



CHEM-112: ORGANIC CHEMISTRY I

Effective Term

Fall 2026

BOT Approval Date

01/15/2026

Discipline

CHEM - Chemistry

Course Number

112

Course Title

Organic Chemistry I

Short Title

Organic Chemistry I

Credit Status (CB 04)

D - Credit - Degree applicable

Units**Lecture Units**

3.00

Lab Units

2.00

Total Units

5.00

Hours**Lecture Contact Hours**

48-54

Out of Class Hours Lecture

96-108

Lab Contact Hours

96-108

Out of Class Hours Lab

0.00

Total Contact Hours

144 - 162

Total Out of Class Hours

96 - 108

Total Student Learning Hours

240 - 270

Is this an existing Extensive Lab?

Yes

Distance Education

Yes

Distance Education**Distance Education Type**

Hybrid Only

What will be done in face-to-face meetings

The laboratory will be held as part of face to face meetings. Students will perform hands-on qualitative and quantitative experiments that incorporate data analysis. The in-person laboratory activities are required to meet the laboratory learning objectives.

Are you using publisher content?

No

Regular Substantive Interaction

Instructor-to-student, student-to-student, and student-to-content contact shall be distributed in a manner that will ensure regular substantive interaction (RSI) is maintained not only weekly but also for the duration of the course. Instructor interactions should be equivalent in time, quality and consistency to the engagement students would receive in a face-to-face course—for example, through announcements, discussion participation, personalized feedback, video messages, or other instructional communications. Instructors are expected to be responsive to student inquiries within a 24-72 hour time frame excluding holidays. RSI will be maintained through a variety of methods:

- Orientation - Students must be oriented to the online and face-to-face portions at the start of the course.
- Announcements - Announcements using the course management system must be posted at least weekly to keep students current on course events, due dates, materials, etc.
- Discussion Forums - Content-related discussion forums within the designated CMS will include appropriate instructor participation and will be initiated and maintained, with timely feedback provided. Instructors are required to monitor the discussions and related activities to provide guidance and direction. Open-ended discussion boards may be used to further learning and interaction.
- MSJC Communication – Instructor will use MSJC-administered communication tools (such as email or the designated CMS communication tools) to regularly communicate with and provide ease of access to students.
- Timely Feedback - Timely feedback on student work will be provided by the instructor, which may include comments and/or rubrics, within the Grades area of the designated CMS.
- Scheduled Meetings – Hybrid and synchronous courses will meet at regularly scheduled times.

ADA Compliance - All course interactions and content must be designed with accessibility in mind and meet ADA requirements.

C-ID (Admin Only)

C-ID CHEM 150

Catalog Description

This course is the first of a two-semester sequence in organic chemistry. The topics covered include molecular properties, structure and bonding, stereochemistry, reactions and synthesis of alkane, alkenes, alkynes and alkyl halides, NMR and IR spectroscopy.

Requisites**Prerequisite(s)****Prerequisite(s) (must be taken before)**

CHEM-102 (with a grade of C or better).

Codes**TOP Code (CB 03)**

1905.00 - Chemistry, General

CIP Code

40.0504 - Organic Chemistry.

Repeatability Code

No

Grading Option

Letter grade OR P/NP

Minimum Qualifications

Minimum Qualifications	And/Or
Chemistry (Masters Required)	End

GE Information

Check GE Types Requested

AA/AS A - Natural and Physical Sciences

Cal-GETC Areas

Approved Cal-GETC Area

AREA-5A

Approved Second Cal-GETC Area

AREA-5C

Learning Objectives

Learning Objectives

Learning Objective
1. Analyze the structure of atoms using modern atomic theory, valence bond theory and molecular orbital theory, and evaluate the fundamental properties of compounds including acid-base, thermodynamic, kinetic, and physical properties to describe physical and chemical characteristics, deduce compound names using the IUPAC system, and identify functional groups.
2. Evaluate generalized reactions, and categorize various reactions as addition, substitution, condensation, elimination, or oxidation-reduction.
3. Formulate the three dimensional structure of molecules, predict possible isomers, and analyze the chemistry that leads to enol-keto tautomerism in addition to recognition and characterization of stereochemistry, and the optical activity of a compound.
4. Scrutinize in detail the chemistry and structure of the families of alkanes, cyclic hydrocarbon compounds, alkenes, alkynes, alkyl halides, and benzene with emphasis on reactions and reaction mechanisms.
5. Observe regiochemistry and Markovnikov's Rule, and apply Hammond's postulate and potential energy when evaluating carbocations, stable intermediates, and transition states.
6. Apply the general principles and patterns of alkene reactions to form halohydrins, alcohols, alkanes, carbonyls, carboxylic acids, cyclopropane, epoxide, and polymers, and alkyne reactions to form halohydrins, alkenes, alkanes, carbonyls, carboxylic acids, and amines.
7. Analyze and deduce the properties of nucleophiles, electrophiles, leaving groups, and solvents as they pertain to substitution and elimination reactions such as, SN1, SN2, E1, and E2.
8. Investigate the general properties of electromagnetic radiation to determine molecular structure by analyses of infrared (IR) spectroscopy, ultraviolet/visible (UV-VIS) spectroscopy, and nuclear magnetic resonance (NMR) spectroscopy; in addition, utilize mass spectrometry (MS) for molecular identification, as well as gas chromatography (GC).
9. Practice lab safety, wear proper personal protective equipment (PPE), utilize Safety Data Sheets (SDS), observe chemical hazards and use proper chemical hygiene, in addition to explaining and demonstrating correct procedures for safe handling and disposal of hazardous waste.
10. Construct microscale glassware (microbell, picnometer, magnetic spin bar, evacuated capillary, microburette), and demonstrate specific precautions when using needles and sharps; assemble taper glassware apparatus and safely conduct experimental procedures.
11. Operate electrical equipment such as but not limited to melt temps, vortexes, and centrifuges according to manufacturer instructions, and extract accurate data from refractometers, polarimeters, and analytical balances to the correct level of instrument precision.
12. Operate, analyze, and interpret GC, FT-IR, UV-VIS, and NMR data and results both manually and with the use of software.
13. Determine physical properties in the laboratory, and in the field to the correct level of instrument precision.
14. Perform simple distillation, extraction, sublimation, crystallization, and evaporation techniques in addition to various chromatography techniques, including but not limited to thin layer chromatography and gas chromatography.
15. Employ a variety of solubility and chemical tests and identify functional groups based on observations of results.

16. Carry out single-step synthesis reactions at the microscale and semi-microscale levels with purification and characterization of product(s).
17. Maintain a proper laboratory notebook and organized computational files of analytical data/results.
18. Construct a clear/concise scientific laboratory report with experiential objectives, procedures, data/results, conclusions, and ACS formatted references for each experiment throughout the semester.
19. Evaluate chemical concepts relating to organic structure and reactivity to analyze real-world applications of organic chemistry that are culturally relevant and accentuate diversity and inclusion.

Learning Outcome Information

Course Learning Outcomes

Learning Outcome
1. Students will classify organic molecules by type and functional group according to IUPAC rules.
2. Students will analyze three-dimensional molecular shapes using models and drawings to explain their role in chemical behavior.
3. Students will analyze spectroscopic data to determine molecular structure.
4. Students will apply knowledge of organic chemistry to solve problems similar to those on ACS Organic Chemistry Exams.
5. Students will apply problem-solving strategies to independently address chemical problems.
6. Students will use reflection to clarify understanding and deepen learning.

Content

Course Lecture Content

1. Structure and Bonding
 - a. electron orbitals and shells
 - b. ground state electron configurations
 - c. ionic bonds and valence shell electrons
 - d. ionization energy
 - e. electron affinity
 - f. covalent bonds
 - g. Lewis structures
 - h. hybridization of atomic orbitals
 - i. bond lengths and bond energies
2. Molecular Properties
 - a. electronegativity
 - b. dipoles and polarity
 - c. structure determination
 - d. formal charges
 - e. oxidation numbers
 - f. resonance structures
 - g. acid and base properties
 - h. equilibrium
 - i. free energy
 - j. enthalpy
 - k. entropy
 - l. bond dissociation energy
 - m. heats of reaction
3. Reactions Overview
 - a. addition reactions
 - b. substitution reactions
 - c. elimination reactions
 - d. condensation reactions
 - e. reaction mechanisms
 - f. activation energy

- g. reaction rates
- h. intermediates
- i. transition states
- j. potential energy diagrams
- k. synthesis of organic compounds
- 4. Alkanes and Cyclic Hydrocarbons
 - a. IUPAC naming system
 - b. aliphatic hydrocarbons
 - c. alkyl groups
 - d. other functional groups
 - e. isomers
 - f. stereochemistry
 - g. physical and chemical properties
 - h. naming cycloalkanes
 - i. cis-trans isomerism
 - j. anti and gauche conformations
 - k. Bayer Strain Theory
 - l. mono and disubstituted cycloalkanes
 - m. IUPAC Nomenclature
- 5. Alkenes
 - a. nomenclature
 - b. physical and chemical properties
 - c. structure
 - d. degree of unsaturation
 - e. laboratory and industrial preparation
 - f. elimination reactions, which include alcohol dehydration reactions, dehydrohalogenation reactions, and dehydration reactions
 - g. electronic structure and stability
 - h. electrophilic addition reactions, which include hydration reactions, oxymercuration reactions, and hydroboration reactions
 - i. Markovnikov's rule
 - j. oxidation and reduction reactions
 - k. polymerization reactions
 - l. use of alkenes in synthesis
 - m. IUPAC Nomenclature
- 6. Alkynes
 - a. nomenclature
 - b. physical and chemical properties
 - c. structure
 - d. degree of unsaturation
 - e. laboratory and industrial preparation
 - f. dihalide elimination reactions
 - g. electronic structure and stability
 - h. electrophilic addition reactions, which include hydration reactions, and hydroboration reactions
 - i. oxidation and reduction reactions
 - j. alkylation reactions
 - k. use of alkynes in synthesis
 - l. IUPAC Nomenclature
- 7. Stereochemistry
 - a. physical properties of stereoisomers
 - b. enantiomers
 - c. chirality
 - d. specific rotation
 - e. optical activity
 - f. diastereomers
 - g. meso compounds

- h. racemic mixtures
 - i. isomerism
 - j. Fisher projections
 - k. stereochemistry of addition reactions
8. Alkyl Halides
- a. nomenclature
 - b. physical and chemical properties
 - c. structure
 - d. preparation
 - e. halogenation of alkanes, alkenes, and alcohols
 - f. preparation of Grignard reagents and organometallic compounds
 - g. oxidation-reduction reactions
 - h. first and second order nucleophilic substitution reactions
 - i. elimination reactions
 - j. kinetics of substitution reactions
 - k. steric effects
 - l. attacking groups and leaving groups effects
 - m. solvent effects
 - n. use of alkyl halides in synthesis
 - o. IUPAC Nomenclature
9. Infrared Spectroscopy (IR)
- a. regions of the spectrum
 - b. frequency
 - c. wavelength
 - d. amplitude
 - e. using IR to identify an unknown compound
10. Nuclear Magnetic Resonance Spectroscopy (NMR)
- a. the nature of absorption
 - b. Proton NMR
 - c. characterizing of molecular structure
 - d. chemical shifts
 - e. spin-spin splitting patterns
 - f. coupling constants
 - g. integrating spectra to determine the number of hydrogen atoms in a compound
 - h. Carbon-13 NMR
 - i. magnetic resonance imaging (MRI)
 - j. uses of NMR in determining the structure of a compound
11. Retrosynthetic Analysis and Multi Step Synthesis
- a. Retrosynthetic Analysis
 - b. Multi step synthesis
 - c. Applications of stereospecific and stereoselective reactions
 - d. Chemoselectivity
 - e. Applications of named reactions in total synthesis
 - f. Contributions of chemists from different cultures and underrepresented groups to the organic chemistry literature with a focus on total synthesis and reaction development.

Course Lab Content

Students work independently in the laboratory completing experiments and manipulating equipment, while handling and observing the physical appearance, properties, chemical reactivity, and hazards of volatile organic compounds. Safety in the lab is a priority, and all students must pass a safety exam before they are released to perform wet lab experiments. As part of the safety exam, students must demonstrate the ability to work autonomously and productively in a chemistry lab setting; laboratory assignments require hands on manipulations, visual, and auditory abilities.

- 1. Safety
 - a. General Laboratory Safety
 - b. Personal Protective Equipment (State and Federal requirements)

- c. SDS and Chemical Hygiene (Safety Data Sheets, Aldrich catalog, CRC, and Merck index)
- d. Handling and Disposal of Hazardous Waste (State and Federal requirements)
- e. Glassware and Sharps
- f. Accident Safety
- g. Safety Equipment
- 2. Laboratory Equipment
 - a. Standard Taper Glassware
 - b. Support Apparatus
 - c. Construct glassware (micro-burets, -pycnometer, -bells, stir bars, evacuated capillaries)
 - d. Electrical Equipment, not limited to: hot plates, melt temps, centrifuges, vortexes, ovens
 - e. Refractometers
 - f. Polarimeters
 - g. Analytical balances
 - h. Compressed Gas Cylinders
- 3. Instrumentation and Associated Software
 - a. GC (Gas Chromatography)
 - b. FT-IR (Fourier Transform Infrared Spectroscopy)
 - c. NMR (Nuclear Magnetic Resonance Spectroscopy)
 - d. UV-VIS (Ultraviolet-Visible Spectroscopy)
- 4. Techniques - Beginning
 - a. Determination of Physical Properties (evacuated & unevacuated mp, bp, density, etc.)
 - b. Simple Distillation and Distillation using advanced techniques
 - c. Solvent Extraction
 - d. Sublimation
 - e. Crystallization
 - f. Chromatography (TLC and GC)
- 5. Single-step Synthesis, purification techniques and product analyses (E1 Elimination, Catalytic Hydrogenation, Benzoin, Cannizzaro Reaction)
 - a. Microscale
 - b. Semi-microscale
 - c. Macroscale
- 6. Molecular Modeling (recognition and identification of functional groups, hybridization, geometry, and IUPAC nomenclature)
- 7. Laboratory Notebook and Computational Data Files
 - a. Derivation of clear/concise experimental objectives
 - b. Retention, understanding and interpretation of mechanisms
 - c. Streamlining and organization of preparation and procedures
 - d. Tabular formatting of chemical hazards, data, observations, and results
 - e. Problem solving and troubleshooting
 - f. Data analyses including calculations of theoretical and percent yields
 - g. Critical evaluation/discussion of experimental conclusions in comparison to current literature
 - h. Proper formatting of references according to American Chemical Society (ACS)
 - i. Analyses of analytical spectral data in comparison to current literature

Methods of Instruction

Method

Group Projects

Integration

Group assignments, projects, and homework will be used to evaluate, analyze, compare and contrast various mechanisms of syntheses, explain the chemical behavior of reactive species that drive a reaction forward, characterize physical, chemical, and analytical data/results, and develop intuitive understanding of spectroscopic data in real time.

DE Adaptations for MOI

The method could be done in an online/asynchronous way through the use of the course management system discussion boards.

Method

Lab Activities

Integration

Laboratory experimentation will provide a hands on opportunity to unite lecture material with real-world chemistry at the microscale, semi-microscale, and macroscale levels using updated protocols and equipment in a controlled laboratory environment, and in the field to convey active learning. Students will (1) collect scientific data while performing lab experiments, (2) format and write lab reports using scientific methods including an organized presentation of data and results, and (3) demonstrate application of knowledge through post-laboratory analysis. All laboratory activities will focus on laboratory skills, experimental techniques, proper use of equipment, safe lab practices and chemical hygiene, waste disposal, and quality of data/results.

DE Adaptations for MOI

N/A- Lab portion will be in-person. Students can submit their lab reports in person on paper, in their laboratory notebook, or online in the assignments section of the course management system.

Information relating to preparing a complete laboratory report can be provided through in-lab lectures and activities or through accessible documents and accessible lecture recordings delivered through the module sections of the course management system.

Method

Lecture

Integration

Lecture will utilize whiteboard, power point, spectroscopy, molecular models, demonstrations, and multimedia in an interactive discussion-based, problem solving forum to prepare students for active participation in experimental procedures in the lab. Lecture material will be used to convey concepts of organic chemistry such as identifying and naming compounds, how to synthesize new compounds, and how to isolate and characterize molecules with various functional groups.

DE Adaptations for MOI

Lecture can be given in online asynchronous fashions such as through accessible pre-recorded lectures with follow along note-taking. Students can access the pre-recorded lectures the course management system. Students can submit their notes through a labeled note taking assignment in the course management system.

Method

Activity

Integration

Laboratory model kits and molecular modeling software programs will be used to create three-dimensional representations of organic molecules and demonstrate how reactions occur.

DE Adaptations for MOI

N/A-This portion is for the in-person lab.

Method

Role Playing/Simulation

Integration

Computer simulations and other multi-media will be used to demonstrate proper laboratory techniques such as how to perform attenuated total reflectance (ATR) FT-IR. Additionally simulation and multi-media resources will be utilized to observe virtual mechanisms during multi-step syntheses reactions.

DE Adaptations for MOI

Students can access accessible material through clearly labeled modules and pages in the course management system. A range of accessible resources including pre-recorded lecture videos, laboratory demonstration videos, accessible handouts, and/or other multimedia can be provided through the course management system.

Method

Discussion

Integration

Students will present and discuss the contributions of scientists from diverse backgrounds and underrepresented groups to the scientific literature. Students will post and present an article from the chemical literature or other relevant source showcasing the contribution of a scientist or scientists to the field of organic chemistry. Students will connect the work in their selected article to the concepts and reactions discussed in the course.

For example, a student can select an article focusing on a total synthesis that utilizes an alkene addition reaction covered in the course.

DE Adaptations for MOI

Discussions will be administered using online discussion boards accessed through CMS while adhering to accessibility standards.

Methods of Evaluation**Method**

Exams/Tests

Integration

Lecture midterm exams will be utilized to monitor student progress throughout the course, and modify teaching practices to better serve student learning and engagement. Exams will contain questions relevant to the course topics such as structure and bonding, molecular properties, reactions of alkenes, alkynes, and alkyl halides, stereochemistry, NMR spectroscopy and IR spectroscopy.

DE Adaptations for MOE

Testing will be done in-person and proctored.

Method

Final Performance

Integration

The final exam will assesses the students' comprehensive understanding of the identification, physical properties, chemical reactivity, and synthesis, of organic compounds containing various functional groups in addition to structure/function relationships of biochemical molecules.

DE Adaptations for MOE

Testing will be done proctored and in-person.

Method

Group Projects

Integration

Student's work will be assessed in small groups of 3 or 4 as they undertake intellectually challenging syntheses reactions and utilize spectral data to acquire or identify products using brainstorming by leveraging multiple resources and engaging in collaborative efforts.

DE Adaptations for MOE

Group projects can be done through discussion sections or group-based assignments through the CMS. Students will post in the discussion sections in the CMS. Students will submit their work for group based assignments through a clearly labeled assignment page in the CMS.

Method

Homework

Integration

Homework will be used to assess student familiarity of physical properties, chemical reactivity and synthesis of new compounds containing various functional groups, and to generate discussion.

DE Adaptations for MOE

Student can complete and turn in homework through the online CMS. Homework can be submitted through assignment pages in the CMS or through CMS quiz pages.

Method

Class Performance

Integration

Practicums and Exams are conducted to assess student knowledge of safe practices, policies, and chemical hygiene in addition to student learning and practical application of the course material. Students will evaluate experimental data, calculate and analyze results such as expected and unexpected percent yields and percent errors, troubleshoot problems, and propose alternative procedures, techniques, and/or equipment to describe and explain potential improvements.

DE Adaptations for MOE

N/A-Lab practicums are done entirely in person in laboratory. Students submit their lab practicum results in person in laboratory.

Method

Papers

Integration

Pre-laboratory assignments and formal laboratory reports will be assessed to determine student engagement and performance in evaluation and interpretation of laboratory exercises in which distillation, extraction, synthesis, purification, and characterization of compounds will be conveyed in an organized format, including an objective, table of physical properties/hazards, chemical reaction, protocol, data/results, calculations, discussion and conclusions, references, and appendix written clear and concise with appropriate scientific language, and acknowledgment of literature values.

DE Adaptations for MOE

Students can complete this outside of the lab/classroom and submit through an assignment page clearly labeled in the course management system. The assignment instructions will be provided in the course management system, and the instructor will provide feedback through the course management system in a timely manner.

Method

Research Projects

Integration

Students will engage in research projects throughout the semester where they examine a topic or researcher in the organic chemistry literature relevant to the reactions or principles covered in the course. For example, students will research a named reaction, chemical technique, or researcher of their choice in the chemical literature. To gain an appreciation for the historical and current contributions of researchers from a diverse range of backgrounds and underrepresented groups, students will highlight examples of the contributions to organic chemistry from diverse groups to their topic of choice. Students will connect the work examined in the literature to the concepts and techniques covered in the course.

DE Adaptations for MOE

Students can complete this outside of the lab/classroom and submit through an assignment page clearly labeled in the course management system. The assignment instructions will be provided in the course management system, and the instructor will provide feedback through the course management system in a timely manner.

Method

Class Participation

Integration

Students will discuss the historical and current contributions of chemists from a diverse range of cultural and ethnic backgrounds. Students will discuss the work of chemists currently practicing in the field of organic chemistry and how their work is influenced by their personal backgrounds, their research backgrounds, and the contributions of other chemists. Discussions can be held in person or via the course CMS system.

DE Adaptations for MOE

Discussion can be held on the CMS discussion board. All materials will be provided in accessible formats. The instructor will provide feedback and contribute to the discussion in a timely manner.

Assignments**Assignment Type**

Writing

In-class and/or outside of class

In-class

Outside of class

Formative or Summative

Formative

Assignment

Structure and Bonding.

Draw the Lewis structure of a vinyl chloride molecule.

Draw all the bonds in propene and indicate the hybridization of each carbon atom.

Give the ground state electron configuration of an aluminum atom.

Which of the following compounds have covalent bonds and which have ionic bonds? CH₄, CH₂Cl₂, LiI, KBr, MgCl₂, Cl₂. ed.)

Feedback: Responses will be graded based on accuracy. Partial credit will be provided for correct work for each step of the problem in addition to the correct final response. Please check the course management system for feedback on your assignment and your grade for this assignment.

How assignment will be adapted in online format

Assignment can be delivered as an online assignment through the Canvas LMS. Students will receive their grades for each assignment in the CMS gradebook. Feedback for each assignment will be provided through the CMS as either written feedback, a video or audio file, or an image containing instructor feedback.

The instructor will provide feedback through the CMS in a timely manner.

Assignment Type

Reading

In-class and/or outside of class

Outside of class

Formative or Summative

Formative

Assignment

Collaborative problem solving is a key component of scientific practice. You will read the following excerpt from the lecture textbook. After reading the assigned textbook excerpt, you will research and select a problem or example from the lecture textbook or another scholarly resource that best covers a chemical concept presented in the assigned reading. You will post your problem or example in the discussion forum and reply to 2 other student posts in the discussion forum.

Feedback: Responses will be graded based on completeness and accuracy. Please check the course management system for feedback on your assignment and your grade for this assignment.

How assignment will be adapted in online format

Students will submit their responses in the CMS discussion forum for each activity. Discussion will be facilitated by the instructor through the Canvas CMS discussion forum. Feedback for each assignment will be provided through the CMS as either written feedback, a video or audio file, or an image containing instructor feedback.

The instructor will provide feedback through the CMS in a timely manner.

Assignment Type

Writing

In-class and/or outside of class

In-class

Outside of class

Formative or Summative

Summative

Assignment

Draw and name all monochloro products you might obtain from the reaction of 2-methylpentane with chlorine.

Which of the following species would you expect to behave as electrophiles, and which as nucleophiles? H^+ , OH^- , NH_3 , Mg^{2+} .

Calculate H for each step in the gas-phase radical substitution reaction of chlorine with methane.

Sketch a reaction energy diagram for a two-step reaction with an endothermic first step and an exothermic second step. Label all parts of the diagram corresponding to reactant, product, and intermediate.

Feedback: Responses will be graded based on accuracy. Partial credit will be provided for correct work for each step of the problem in addition to the correct final response. Please check the course management system for feedback on your assignment and your grade for this assignment.

How assignment will be adapted in online format

Quizzes can be delivered in an online asynchronous or online synchronous format through the CMS. Students submit their quizzes through the CMS. Quizzes can also be delivered during in-person meeting times. Feedback for each assignment will be provided through the CMS as either written feedback, a video or audio file, or an image containing instructor feedback.

The instructor will provide feedback through the CMS in a timely manner.

Assignment Type

Writing

In-class and/or outside of class

In-class

Formative or Summative

Summative

Assignment

Exam

Please complete the following questions. Show all work clearly for each question.

Draw the structure of 3,4-diisopropyl-2,5-dimethyl-3-hexene.

Predict the product of the reaction of cyclohexene with hydrochloric acid.

Propose a mechanism to account for the formation of 1-bromo-1-ethylcyclohexane on reaction of vinylcyclohexane with HBr.

A compound of formula $C_{10}H_{14}$ undergoes catalytic hydrogenation but absorbs only 2 equivalents of hydrogen. How many rings does the compound have?

What product(s) would you expect from the reaction of cyclopentene with NBS and water? Show the stereochemistry.

Simmons-Smith reaction of cyclohexene with diiodomethane gives a single cyclopropane product, but reaction with 1,1-diiodoethane gives a mixture of two isomeric methylcyclopropane products. What are the two products, and how do they differ?

Feedback: Responses will be graded based on accuracy. Partial credit will be provided for correct work for each step of the problem in addition to the correct final response. Please check the course management system for feedback on your assignment and your grade for this assignment.

How assignment will be adapted in online format

Exams can be delivered in an online format through the CMS, as a take home format where students receive a hard copy of the exam during scheduled class meetings or during the in-person meeting times. Students can submit their exams through a labeled assignment page through the CMS or as a hard copy document during face-to-face course meetings. Feedback for exams will be provided through the CMS as either written feedback, a video or audio file, or an image containing instructor feedback.

The instructor will provide feedback through the CMS in a timely manner.

Assignment Type

Writing

In-class and/or outside of class

In-class

Outside of class

Formative or Summative

Formative

Assignment

As part of this activity, you will work collaboratively on a problem presented in-class. Please write your response or proposed solution to the problem on a separate sheet of paper. Afterwards you will be asked to share your responses with the class and the instructor at the end of the problem solving session.

Below is an example problem set that can be used during an in-class problem solving session:

Taking the known relative reactivities of 1 $^{\circ}$, 2 $^{\circ}$, and 3 $^{\circ}$ hydrogen atoms into account, what product(s) would you expect to obtain from monochlorination of 2-methyl-butane? What would the approximate percentage of each product be?

How would you prepare 2-chloro-2-methylpropane from the appropriate alcohol?

Feedback: Responses will be graded based on accuracy. Partial credit will be provided for correct work for each step of the problem in addition to the correct final response. Please check the course management system for feedback on your assignment and your grade for this assignment.

How assignment will be adapted in online format

Students can collaborate via the online CMS discussion forum and engage in instructor facilitated discussion. Students can also collaborate and discuss during the in-person meeting periods. Feedback for each assignment will be provided through the CMS as either written feedback, a video or audio file, or an image containing instructor feedback.

The instructor will provide feedback through the CMS in a timely manner.

Assignment Type

Writing

In-class and/or outside of class

Outside of class

Formative or Summative

Formative

Assignment

2-chloropropene shows signals for three kinds of protons in its ^1H NMR spectrum. Explain.

Methyl 2,2-dimethylpropanoate has two peaks in its ^1H NMR spectrum. What are their approximate chemical shifts?

Draw the structure for a compound with the following splitting pattern: $\text{C}_3\text{H}_7\text{Cl}$, with one doublet and one septet.

Propose a structure for a compound that fits the following description: a hydrocarbon with seven lines in its ^{13}C NMR spectrum.

Feedback: Responses will be graded based on accuracy. Partial credit will be provided for correct work for each step of the problem in addition to the correct final response. Please check the course management system for feedback on your assignment and your grade for this assignment.

How assignment will be adapted in online format

Assignment can be delivered online through the Canvas CMS. Students will receive instructor feedback through comments, Canvas CMS feedback, and through peer-to-peer feedback in the course discussion forums. Feedback for each assignment will be provided through the CMS as either written feedback, a video or audio file, or an image containing instructor feedback.

The instructor will provide feedback through the CMS in a timely manner.

Assignment Type

Writing

In-class and/or outside of class

Outside of class

Formative or Summative

Formative

Assignment

Discussing chemical concepts with your peers is a key way to improve your understanding and comprehension of chemical concepts. Your peers in the course have a diverse range of perspectives that inform how they approach and solve problems. To this end, you will select a chemical concept presented from any of the assigned lecture modules and propose a real life example of that chemical concept or principle. Please draw connections between your lived experiences and the chemical concepts and principles we have observed in both lecture and laboratory. Also, provide a reply to at least two of your peers' posts.

Feedback: Responses will be graded based on completeness and accuracy. Please check the course management system for feedback on your assignment and your grade for this assignment.

How assignment will be adapted in online format

Students can engage in instructor facilitated discussion through the course CMS discussion forum. Feedback for discussions will be provided through the CMS as either written feedback, a video or audio file, or an image containing instructor feedback.

The instructor will provide feedback through the CMS in a timely manner.

Assignment Type

Writing

In-class and/or outside of class

Outside of class

Formative or Summative

Summative

Assignment

Using the data collected during the in-person laboratory experiment, prepare a complete laboratory report for experiment 11 catalytic hydrogenation. Your complete laboratory report should meet each category in the laboratory report rubric.

Below are the full laboratory report requirements and rubric.

LABORATORY REPORT REQUIREMENTS:

Prelab. This portion of the lab report includes your name, date, course number (.25 points), the complete title of the experiment (exactly as it appears in the manual) 0.25 points, and the Objective (3 points). Also included is a table of chemicals and reagents with the appropriate physical and chemical properties for each substance. Table headers should be: MW, MP, BP, Density, refractive index, amount, hazards, and the table should have a number and title (Table 1: Physical and Chemical Properties of Reagents) 2 points. Table 1 is followed by Chemical Reactions (using structures not chemical formulas); if there are no reactions, this section will contain Structures (1 point).

The experimental Procedure (2 points) is given in outline form, numbered, or with bullets. Each separate technique has a subheading.

Data and Results section (3 points) is completed during the lab and includes the date and time that the results were obtained. Include all data, observations, measurements, and results in tabular format labeled: Table #: Title (.25 points). Analytical results, such as spectral data/results should be attached at the end of the report, and labeled: Figure #: Title (.25 points). You may also be asked to turn in your product, TLC, or other materials with your lab report.

Calculations This section should directly follow the Data and Results section. ALL calculations for ALL trials should be in this section, neatly organized with subheadings in the same chronological order as the experiment is performed with proper significant figures (2-3 points).

Discussion and Conclusions This section should include a summary of the data and results of the experiment, including all experimental data (give the average if multiple trials were conducted), calculated yield, % errors, comparison to literature values (give the literature values), physical data/results, chemicals tests results, graphical values, and any other necessary information required to summarize the data and results as they apply to the 'Objectives' of this lab. This section, like all other sections should be in chronological order. Lastly, point out any problems that may have affected your overall experiment and how the experiment could be improved. Such improvements should describe peer reviewed methods and/or sophisticated instrumentation from literature sources that you have researched. Stating that you will clean glassware, make less mistakes, or be more careful next time is not acceptable (4 points).

References: Give a list of references in ACS formatted style (2 points). Answer any questions that may be assigned as a part of the lab.

Feedback: Reports will be scored using the laboratory report rubric provided in the syllabus and in the course management system. Please check the course management system for feedback on your assignment and your grade for this assignment.

How assignment will be adapted in online format

Students can prepare their laboratory report asynchronously using the data collected during the in-person lab sessions. Students can review example reports, rubrics, and guides to writing lab reports through accessible resources and pages found in the CMS. Labs

will be completed in a face-to-face format as required to fulfill the course laboratory learning objectives. Feedback for reports will be provided through the CMS as either written feedback, a video or audio file, or an image containing instructor feedback.

The instructor will provide feedback through the CMS in a timely manner.

Assignment Type

Writing

In-class and/or outside of class

Outside of class

Formative or Summative

Formative

Assignment

Organic chemistry has had a notable impact on our lives and society. Individuals from diverse backgrounds and underrepresented backgrounds have contributed to the field of organic chemistry. Importantly, the products of research in organic chemistry such as chemical process, pharmaceuticals, and chemical products have often led to disparate impacts on underrepresented groups and disadvantaged populations.

As part of this activity, you will select a chemical process, pharmaceutical, or chemical product developed through the application of organic chemistry and research the impact of that pharmaceutical

or chemical product on society. If the product or pharmaceutical has had a disproportionate impact (positive or negative) on a specific group or subsection of society, please highlight that impact in your response.

Feedback: Responses will be graded based on completeness and accuracy. Please check the course management system for feedback on your assignment and your grade for this assignment.

How assignment will be adapted in online format

Students can engage in instructor facilitated discussion through the course CMS discussion forum. Feedback for discussions will be provided through the CMS as either written feedback, a video or audio file, or an image containing instructor feedback. The instructor will provide feedback through the CMS in a timely manner.

Assignment Type

Writing

In-class and/or outside of class

Outside of class

Formative or Summative

Summative

Assignment

Write a discussion post (via CMS) to highlight the contributions of chemists from diverse cultural, ethnic, and gender backgrounds to the field of organic chemistry. Your post can focus on the development of a reaction, the synthesis of a natural product or other molecule, or the development of laboratory processes and practices. Grades will be based on the clarity of writing, accuracy of scientific explanations, and thoughtful discussion of diversity and historical context. Feedback will be provided within a reasonable timeframe after submission.

How assignment will be adapted in online format

This assignment can be assigned as a discussion through online discussion boards in CMS.

Course Materials

Textbooks

Mayo, Pike, and Forbes (2023). Microscale Organic Laboratory, 7th ed. John Wiley and Sons. ISBN: 978-1-119-11052-1

Klein, D. , Starkey, L (2025). Organic Chemistry, 5th ed. John Wiley and Sons. ISBN:978-1394189373

Other Resources

Minimum Qualification

Class Size Information

Class Size

24

Class Size Category

J - Specialty lab

Diversity and Inclusion

Course Design and Materials: Course will incorporate diverse perspectives, authors, and examples that reflect a variety of cultures, identities, and lived experiences. Instructional materials will be reviewed regularly to ensure representation, inclusivity, and alignment with equity-minded practices across disciplines.

Inclusive Learning Environment: Instructors will establish classroom norms and policies that promote respect, civil discourse, and belonging in both online and face-to-face classes. Clear expectations for communication and engagement will support a learning space where all students feel valued and heard.

Accessible Instruction: Course content will be delivered using accessible design. Materials will follow accessibility guidelines within the CMS, including captioned media, readable document formats, and multiple means of engagement to support diverse learning.

Equitable Teaching Practices: Instructors will use transparent and grading criteria, varied assessment methods, and timely feedback to promote fairness and student success. Opportunities for revision, reflection, and multiple demonstrations of learning may be incorporated when appropriate to the discipline.

Culturally Responsive Pedagogies: Instructional strategies will encourage critical thinking about diverse perspectives and systems of power relevant to the course content. Faculty will foster opportunities for students to connect course material to real-world contexts.

Ongoing Reflection and Improvement: Faculty will engage in continuous professional development related to IDEAA principles and reflect on course practices using metacognition to identify opportunities for increased equity, inclusion, and accessibility.

Explain how diversity and inclusion(e.g., gender, culture/race, sexuality, etc.) is infused into the course.

The course revisions operate with a foundational intention of Diversity and inclusion. While vastly underrepresented in the field; women, BIPOC, LGBTQ+, and disabled scientists have made contributions in chemistry, these scientists and their accomplishments will be highlighted within the lecture content and as the focus of an assignment. Students will examine the contributions of a diverse range of chemists to the field of organic chemistry through an examination of their contributions to the development of named organic reactions covered in this course. The historical and current contributions of scientists from underrepresented to groups to the chemical literature will be highlighted by reviewing article excerpts and publications from these scientists showcasing the application of organic reactions and principles to organic synthesis.

Describe how assignments, instruction, evaluation, course content, and interactions are contextualized for diverse learners promoting an equitable course.

To support diverse learners, more emphasis has been placed on the process of learning and establishing a growth mindset, as well as the role of individual differences in the learning process. This will encourage students to have an increased self-awareness, awareness of others and to engage as individuals and value students as whole people in the learning process. We have incorporated increased reflection on the process of learning to support students who may be new to academia, especially those from under-represented groups. We have made adjustments to the course to explicitly highlight contributions to organic chemistry, both historical and current, from people other than the European white males typically presented in textbooks so as to inspire students from groups that historically have not felt welcome in science courses to see science as diverse and inclusive. We have adjusted the methods of instruction and evaluation to include a diversity of modes beyond lectures and exams to encourage greater engagement, community, and support for students. Assignments show a variety of approaches to the course content utilizing a variety of sources, including

written texts, popular and scientific articles, accessible videos, and websites while scaffolding approaches to help them understand the critical reading and thinking process.

A variety of different types of assignments are used throughout the course and students are given many opportunities to choose the topic of focus for the assignments. The course content, objectives, methods of instruction, methods of evaluation, and assignments, allow students to interact with their instructor, and each other, while learning about real world issues, to build critical thinking skills in community and through personal interaction, in-class and out of class practice to apply skills, and to receive feedback both informally in discussions and other formative types of low stake assignments and formally through summative assessments.

Interactions

Explain how the course will incorporate student-to-student interaction.

Students will engage in a variety of collaborative activities such as break-out rooms, discussion boards, or small group assignments online through the CMS so that students will have frequent opportunities to engage in peer-to-peer discussions designed to foster community and encourage students to experience variant interpretations of the content under analysis. Students will share their perspective and approach to open ended organic synthesis problems and collaborate with their peers to refine and improve their retrosynthesis and forward synthesis routes. During the in-person class meetings, students will have the opportunity to discuss and interpret the results of their completed laboratory experiments.

Students will successfully perform laboratory experiments individually and compare, contrast, and discuss their data and results with their peers. Many organic chemistry lab experiments explicitly require students to compare their results with results obtained by other students and discuss the similarities and differences in their results with their peers. Importantly, students will collaborate to identify ways the experiment could be improved or refined to increase the yield, more efficiently identify the unknown, and/or improve the precision and accuracy of the collected physical property data. Cooperation and collaboration will be required to successfully perform and analyze the results of laboratory experiments.

Explain how the course will incorporate instructor-to-student interaction.

The instructor will lead lectures in class or online either synchronously or asynchronously. Discussions will be conducted in person during class or through CMS discussion forums, or through breakout rooms in a video-conferencing platform. The instructor will lead and guide students through laboratory exercises and in-person lecture activities. The instructor will provide feedback to students in the CMS gradebook with regards to responses to formative assignments such as discussions and presentations, as well as provide feedback on summative assignments such as reports, projects, and exams. For example, the instructor will provide feedback on the summative laboratory reports in order to improve the style, formatting, and presentation of the laboratory report to align with ACS style guidelines. As organic chemistry problems are often open-ended, the instructor feedback can include discussions of alternative routes and approaches to solve synthesis problems. The instructor will communicate with students in class as well as through canvas announcements, email, discussion boards, and in office hours. Frequent instructor feedback and instructor-to-student interaction contributes to student mastery of laboratory techniques and their mastery of the course lecture concepts.

Explain how the course will incorporate student-to-content interaction.

To learn critical thinking concepts and explore chemical processes, the instructor will provide a variety of media for learning. Students will reference accessible and ADA compliant materials such as assigned readings (textbooks, lab manuals/exercises, articles, websites), written lecture materials or transcripts of lectures, illustrative images, charts and graphs, video or audio lectures, narrated PowerPoint presentations, embedded or linked multimedia content (such as films, YouTube videos, lab simulations, podcasts, etc.), and student created content, through presentations and discussions.

Explain how the course will incorporate student-to-self interaction (metacognitive).

Through discussions, presentations, and assignments, students will pose questions about science as well as how they approach their assignments and analysis. Through readings, lectures, activities, and discussions, students will explore connections between the course content and personal experiences, to demonstrate how science can be a vehicle for analyzing current societal and community concerns. The analytical and critical thinking skills students use in this course while analyzing scientific information have broad applications beyond the classroom. Many assignments in this course allow students to choose their own topic and to reflect on why they chose the topic, how they relate to the topic, and how they may use the newfound information to impact their lives, the lives around them, and the environment.

Through the course assignments and activities students will connect organic chemistry concepts to their personal experiences and their prior knowledge from related chemistry and biology courses. Students will be able to realize their prior experience and knowledge using the concepts and approaches presented throughout the organic chemistry course. The course challenges students to grapple with their own relationship to organic chemistry and how chemical literacy is crucial to effective citizenship and to addressing current societal, community, and personal concerns.