identity. **Enrollment in Piazza is mandatory, and five points are assigned to Piazza enrollment.** Usage during the semester is optional. Enroll in the course by clicking on the “Piazza” link in the sidebar on Canvas and following the instructions there.

Due to changes in 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 the course name in the message and a full name and A-Number in the message body. 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 holds in-person Office Hours based on the schedule on the first page of this syllabus. Office Hours do not require reservations so just come in and ask questions! Separate appointments may be possible upon request. Regular Office Hours will first be held during Week 2 of the semester.

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 Friday 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 in present the “Grades” section of Canvas, 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**

CHEM 1210 is a four-credit class, meaning there are four “50 minute” contact hours per week. Three of these contact hours are the MWF in-person lectures. The fourth weekly contact hour are out of class, on-line lectures to be watched on the Thursdays indicated on the syllabus. If students have access to the optional textbook, it can be helpful to read the textbook, as outlined in the schedule at the end of this syllabus, prior to lecture. Taking notes while reading the textbook can help create a foundation that can be built upon with lecture discussions. PDF copies of blank lecture PowerPoint slides will be available on Canvas that can be printed ahead of each lecture if you wish. Each in-person lecture will be recorded and available on Canvas for viewing at your pleasure.

## **iClicker Questions**

iClicker questions will be asked during in-person Lecture periods and will be used to assess class understanding of topics by providing immediate feedback to both the instructor and you. These questions must be answered individually, but students may consult their notes and discuss the questions with one another. It is the student’s responsibility to register their iClicker either through the iClicker service on Canvas or at [iclicker.com](http://iclicker.com) and to remember to bring their iClicker, in working order, to class each day. iClicker performance will be recorded starting with the second lecture period.

Students may earn up to 10 points extra credit via iClicker questions. 5 of those points are allocated to participating in iClicker questions and the remaining 5 points are allocated to answering iClicker questions correctly. The amount of extra credit awarded for participation will be based on the percentage of iClicker questions answered by each student based on 90% of the total number of questions asked. The amount of extra credit awarded for answering questions correctly will be based on the percentage of correct answers to iClicker questions based on 90% of the total number of questions asked. For example, if a student answers 45 questions and there were 100 questions asked during the term, the student earns 50% (45/90) of 5 points (2.5 points).

## **Chem101 Online Homework**

There are 12 online homework sets administered through Chem101. 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.

## **Post-week Quizzes**

A Post-week Quiz is assigned following most weeks this term. The Quizzes will open at 12:00 PM each Friday and close at 11:59 PM the following Monday. Holidays and other events may affect open dates and due dates so check Canvas for specific dates. Individual Post-week Quizzes are worth 20 points. Students have 60 minutes to complete each Post-week Quiz. Students may use their textbook and notes but must work alone. Students should treat Post-week Quizzes as practice for the Exam in terms of both format and content and it is strongly recommended that students do not use external resources on their first Quiz attempt to gauge their understanding of the material more accurately. Students may take each Post-week Quiz twice to account for technical difficulties. The **highest** score is 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 Post-week Quiz score is dropped at the end of the course.

## **Examinations**

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

First Exam:	Thursday, February 3 to Friday, February 4
Second Exam:	Tuesday, February 22 to Wednesday, February 23
Third Exam:	Thursday, March 17 to Friday, March 18
Fourth Exam:	Thursday, April 7 to Friday, April 8

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. The lowest Midterm Exam score is dropped at the end of the course.

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 in the Testing Center are writing utensils, calculators (scientific preferred, graphing only if the Testing Center clears the memory), scratch paper, and Useful Information Sheets. The Testing Center will provide laptops and authorized auxiliary materials (Useful Information Sheets) as well as scratch paper upon request. Notes, textbooks, internet resources, etc. are not permitted during Exams. Reservations for the Testing Center are made through their website at <http://testing.usu.edu/>. Students must bring a form of ID with them to Check-in for their Testing Center appointment.

A 180-minute cumulative Final Examination will be held in the Testing Center on from Wednesday, April 27 to Saturday, April 30.

### **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 is used to measure comprehension of important concepts. The Pre-test is administered online through Canvas. The Pre-test is 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 is given for completing the Pre-test. The Pre-test is due at 11:59 PM on the Friday of Week 1 of the term.

## **Grading**

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

Getting Started Quiz	20
Piazza Enrollment	5
Pre-test	10
Chem101 Homework	50
Chapter Quizzes	200
Midterm Exams	300
Final Exam	200
<hr/> Total points	<hr/> 785

Percentage of Points Earned	Grade
93-100	A
88-92	A-
85-88	B+
81-84	B
77-80	B-
73-77	C+
66-72	C
60-65	C-
56-59	D+
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.

## Spring 2022 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.

**Orange text** denotes Thursdays that have assigned online recorded lectures.

Week	Day	Date	Lecture #	Topic	Chapter	Assignments Due
1	M	1/10	1	course introduction	1	
	W	1/12	2	matter overview, properties of matter	1	
	R	1/13	3	SI units and derived units	1	
	F	1/14	4	significant figures and calculating with uncertainty	1	GS Quiz/Pre-test
2	M	1/17		<b>Martin Luther King, Jr. Day – No Lectures</b>		P-Quiz 1 (Tues.)
	W	1/19	5	dimensional analysis, atom introduction	1/2	
	R	1/20	6	the nucleus, atomic structure, atomic weight	2	
3	F	1/21	7	molecules introduction, ions and ionic compounds	2	
	M	1/24	8	ionic compound, acid, inorganic, and organic nomenclature	2	P-Quiz 2
	W	1/26	9	reactions introduction, balancing equations	3	
	R	1/27	10	formula weight, the mole	3	
4	F	1/28	11	reaction stoichiometry	3	
	M	1/31	12	limiting reactants, theoretical and percent yield	3	P-Quiz 3
	W	2/2		Exam 1 catch-up/review		
	R	2/3		<b>First Exam (Ch 1–3) 2/3 to 2/4 – No online lectures</b>		
5	F	2/4	13	solutions introduction, electrolytes, solubility	4	
	M	2/7	14	precipitation, metathesis reactions, net ionic equations	4	
	W	2/9	15	acids and bases, neutralization reactions, oxidation numbers, redox reactions	4	
	R	2/10	16	solution concentration, dilutions	4	
6	F	2/11	17	energy fundamentals, enthalpy introduction	4	
	M	2/14	18	enthalpies of reaction, heat capacity	5	P-Quiz 4
	W	2/16	19	calorimetry, Hess' Law	5	
	R	2/17	20	standard enthalpies of formation	5	
7	F	2/18		Exam 2 catch-up/review	5	
	M	2/21		<b>Presidents' Day – No Lectures</b>		P-Quiz 5 (Tues.)
	W	2/23		<b>Second Exam (Ch 4–5) 2/22 to 2/23 – No in-person Lecture</b>		
	R	2/24	21	electromagnetic radiation introduction	6	
8	F	2/25	22	quantum theory, Borh model	6	
	M	2/28	23	particle-wave duality, atomic orbitals	6	P-Quiz 6
	W	3/2	24	multit-electron atoms, electron configurations	6	
	R	3/3	25	effective nuclear charge, atom size, ionization energy	7	
9	F	3/4	26	electron affinity, ion electron configurations	7	
	M	3/7		<b>Spring Break – No Lectures</b>		
	W	3/9				
	R	3/10				
F	3/11					
10	M	3/14	27	metal and nonmetal properties	7	
	W	3/16		Third Exam catch-up/review		
	R	3/17		<b>Third Exam (Ch 6–7) 3/17 to 3/18 – No online lectures</b>		
	F	3/18	28	Lewis Dot symbols, ionic bonds, lattice energy	8	
11	M	3/21	29	covalent bonds, bond polarity	8	P-Quiz 7
	W	3/23	30	Lewis structures	8	
	R	3/24	31	formal charge, resonance structures	8	
	F	3/25	32	octet violations, bond energies	8	
12	M	3/28	33	molecular shape introduction, VSEPR Theory	9	P-Quiz 8
	W	3/30	34	molecular geometry, molecular polarity	9	
	R	3/31	35	valence bond theory, hybrid orbitals	9	
	F	4/1	36	multiple bonds, molecular orbitals introduction	9	
13	M	4/4	37	molecular orbital diagrams and consequences	9	P-Quiz 9
	W	4/6		Fourth Exam catch-up/review		
	R	4/7		<b>Fourth Exam (Ch 8–9) 4/7 to 4/8 – No online lectures</b>		
	F	4/8	38	pressure fundamentals, gas laws	10	
14	M	4/11	39	ideal gas equation, ideal gas relationships	10	
	W	4/13	40	gas stoichiometry, partial pressures	10	
	R	4/14	41	kinetic molecular theory of gases, particle speed, effusion and diffusion	10	
	F	4/15	42	intermolecular forces	11 and 12	
15	M	4/18	43	heating curves, vapor pressure	11 and 12	P-Quiz 10
	W	4/20	44	phase diagrams, unit cells, metal atom packing	11 and 12	
	R	4/21	45	solutions introduction, saturation, solubility, units of concentration	13	
	F	4/22	46	colligative properties	13	
16	M	4/25		Final Exam review/catch-up		P-Quiz 11
	W	4/27		<b>Interim Day – No Lectures</b>		
		4/27-4/30		<b>Final Exam (cumulative) 4/27 to 4/30</b>		

## 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