# CHEM 160: Chemical Structure and Properties

The purpose of this syllabus is to help all students understand the expectations and requirements for the course, and it should be used as a reference for questions about policies. When updates to the syllabus are made during the term, a new version will be posted electronically, and all students will be notified.

## Course Information

**Course:** Chemistry 160 – Chemical Structure and Properties (3 credits: Lecture & Discussion)
**Prerequisites:** Completion of MATH 117 or the equivalent. A student missing a co- or prerequisite may be withdrawn at any time.
**Time Zone:** This syllabus lists dates/times using Chicago local time (U.S. Central Time Zone)
**Lectures:** Section 025, MWF 1:40-2:30, Flanner Hall (FH) Auditorium/133
**Discussions:** You must attend the section for which you registered:

- Section 026: T, 10-10:50 am, Mundelein Center 406
- Section 027: T, 1:00-1:50 pm, FH 105

**LOCUS Course Description & Outcomes:** Lecture and discussion course designed to create foundational knowledge and proficiency in essential chemistry concepts and skills. Topics include atomic structure, periodic properties, bonding and properties of molecules, solid states, interactions and connections of light and matter, quantum and molecular mechanics models of atoms and molecules.
**Course Coordinator:** Dr. Amy Balija abalija@luc.edu
Chemistry 160 is a multi-section lecture & discussion course with common content and common outcomes across all sections. This course includes a Common Final Exam held during the Common Final Exam Period as scheduled by the University. The Course Coordinator consults and coordinates with Section Instructors regarding policies, exam writing, and grading. Your Section Instructor is responsible for communicating with you regarding all course content and policies and is the first and primary person to contact with questions about all aspects of the course. As needed, Section Instructors will consult with the Course Coordinator throughout the semester.

## Instructor Information

| | |
|---|---|
| **Section Instructors:** Amy M. Balija, Ph.D. | Bailey J. Hanson |
| **Office:** FH 104 (Dr. Balija) and FH 314A (Professor Hanson) | |
| **Email Policy:** Direct all emails to abalija@luc.edu and bhanson2@luc.edu with "CHEM 160-025" as the subject line. Send emails from your Loyola email account. Doing this will ensure that your emails are read, and in most cases, we will be able to respond within 48 hours Monday-Friday when classes are in session. You are encouraged to use Office Hours to get immediate answers to your questions, and to use your classmates as resources for help. You are welcome to email us in the evenings/nighttime, and you can expect a response sometime during the next two days. | |
| **Office Hours Policy:** Dr. Balija: You are welcome to stop by at any time to see if my door is open. Occasional extra hours may be announced in class.<br>Professor Hanson: Please email me to schedule an office hours appointment outside of what is listed for additional help or class related questions! For ease of scheduling, please include your next 96 hours of availability in your initial email request. | |
| **Office Hours Schedule:** **Dr. Balija**<br>Tuesday 11:15am-12:30pm, STEM Center in St. Joseph's Hall<br>Wednesday 11:15am-12:15 pm, STEM Center in St. Joseph's Hall<br>Thursday 8-9pm, Zoom (https://luc.zoom.us/j/87234064892)<br>By Appointment<br><br>**Professor Hanson**<br>Monday 4-5 pm, STEM Center in St. Joseph's Hall<br>Wednesday 10am-11 am, STEM Center in St. Joseph's Hall<br>Thursday 1-2 pm, STEM Center in St. Joseph's Hall<br>By Appointment | |

**SI Information**
There are Supplemental Instruction (SI) study sessions available for this course. SI sessions are led by an SI leader, Aaron Origenes, who is a student that has recently excelled in the course. Session attendance is open to all, and while it is voluntary, it is extremely beneficial for those who attend weekly. Times and locations for the SI session can be found here: www.luc.edu/tutoring. Students who attend these interactive sessions find themselves working with peers as they compare notes, demonstrate, and discuss pertinent problems and concepts, and share study and test-taking strategies. Research shows students who regularly attend sessions have higher grades at the end-of-the-semester and more deeply understand course concepts than those who do not. Students are asked to arrive with their Loyola ID number, lecture notes, and textbook.

## Required Course Materials

- Textbook: OpenStax Chemistry, Atoms First 2e. Web-only, digital, or printed version. https://openstax.org/details/books/chemistry-atoms-first-2e?Book%20details
- Textbook: OpenStax Organic Chemistry, A Tenth Edition, Web-only. https://openstax.org/details/books/organic-chemistry
- ALEKS: (https://www.aleks.com/) Class Code: **TPU9P-F4GLF**
- Molecular Model Kit (Duluth Labs MM-005 or equivalent)
- Scientific Calculator (non-programmable, non-graphing, and independent of another device such as a phone or tablet)
- Loyola Sakai course management site: sakai.luc.edu/portal/ and tools integrated into the site.
- Loyola email: messages are sent to the entire class via Sakai, linked to your Loyola email account.
- Additional web-based systems will be used for uploading your work and facilitating feedback and evaluation. Registration will be free but required. These may include Gradescope and other sites.
- Additional software may be used. These may include applications that convert photos to PDFs (examples: CamScanner, Scannable, GeniusScan, Adobe Scan), and collaboration materials for group work (example: OneNote).

**Copyright/Intellectual Property reminder**
Course materials provided by your instructors at Loyola, including my materials, may not be shared outside any course without the instructor's written permission. Content posted without permission will be in violation of Copyright/Intellectual Property laws. Class meetings may not be recorded without the instructor's written permission.

## Learning

Learning will be assessed as described in the Grading System information found later in this syllabus.

**Description:** This course is the first in a sequence of multiple chemistry courses designed to create foundational knowledge and proficiency in essential chemistry concepts and skills. It includes the following topics: atomic structure, periodic properties, characteristics of bonding and properties of molecules, solid states, interactions and connections of light and matter, quantum and molecular mechanics models of atoms and molecules. Historical and current developments in chemistry as well as real-world problems that chemists address are incorporated into the course.

Alongside specific content, these themes will cycle through each of the foundational courses. They include:

- Structure-activity relationships
- The culture and practice of science
- Energy
- Polymers, proteins, and macromolecules
- Sustainability
- Chemical synthesis, purification, characterization, and analysis

**Outcomes:** The emphasis of this course is on understanding, prediction, investigation, explanation, and evaluation over memorization. This means that students must foster their problem-solving skills, ability to make claims based on evidence, use and understanding of models and their limitations, and skills of effective communication of scientific results. It is not enough to know *what* happens in chemistry; the student must also be able to explain *why* it happens. When successful, a student will be able to:

- Differentiate types of matter based on their chemical and physical properties (for example, pure substances vs. mixtures, metals vs. nonmetals, ionic vs. covalent vs. metallic, electrolyte vs. nonelectrolyte).
- Use multiple perspectives of matter (macroscopic, particle, symbolic levels) to qualitatively describe and explain characteristics, properties, and relationships of the following: atomic structure, periodicity, molecular structure, chemical bonding, gases, liquids and solids, solutions.
- Draw and interpret multiple representations of structures depicting connectivity, configuration, and conformations.
- Quantify relationships between variables controlling chemical systems.
- Differentiate among closely related factors, categorize problem types, and select appropriate tools to solve these problems.

## Academic Integrity

Academic integrity is the pursuit of scholarly activity in an open, honest, and responsible manner. Academic integrity is a guiding principle for all academic activity at Loyola University Chicago, and all members of the University community are expected to act in accordance with this principle. Please open and read the foldout for the third item, "Academic Integrity" in the Undergraduate Academic Standards and Regulations.

Academic dishonesty can take several forms, including, but not limited to cheating, plagiarism, copying another student's work, submitting false documents, and deliberately disrupting the performance of other class members. Standards apply to both individual and group assignments.

Regarding the use of Artificial Intelligence: our Provost has expressed to "Let us all make sure we are learning and sharing best practices and not allowing AI to do the learning for us." In this course, any work you submit for credit must represent your own ideas and understanding of the assigned material. If you are uncertain about any case where your use of AI may be in conflict with University or course standards, please see me to discuss your concerns.

An instance of academic misconduct (including those detailed on the website provided above or in this syllabus) will be reported to the Department Chair and the academic Dean's office. You will receive a score of zero on the item in question for any instance of academic misconduct, and that score cannot be dropped. Repeated instances of misconduct may result in additional sanctions, including a grade of F for the course.

## Attendance

**Class Attendance & Course Coverage**

Material comprehension and attendance is obtained via Plicker. Keep your Plicker card safe and bring it to every class.

Early in the course, you will be given an opportunity to provide contact information to other people and to introduce yourself to multiple classmates. If you miss a class for any reason, it is your responsibility to work through the content. Contact a classmate for further discussion of the topics as you are still responsible for all material covered and assigned.

An outline will be shown at the beginning of each class and uncompleted lecture notes/handouts/ links/animations will be posted on Sakai. We will not cover every topic in every chapter of the textbook this semester. Focus first on the material that is directly covered in lecture and assigned or recommended. Explore the additional material in the textbook for your own interest and enrichment.

We have a Universal Absence Accommodation Policy. Please refer to this with the Grading System.

**Classroom & Group Work Guidelines**

The classroom is a space designed for learning. My expectations are that all voices will be heard and appreciated in the classroom, and that we will invite each other to engage while recognizing that contributions can take multiple forms.

**Student and Faculty Expectations**

*Expectations of Students:* I expect students to take ownership of their learning and to use office hours and SI sessions as learning resources. It is anticipated that the average independent working time (outside of class) required to learn the material in order to achieve a minimal passing grade of C- is 1-2 hours per day, every

day, but your needs will also vary depending on your prior knowledge and ability to master cumulative concepts in the course material as the semester progresses.

*Expectations of Instructor:* I will provide you with the tools, environment, encouragement, and support to learn Chemistry. Because the course objectives are based on what students learn, my teaching techniques include homework, groupwork, and active learning. I expect all of us will work together!

**Accommodations for Religious Observances**
If you have observances of religious holidays that will cause you to miss class or otherwise affect your academic work in the course you must alert the instructor ***no later than Friday of Week 2 in the semester*** to request accommodations. Advance notice must be sent to the instructor through Loyola email by this deadline.
**Loyola University Absence Policy for Students in Co-Curricular Activities (including ROTC)**
Students missing classes while representing Loyola University Chicago in an official capacity (e.g., intercollegiate athletics, debate team, model government organization) shall be allowed by the faculty member of record to make up any assignments and to receive notes or other written information distributed in the missed classes.

Students should discuss with faculty the potential consequences of missing lectures and the ways in which they can be remedied. Students must provide their instructors with proper documentation i.e., "Athletic Competition & Travel Letter" describing the reason for and date of the absence.

This documentation must be signed by an appropriate faculty or staff member and it must be provided to the professor in the first week of a semester. It is the responsibility of the student to make up any assignments. If the student misses an examination, the instructor is required to allow the student to take the examination at another time.
(https://www.luc.edu/athleteadvising/attendance.shtml)

Students who will miss class for an academic competition or conference must provide proper documentation to their instructor as early in the semester as possible. Advance notice must be sent to the instructor through Loyola email.

## Information about Accessibility Support

**Student Support: Requests for Accommodation**
Loyola University Chicago provides reasonable accommodations for students with disabilities. Any student requesting accommodations related to a disability or other condition is required to register with the Student Accessibility Center (SAC). Professors will receive an accommodation notification from SAC, preferably within the first two weeks of class.

Students are encouraged to meet with their professor individually to discuss their accommodations. All information will remain confidential.

Please note that in this class, software may be used to audio record class lectures to provide equal access to students with disabilities. Students approved for this accommodation use recordings for their personal study only and recordings may not be shared with other people or used in any way against the faculty member, other lecturers, or students whose classroom comments are recorded as part of the class activity. Recordings are deleted at the end of the semester.

For more information about registering with SAC or questions about accommodations, please contact SAC at 773-508-3700 or SAC@luc.edu.

*If you use the Testing Center, please schedule all the tests for this class at the beginning of the semester. If a scheduled test date changes, you will still be accommodated if you had scheduled your test in advance.*
*If you have any questions or concerns regarding the implementation of your accommodations in this course, please contact the SAC for assistance.*

## Information About Title IX

Please refer to the information at this link: Office for Equity & Compliance's recommended syllabus language

## Additional Scheduling and Dates Information

- A link to the official Loyola calendar can be found here: https://www.luc.edu/academics/schedules/
- The withdraw deadline for the semester is on Friday, November 1.

**Final Exam**

The University sets the schedule for all final exams. The final will be held on:

***Thursday, December 12th, 7:00 PM in a classroom TBA (will be listed in LOCUS)***

You will have exactly 2 hours to complete the exam. Additional time will not be granted, even if you start late. There will be no make-up final exams given under any circumstance, and the exam will not be given early, either.

Instructors may not reschedule final exams for a class for another day and/or time during the final exam period. There can be no divergence from the posted schedule of dates for final exams. Individual students who have four (4) final examinations scheduled for the same date may request to have one of those exams rescheduled. If a student reports having four final examinations scheduled for the same date, students should be directed to e-mail a petition to Adam Patricoski, Assistant Dean for Student Academic Affairs, CAS Dean's Office (apatricoski@luc.edu).

**Pass/Fail Conversion Deadlines and Audit Policy**

A student may request to convert a course into or out of the "Pass/No-Pass" or "Audit" status only within the first two weeks of the semester. For the Fall 2024 semester, students can convert a class to "Pass/No-Pass" or "Audit" through Monday, September 9th. Students must submit a request for Pass/No-Pass or Audit to their Academic Advisor.

## Department Course Repeat Rule

Effective with the Fall 2017 semester, students are allowed only THREE attempts to pass Chemistry courses with a C- or better grade. The three attempts include withdrawals (W). The Department advises that it is preferable to complete a course with a grade of C or C-, and to demonstrate growth in future coursework, than to withdraw from a course.

After the second attempt, the student must secure Department approval for a third attempt. Students must fill out the Permission to Register Form, and arrange a meeting with the Undergraduate Program Director, Assistant Chairperson, or Chairperson in Chemistry. If approved, a signed copy of this form is then sent to the student's Advising office to secure final permission for the attempt.

## Additional Course Material and Recording Statements

In general lecture, meetings may be recorded. The following is a mandatory statement for all courses in the College of Arts & Sciences (CAS). We will discuss class norms and standards during the first week and continue the discussion as needed throughout the semester.

**Recording of Online Class Meetings**

In this class software will be used to record live class discussions. As a student in this class, your participation in live class discussions will be recorded. These recordings will be made available only to students enrolled in the class, to assist those who cannot attend the live session or to serve as a resource for those who would like to review content that was presented. All recordings will become unavailable to students in the class when the Sakai course is unpublished (i.e. shortly after the course ends, per the Sakai administrative schedule). Students who prefer to participate via audio only will be allowed to disable their video camera so only audio will be captured. Please discuss this option with your instructor.

The use of all video recordings will be in keeping with the University Privacy Statement shown below:

**Privacy Statement**

Assuring privacy among faculty and students engaged in online and face-to-face instructional activities helps promote open and robust conversations and mitigates concerns that comments made within the context of the class will be shared beyond the classroom. As such, recordings of instructional activities occurring in online or face-to-face classes may be used solely for internal class purposes by the faculty member and students registered for the course, and only during the period in which the course is offered. Students will be informed of such recordings by a statement in the syllabus for the course in which they will be recorded. Instructors who

wish to make subsequent use of recordings that include student activity may do so only with informed written consent of the students involved or if all student activity is removed from the recording. Recordings including student activity that have been initiated by the instructor may be retained by the instructor only for individual use.

**Additional Content, Copyright & Intellectual Property Statement**
By default, students may not share any course content outside the class without the informed written consent of the owner of that content. This includes any additional recordings posted by students, materials provided by the instructor, and publisher-provided materials. For example, lectures, quiz/exam questions, book figures/slides, and videos may not be shared online outside the class. In some cases, copyright/IP violations may overlap with breaches of academic integrity. Remember that obtaining consent to share materials is an active process.

## Evaluation and Grading

**Course Grading System Design**
This course utilizes specification grading. In specification grading, students work to successfully master objectives on assessments (tests). In this course, we have two types of objectives: foundational objectives (FOs) and comprehensive objectives (COs). With this grading system, students can determine what overall grade they will attempt. Instructors outline the standards and requirements for each FO and CO in course material and practice problems. During a pre-determined assessment period, the instructor will give a specific list of FOs and COs that the students can attempt. Students choose which FOs and COs to attempt. Objectives that students get correct are considered mastered and count towards their overall grade. For those objectives not mastered, students should determine what was not correct. For many of the objectives, there will be additional attempts during the semester so students can reattempt mastery of that objective. There is no partial credit in this grading system. Specifications grading provides students the choice of what topics they are assessed during a particular testing period.

The grading standards listed below provide the standards needed to obtain a particular grade. In this testing environment, students have the choice to strive for a particular grade, depending upon how many FOs and COs they master and homework/group work. Note: In this assessment system, student grades can only go up, they can never drop.

Some notes in preparing for this grading system:

1. Understand the standards and requirements for each letter grade so you choose the level of academic achievement to pursue in this course. Strive for high achievement. We believe in the potential of all students to learn and improve their abilities in chemistry.
2. Expect a challenging but flexible learning environment. The standards for demonstrating your Mastery of the course material are high in each area, but the methods for meeting the standards are designed to give you multiple chances to revise and improve the quality of your work throughout the semester.
3. Learn from mistakes. Deep, connected learning involves hard work and reflection on your progress. Chemistry is a cumulative subject where new topics build on prior knowledge and this system is designed for cycles of learning.

**Grading Standards**
The standards for each letter grade are listed here according to all required course components, listed in columns. You must meet or exceed all the standards listed to earn the corresponding letter grade: standards are not averaged across components. These lists are intended for complete transparency: you do not need to do any extra work to figure out what is required for any grade, and we will revisit the standards and expectations after the early rounds of testing to help you gauge your progress in the course. Grades are only based on the criteria listed in the syllabus: no substitutions, and no additions. Descriptions of the components are found on the following pages.

| | FO Mastery | CO Mastery | CO Total (M+P) | Homework / Group Work |
|---|---|---|---|---|
| **A** | ≥ 23 | ≥ 13 | ≥ 14 | Homework ≥ 90% AND ≤ 2 missed quizzes |
| **A-** | ≥ 22 | ≥ 12 | ≥ 14 | Homework ≥ 90% AND ≤ 2 missed quizzes |
| **B+** | ≥ 21 | ≥ 11 | ≥ 13 | Homework ≥ 80% AND ≤ 3 missed quizzes |
| **B** | ≥ 20 | ≥ 10 | ≥ 12 | Homework ≥ 80% AND ≤ 3 missed quizzes |
| **B-** | ≥ 19 | ≥ 8 | ≥ 11 | Homework ≥ 80% AND ≤ 3 missed quizzes |
| **C+** | ≥ 18 | ≥ 7 | ≥ 10 | Homework ≥ 70% AND ≤ 4 missed quizzes |
| **C** | ≥ 17 | ≥ 5 | ≥ 9 | Homework ≥ 70% AND ≤ 4 missed quizzes |
| **C-** | ≥ 16 | ≥ 4 | ≥ 8 | Homework ≥ 70% OR ≤ 4 missed quizzes |
| **D** | ≥ 8 | ≥ 2 | ≥ 4 | Homework ≥ 50% OR ≤ 6 missed quizzes |
| **F** | a student who fails to meet the standards for a grade of D will receive a grade of F for the course | | | |

**Posting of Grades**
Final course grades at the end of the semester are posted only on LOCUS. Final grades are never sent via email. ALEKS scores are automatically recorded in the ALEKS Gradebook for that system. Each student will see an estimated midterm grade in LOCUS before the withdraw deadline.

**Course Assessment**
All the following are required components of your course grade:

**ALEKS: Required Homework**
Online homework will be assigned through ALEKS and will be due at 11:59 pm on the corresponding due date. Look on the ALEKS website (https://www.aleks.com/) Class Code: **TPU9P-F4GLF** to determine the dates when the assignments will be due. **No** extensions will be given. You are allowed to work with others to complete the homework. However, remember that you will take the exam by yourself, so you must understand how to complete problems individually.

**Plicker Question**
Students will be provided with a Plicker card which they will keep for the entire semester. At the beginning of class, a problem will be placed on the slide which students should attempt to solve. The students will use the Plicker card to answer the question. Students will be graded on completeness, not correctness. **No** points will be given to students that come in late to class or to students that are missing their Plicker card.

**Group Quizzes/Work//Discussion**
During Discussion, students will work in groups to solve problems. At the end of the discussion, each student will hand in through Gradescope a copy of the work completed. The work will be graded based on completeness, not correctness. The lowest two discussion grades will be dropped.

**Foundational Objectives (FOs): Mastery Testing**
The purpose of testing is to align your course grade with your level of learning, based on your mastery of Foundational Objectives (FOs). The FOs are all related to the Course Content & Learning Outcomes on the first page of this syllabus. A list of FOs will be updated for each unit as we progress through the material. Questions will be scored as Mastered or Not Mastered for each FO. A score of Mastered is earned for correctness and completeness of the problem(s), and each FO may only be counted once toward your FO Mastery Standard. You will have multiple chances to demonstrate mastery of all the FOs during the term: for example, if you receive a score of Not Mastered for any FO on the first test (or if you choose not to attempt an FO), you can try again to earn a score of Mastered for that FO on the second test. Revision of work that does not meet mastery standards is expected for your learning. Because you will have more than one chance to master the FOs, you will also be able to choose which FOs to work toward for the course. Note that the standards for earning Mastery will be high: by definition, there is no partial credit, but you will learn the standards from the examples for class activities. Rounds of testing are scheduled for **9/6, 9/13, 10/4, 10/25, 11/15**, **12/6** with an additional round scheduled during the final exam period. Specific FO lists and timing will be announced at least one week in advance. All procedures, allowed resources, and requirements will be posted before each round of testing. Refer to the Universal Absence Accommodation Policy for missed tests.

**Comprehensive Objectives: Mastery Testing & Proficiency Revisions**
The purpose of testing is to align your course grade with your level of learning, based on your mastery of comprehensive topics. The purpose of COs is to allow you to demonstrate your higher-level skills of applying and analyzing, requiring you to go beyond memorization of facts and processes and transfer your understanding of essential course concepts to new scenarios. The COs are all related to the Course Content & Learning Outcomes on the first page of this syllabus. A list of COs will be updated for each unit as we progress through the material. COs will be scored as Mastered or Not Mastered. A score of Mastered is earned for correctness and completeness of the problem(s). Note that the standards for earning Mastery will be high: there is no partial credit, but you will learn the standards from the examples for class activities. Each round of testing on COs will be followed by an opportunity to resubmit work to earn a score of Proficient for an CO that was Not Mastered in the first testing opportunity. Resubmissions for Proficiency may also earn reattempts of COs. Reattempts may take place in later rounds of testing. Note that your grade will not count both Mastery and Proficiency for the same item; a CO that is scored Proficient and then is subsequently Mastered on a re-attempt will count only as being Mastered. Rounds of testing are scheduled for **9/13, 10/4, 10/25, 11/15**, **12/6** with an additional round scheduled during the final exam period. Specific CO lists and timing will be announced at least one week in advance. All procedures, allowed resources, and requirements will be posted before each round of testing. Refer to the Universal Absence Accommodation Policy for missed tests.

**Universal Absence Accommodation Policy**
The purpose of a universal absence accommodation policy is to account for emergency circumstances (e.g., serious illness, caring for a family member, car accident) that require you to be absent from class, while maintaining fairness in grading for students who attend and complete all in-class graded assignments. We believe that class attendance and participation are essential for your success in this class, and that your health is important to us and our shared community. Please use good judgement and stay home if necessary/prudent for your circumstances.
This is the universal accommodation policy for in-class graded assignments:

- Group Work: the specification for an A automatically accommodates 2 missed quizzes.
- FOs: multiple attempts at Mastery are automatically provided during the term.
- COs: you are eligible to submit for Proficiency after the first attempt at an CO whether you complete the problems or not; reattempts at Mastery may be available during the term.

You may provide documentation for an absence, but it is not required. These accommodations are automatically available to all students.

**Course Topics**
We will not cover every topic in every chapter of the textbook this semester, but the material will usually come from the Chapters listed below. Focus first on the material that is directly covered in classes and assigned or

recommended. Explore the additional material in the textbook for your own interest and enrichment. Supplemental sections from other OER sources may be used in this course.

Chapter 1: Essential Ideas
Chapter 2: Atoms, Molecules, and Ions
Chapter 3: Electronic Structure and Periodic Properties of Elements
Chapter 4: Chemical Bonding and Molecular Geometry
Chapter 5: Advanced Theories of Bonding
Chapter 6: Composition of Substances and Solutions
Chapter 10: Liquids and Solids
Chapter 11: Solutions and Colloids
Chapter 19: Transition Metals and Coordination Chemistry
Chapter 21: Organic Chemistry

**Changes to Syllabus**
There may be changes to the syllabus during the semester. ***You are responsible for all syllabus changes made in class whether or not you attend.***

| Objective # | Foundational Objective (FO) |
|---|---|
| 1 | List the names and symbols of common elements. |
| 2 | Identify and draw particle-level depictions of pure substances and mixtures. This may include representations of physical and chemical changes. |
| 3 | Relate mass, volume, and density using quantitative and qualitative descriptions. |
| 4 | Convert between symbols and number of subatomic particles for atoms and atomic ions. |
| 5 | Convert among mass, moles, and number of particles, including the use of Avogadro's number. |
| 6 | Identify and classify elements according to the organization of the Periodic Table. |
| 7 | Convert among wavelength, frequency, and energy of photons. |
| 8 | Apply quantum mechanics to explain atomic emission and absorption spectra. |
| 9 | Describe and identify quantum numbers, orbital types, and properties of atomic orbitals (size, shape, orientation). |
| 10 | Use the periodic table to write and interpret electron configurations. |
| 11 | Correlate atomic and ionic properties with electron configurations and position on the periodic table. |
| 12 | Write names and formulas for ionic and molecular compounds. |
| 13 | Identify and describe ionic, metallic, and covalent bonding. |
| 14 | Draw Lewis structures from chemical formulas. |
| 15 | Identify formal charges in structures. |
| 16 | Convert between condensed and Lewis structures. |
| 17 | Convert between bond-line and Lewis structures. |
| 18 | Identify resonance contributors. |
| 19 | Determine sigma and pi bonds for a structure. |
| 20 | Identify hybridization, molecular geometry, electron domain geometry, and approximate bond angles. |
| 21 | Identify and draw constitutional (structural) isomers. |
| 22 | Identify and draw E-Z isomers. |
| 23 | Identify and draw conformers. |
| 24 | Convert between bond-line and Newman projections. |
| 25 | Identify chiral centers. |

| Objective # | Comprehensive Objective (CO) |
|---|---|
| 1 | Describe samples of matter according to their masses and dimensions. This may include a combination of quantitative and qualitative descriptions. |
| 2 | Use a particle-level understanding of matter to differentiate among masses of individual atoms and molecules, atomic and formula weights. This includes mass spectral data. |
| 3 | Use the periodic table and the wave behavior of matter to predict, draw, list and interpret the arrangements of electrons in atoms. This includes energy and magnetic properties. |
| 4 | Write electron configurations of ions. Explain atomic properties based on attractions between nuclei and valence electrons. |
| 5 | Predict, identify, and differentiate substances based on ionic, covalent, and metallic bonding. This includes using names formulas, and Lewis dot representations to describe matter on the particle-level. |
| 6 | Convert among names, Lewis, bond-line, and condensed structures. |
| 7 | Draw and interpret Lewis structures, including the use of resonance contributors, to predict properties of covalently bonded species. This includes bond length, bond strength, and charges on atoms. |
| 8 | Use Valence Bond Theory to describe orbital overlap, resonance structures, and geometry. |
| 9 | Use models and dash-wedge perspective drawings to draw, interpret, and identify three-dimensional shapes. |
| 10 | Identify, interpret, and draw representations of chiral and achiral structures, including meso compounds. |
| 11 | Describe and interpret the three-dimensional shape and polarity of covalently bonded structures. |
| 12 | Identify and depict interparticle (intermolecular/non-covalent) forces for pure substances and mixtures. |
| 13 | Predict and correlate physical properties of liquids to types and strengths of interparticle forces. |
| 14 | Solve quantitative problems using molarity for conversions involving solute mass, solute moles, and solution volume. This includes calculating and using ion concentrations for solutions of electrolytes and identifying depictions of electrolytes in aqueous solution. |
| 15 | Relate descriptions of energy, temperature, and pressure to physical changes. This includes using enthalpy diagrams, heating curves, and drawing phase diagrams. |