CHEM 180: Chemical Reactivity I

The purpose of this syllabus is to describe the course, resources, and policies. It is meant 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 180 – Chemical Reactivity I (3 credits: Lecture & Discussion)
Prerequisites: Completion of Math 118 and Chem 160, or the equivalent, with a grade of C- or better. A student missing a prerequisite may be withdrawn at any time.
Time Zone: This syllabus lists dates/times using Chicago local time (U.S. Central Time Zone)
Lectures: TTh 11:30am-12:45pm, Cuneo Hall 210
Discussions: You must attend the section for which you registered:

- Sec 007: 1:40-2:30 Flanner Hall 105
- Sec 008: 2:45-3:35 Flanner Hall 105

Course Coordinator: Dr. James Devery (Ph.D.) jdevery@luc.edu
Chemistry 180 is a multi-section lecture & discussion course with common content and common outcomes across all sections. This course includes a Common Final Exam during the Common Final Exam Period as scheduled by the University. The Course Coordinator is responsible for consultation and coordination with 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 you should contact with questions about all aspects of the course. As needed, all Section Instructors will consult with the Course Coordinator throughout the semester.

Instructor Contact Information

Section Instructor: Dr. Amy Balija
Office: FH 104
Email: abalija@luc.edu

Email Policy & Timing:

General Emails: Please use your Loyola (@luc.edu) email address and send it to abalija@luc.edu with only "CHEM 180" in the subject line of the message. Doing this will ensure that I read your message. In most cases, I will be able to respond within 24-48 hours M-F when classes are in session. Please use Office Hours to get immediate answers to your questions, and to use your classmates as resources for help. You are welcome to email me in the evenings/nighttime, and you can expect a response during the next day.

Comprehensive Objective (CO) Emails: Please use your Loyola (@luc.edu) email address and sent it to abalija@luc.edu with CHEM 180: CO # in the subject line of the message. You must email me by the 5 pm the day before CO test corrections are due in order to get a response. Please use my Office Hours, the SI, and your classmates as resources for immediate help.

Office Hours Policy:

You are welcome to stop by at any time to see if my door is open and check my posted schedule. Occasional extra hours may be announced. Bring your questions anytime during the times listed. I encourage working together during office hours so bring a classmate with you or meet your classmates there to work together. If you are unable to make my office hours, email me to schedule a time to meet.

Office Hours Schedule:		
	M 11:30am-1 pm	STEM Center, St. Joseph's Hall Cafeteria
	T 1:00-2 pm	FH 104
	Th 1:00-2:30 pm	STEM Center, St. Joseph's Hall Cafeteria
	By appointment	

SI Information

There are Supplemental Instruction (SI) study sessions available for this course. SI sessions are led by an SI leader, Emma Eisen, 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

- WileyPlus, see Sakai for additional information and recommendations
- 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, and collaboration materials for group work.

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.

Course Description

This course is the second 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: acids and bases, buffers, chemical equilibrium, molecular thermodynamics and kinetics, nucleophilic substitutions, elimination reactions, carbonyl compounds and reactions with applications to biochemical pathways. 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
- Culture and practice of science
- Energy
- Polymers, proteins, and macromolecules
- Sustainability
- Chemical synthesis, purification, characterization, and analysis

Learning 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:

- Qualitatively and quantitatively describe and explain how molecular structure and stability changes over time in chemical reactions.
- Draw and interpret multiple representations of structures depicting reactivity.
- Predict and draw reaction products.
- Propose and draw logical reaction mechanisms.
- Quantify relationships between variables controlling chemical systems.
- Differentiate among closely related factors, categorize problem types, and select appropriate tools to solve these problems.
- Apply chemical principles to explain natural phenomena.

Class Attendance & Course Coverage

Material comprehension and attendance is obtained via an online system. Additional information will be discussed later.

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.

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. You will write expectations/guidelines for your group work this semester: this will be an essential part of the course.

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 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!

Student Accommodations
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 in order 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 equitable 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.

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 approval for a third attempt. Students must come to the Chemistry Department, fill out a permission to register form or print it from the Department of Chemistry & Biochemistry website: https://www.luc.edu/chemistry/forms/ and personally meet and obtain a signature from either the Undergraduate Program Director, Assistant Chairperson, or Chairperson in Chemistry. A copy of this form is then taken to your Academic Advisor in Sullivan to secure final permission for the attempt.

Academic Integrity
All students in this course are expected to have read and to abide by the demanding standard of personal honesty, drafted by the College of Arts & Sciences, which can be viewed at:
https://www.luc.edu/cas/advising/academicintegritystatement/
A basic mission of a university is to search for and to communicate the truth as it is honestly perceived. A genuine learning community cannot exist unless this demanding standard is a fundamental tenet of the

intellectual life of the community. Students of Loyola University Chicago are expected to know, to respect, and to practice this standard of personal honesty.
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.

Any 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.

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.

Accommodations for Religious Reasons
If you have observances of religious holidays that will cause you to miss class or otherwise effect your performance in the class you must alert the instructor ***within 10 calendar days of the first class meeting of the semester*** to request special accommodations, which will be handled on a case by case basis.

Other Items
• 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 Monday, March 25.
• Loyola is using SmartEvals to provide instructor & course feedback. OIE will send emails near the end of the term.
• Additional resources, advice, and suggestions for success (from multiple sources) will be posted/updated on Sakai.

Class Recording & Content Information

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.

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.

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 Spring 2024 semester, students can convert a class to "Pass/No-Pass" or "Audit" through Monday, January 29th. Students must submit a request for Pass/No-Pass or Audit to their Academic Advisor.

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

Wednesday, May 1st, 7:00 PM

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.

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).

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:

- Discussion: the specification for an A is ≥ 12 completions to allow at least 2 missed discussion grades.
- 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 are available during the term.

You must provide documentation for an absence. This accommodation is automatically available to all students.

Course Topics
We will not cover every topic in every chapter of the custom e-text 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.

Chapter 1: Introduction to Structure and Reactivity
Chapter 2: Functional Groups and Bronsted-Lowry Acids and Bases

Chapter 3: Introduction to Equilibrium
Chapter 4: Acid–Base Equilibria and Buffers
Chapter 5: Thermodynamics
Chapter 6: Chemical Kinetics
Chapter 7: Introduction to Reactions and Mechanisms
Chapter 8: Nucleophilic Substitution Reactions and Elimination Reactions
Chapter 9: Alkanes and Cycloalkanes
Chapter 10: Stereoisomerism and Reactions
Chapter 11: Introduction to Carbonyl Chemistry and Nucleophilic Addition Reactions
Chapter 12: Carbohydrates
Chapter 13: Carboxylic Acids and Their Derivatives: An Introduction to Nucleophilic Acyl Substitution Rxns
Chapter 14: Lipids, Amino Acids and Peptides

Course Grading System Design

Design

There are three basic principles that we have used to design the grading system for this course. These are for you to:

1. Understand what the standards and requirements are for each letter grade so that you can choose what level of academic achievement to pursue in this course. We encourage each of you to strive for high achievement because 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 the new topics build on prior knowledge and this system is designed for cycles of learning.

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 of 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.

A Standards	B Standards	C Standards
WileyPlus: ≥ 90% Overall Grade	WileyPlus: ≥ 80% Overall Grade	WileyPlus: ≥ 70% Overall Grade
Quizzes: ≥ 12	Quizzes: ≥ 11	Quizzes:≥ 9
FO Mastery: ≥ 34	FO Mastery: ≥ 28	FO Mastery: ≥ 22
CO Mastery: ≥ 16 + 2 Proficiency	CO Mastery: ≥ 11 + 3 Proficiency	CO Mastery: ≥ 5 + 5 Proficiency
Project: A-Spec	Project: ≥ B-Spec	Project: ≥ C-Spec
A− Standards	**B− Standards**	**C− Standards**
WileyPlus: ≥ 90% Overall Grade	WileyPlus: ≥ 80% Overall Grade	WileyPlus: ≥ 70% Overall Grade
Quizzes:≥ 12	Quizzes:≥ 10	Quizzes:≥ 9
FO Mastery: ≥ 32	FO Mastery: ≥ 26	FO Mastery: ≥ 20
CO Mastery: ≥ 14 + 3 Proficiency	CO Mastery: ≥ 9 + 5 Proficiency	CO Mastery: ≥ 4 + 4 Proficiency
Project: A-Spec	Project: ≥ B-Spec	Project: ≥ C-Spec
B+ Standards	**C+ Standards**	**D Standards**
WileyPlus: ≥ 80% Overall Grade	WileyPlus: ≥ 70% Overall Grade	WileyPlus: ≥ 50% Overall Grade
Quizzes: ≥ 11	Quizzes:≥ 10	Quizzes: ≥ 6
FO Mastery: ≥ 30	FO Mastery: ≥ 24	FO Mastery: ≥ 12
CO Mastery: ≥ 13 + 3 Proficiency	CO Mastery: ≥ 7 + 5 Proficiency	CO Proficiency: ≥ 6

Project: ≥ B-Spec Project: ≥ C-Spec

Note: 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. WileyPlus scores are automatically recorded in the WileyPlus Gradebook for that system. Scores for all other required components will be made available on Sakai. 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:

WileyPlus: Required Homework
On-line homework will be assigned through WileyPlus and will be due at 11:59 pm on the corresponding due date. Look on the WileyPlus website (https://education.wiley.com/ngonboard/index.html#/Login) to determine the dates when the assignments will be due. Additional information is listed on Sakai. **No** extensions will be given. You are allowed to work others to complete the homework. However, remember that you will take the exam by yourself, so you must understand how to complete problems individually.

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.

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 **1/30**, **2/20**, **3/19**, **4/9**, **4/25** with an additional round scheduled during the final exam period. Specific FO dates 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.

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: by definition 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 will also earn reattempts of COs. Reattempts will take place with the next round 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 **2/20**, **3/19**, **4/9**, **4/25** with an additional round scheduled during the final exam period. Specific CO dates 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.

Project
Specifications and dates will be provided, beginning in March.

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.***

Foundational Objectives (FOs):

Unit	Objective #	Foundational Objective (FO)
Structure and Functional Groups	1	Use formulas, names and structures to represent types of covalent and ionic bonding between atoms.
	2	Identify the molecular ion (M+•) from MS data. Correlate MS data with the presence of nitrogen, bromine, or chlorine.
	3	Convert among Lewis, bond-line and condensed structures and formulas, including the use of formal charges.
	4	Draw and identify depictions, including shapes and nodes, for atomic, hybrid, and molecular orbitals.
	5	Identify and label geometry, hybridization, sigma bonds and pi bonds for any atom/group of atoms.
	6	Use lines, wedges and dashes to represent and interpret three-dimensional structure.
	7	Draw resonance contributors given a structure, formula, or name.
	8	Draw, identify and label the delocalization of electrons (charge) by resonance.
	9	Draw and identify structures containing functional group(s) by bonding pattern and classification of compound.
	10	Draw the conjugate acid/base for a given structure.
	11	Use IUPAC nomenclature to name and draw structures for saturated compounds.
	12	Use IUPAC nomenclature to name and draw structures for unsaturated compounds.
Acid-Base Chemistry and Introduction to Equilibrium	13	Write equilibrium expressions from reactions and write balanced reactions from expressions.
	14	Relate the value of an equilibrium constant to reaction yield and energy of the system.
	15	Rank basicity and acidity using pKa values and/or analysis of structure.
	16	Predict the equilibrium position of acid-base reactions using thermodynamic stability of reactants and products.
	17	Relate pH to concentrations of acids and bases in aqueous solutions.
	18	Identify acids and bases to prepare a buffer.
	19	Describe how a buffer reacts to the addition of strong acids and bases.
	20	Draw predominant structures at a given pH.
	21	Write proton-transfer reactions and mechanisms, using structures, formulas, and names.
	22	Identify and compare/contrast Brønsted-Lowry and Lewis acids/bases by structure and reaction.
	23	Draw the products or draw the curved arrows for any step of a mechanism.
	24	Identify whether an atom or group of atoms constitutes a nucleophile, electrophile, or good leaving group.
Reactivity: Mechanism and Predicting Products	25	Identify stereoisomers using R/S, cis/trans, E/Z nomenclature.
	26	Use IUPAC nomenclature to name and draw structures for specific stereoisomers of compounds.
	27	Draw stereoisomers of chiral and achiral structures.
	28	Use Newman projections to draw, identify, and label conformers

	29	Predict the enthalpy, entropy, and free energy change for reactions.
	30	Identify whether a carbocation will rearrange, and provide structures and mechanisms for the rearrangement.
	31	Relate rate, concentration, and temperature data to rate equations.
	32	Apply Hammond's Postulate to draw a transition state for a reaction step.
Carbonyl Reactivity: Mechanisms and Synthesis	33	Draw and use chair conformations for conformational analysis.
	34	Identify and draw stereoisomers using bond-line and Fischer projections.
	35	Draw acyclic and cyclic forms of monosaccharides.
	36	Identify configurations and connectivity of monosaccharides and oligosaccharides.

Comprehensive Objectives (COs):

Objective Number	Comprehensive Objective (CO)
1	Synthesis 1: Identify acids, bases, and solvents for a reaction based on application of the leveling effect.
2	Synthesis 2: Identify the composition of all sections of a titration curve.
3	Mechanism 1: Propose a plausible mechanism for substitution/elimination and reaction coordinate drawing
4	Data 1: Reaction Progress Kinetic Analysis
5	Synthesis 3: Predict the major and minor products for substitution/elimination
6	Data 2: Mass Spec with synthesis
7	Mechanism 2: Draw mechanism for addition reactions to carbonyls
8	Mechanism 3: Predict the major product and draw a mechanism for addition reactions to carbonyls
9	Synthesis 5: Fill in the blank for addition reactions to carbonyls
10	Synthesis 6: Correct the synthesis
11	Mechanism 4: Mechanism involving carbohydrates
12	Nomenclature: Nomenclature of carboxylic acid derivatives
13	Mechanism 5: Draw mechanism for carboxylic acid derivative transformation
14	Mechanism 6: Predict the major product and draw mechanism for carboxylic acid derivative transformations
15	Synthesis 7: Fill in the blank for carboxylic acid derivative transformations
16	Data 3: Mass Spec with synthesis
17	Synthesis 8: Fill in the blank multistep
18	Synthesis 9: Polymer synthesis and properties