CHEM-102: GENERAL CHEMISTRY II

Effective Term
Fall 2026

BOT Approval Date
12/11/2025

Discipline
CHEM - Chemistry
Course Number
102

Course Title
General Chemistry II

Short Title
General Chemistry II

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
During face-to-face meetings, students will conduct laboratory experiments that provide valuable hands-on experience with chemistry. These lab sessions are designed to complement and reinforce the concepts covered in lectures, allowing students to apply theoretical knowledge in a practical setting and also meet the lab objectives.
Students will work with real laboratory equipment, follow proper safety procedures, and develop essential skills such as accurate measurement, data collection, analysis, and critical thinking. It will also provide opportunities for students to collaborate with peers, direct guidance from the instructor, and receive immediate feedback to support their learning.

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.

Catalog Description
This course is a continuation of Chemistry 101. Special emphasis is given to chemical kinetics, equilibrium, thermodynamics, acid-base equilibria, electrochemistry, common reactions of metals and non-metals with an introduction to qualitative analysis.

Requisites

Prerequisite(s)

Prerequisite(s) (must be taken before)
CHEM-101 (with a grade of C or better).

Codes

TOP Code (CB 03)
1905.00 - Chemistry, General

CIP Code
40.0501 - Chemistry, General.

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. Derive the rate law of a chemical reaction, both graphically and by calculation, if supplied changing concentration versus time data and deduce the overall reaction and rate expression when provided with the reaction mechanism.
2. Estimate the activation energy of a reaction graphically or by calculation when given rate constant versus temperature data.
3. Calculate equilibrium concentrations for a reaction system using the concept of mass action and predict shift in direction of a chemical reaction with changes of pressure, temperature, and concentration using LeChatelier's principle.
4. Differentiate between the pH of weak and strong acids, bases and salt solutions and how molecular structure effects these properties.
5. Predict spontaneity of chemical reactions by using thermodynamic tables and free energy concepts as well as calculate entropy and free energy changes in chemical reactions.
6. Classify complex ions and determine the ions coordination number.
7. Predict the products or reactants of alpha and beta decays.
8. Identify organic functional groups.
9. Construct a diagram of a spontaneous electrochemical cell given the cell line notation and calculate the amount of mass deposition over a given period of time.
10. Investigate the general properties of acids bases and salts and show the effect of molecular structure on the pH of solutions. Additionally students will be able to plot titration curves given experimental data and predict ion precipitation based upon solubility principles.
11. Predict cell spontaneity based upon cell potential values. Additionally, how cell potential varies with concentration and explain how batteries and electrolysis processes are related to electrochemical cells.
12. Maintain a safe laboratory environment through proper manipulation of equipment and careful observation of experiments.
13. Determine the identity of ions in an unknown solution using properties of solubility and solution.
14. Discuss the contributions of chemists from diverse cultural, ethnic, and gender backgrounds to areas such as chemical kinetics, equilibrium, and nuclear chemistry, and reflect on how inclusion strengthens scientific innovation.

Learning Outcome Information

Course Learning Outcomes

Learning Outcome
1. Students will apply the principles of chemical equilibrium to find final concentrations of reactants and products when initial concentrations or partial pressures are given.
2. Students will graphically determine the reaction order is zero when concentration versus time data is provided
3. Students will determine if a chemical reaction is spontaneous or not based on the information provided.

4. Students will demonstrate proficiency on general chemistry topics from national American Chemical Society (ACS) General Chemistry Sequence Exams as per the CHEM 120S Sequence C-ID Descriptor by achieving a score that is one-half of one standard deviation below the national average (or higher) on the General Chemistry Exam.

5. Students will utilize problem-solving strategies to independently analyze and solve chemistry problems.

Content

Course Lecture Content

1. Chemical Kinetics:
    a. Reaction rates
    b. Rate laws
    c. Zero, first and second order reaction
    d. Activation energy and temperature dependence of rate constants
    e. Collision theory
    f. Arrhenius equation
    g. Reaction mechanisms
    h. Catalysis
2. Chemical Equilibrium:
    a. Chemical equilibrium and the equilibrium constant
    b. Le Chatelier's principle
    c. Factors that effect chemical equilibrium
    d. Solving equilibrium problems
3. Acids and Bases:
    a. General properties, nature and strength of acids and bases
    b. Auto-ionization of water and pH scale of acids and bases
    c. Properties of salts
    d. Effect of structure on acid-base properties
    e. Acid-base properties of oxides
    f. Lewis acid-base model
4. Applications of Aqueous Equilibria
    a. Solutions of acids or bases containing a common ion
    b. Buffered solutions and buffer capacity
    c. Acid-base indicators
    d. Complex ion equilibria
    e. Solubility equilibria and solubility product constant
    f. Precipitation and qualitative analysis.
5. Spontaneity, Entropy and Free Energy:
    a. Spontaneous processes and entropy
    b. Second law of thermodynamics
    c. Spontaneous processes
    d. Free energy and entropy changes in chemical reactions
    e. Free energy and equilibrium.
6. Electrochemistry:
    a. Electrochemical cells and standard reduction potentials
    b. Cell potential
    c. Free energy dependence of cell potential on concentration
    d. Batteries
    e. Electrolysis
7. Organic Chemistry:
    a. Alkanes, alkenes, and aromatic hydrocarbons
    b. Alcohols, aldehydes, and ketones
    c. Carboxylic acids, esters, ethers and amines.
8. Descriptive Chemistry:

   a. Silicates, carbon, carbide and carbonates
   b. Nitrogen, phosphorous, oxygen, sulfur, and halogens
   c. Metal and alloys
9. Coordination Chemistry:
   a. Naming coordination compounds
   b. Structure and Isomerization
   c. Spectroscopic and magnetic properties of coordination compounds
10. Nuclear Chemistry:
    a. Nuclear structure and stability
    b. Nuclear equations
    c. Types of radioactivity
    d. Use of radioisotopes
11. Effect of Diversity in Advancing Chemistry
    a. Contributions of chemists from diverse and underrepresented groups
    b. Influence of diverse perspectives on key discoveries of thermodynamics, kinetics, coordination compounds and nuclear chemistry

Course Lab Content

1. General safety in the laboratory:
   a. General rules of conduct
   b. Personal protective equipment
   c. Hazardous materials waste disposal
   d. Chemical spills
   e. Handling glassware and sharps
   f. Accident safety
2. Lab techniques:
   a. Weighing
   b. Filtration
   c. Titration
   d. Correct use of equipment and glassware
   e. pH measurement
   f. Spectrophotometry
3. Data collection and analysis:
   a. Efficient data reporting
   b. Interpret results
   c. Effective communication of scientific information
4. Application of key general chemistry concepts through guided laboratory experiments:
   a. Chemical kinetics and rate law
   b. Chemical equilibrium and Le Châtelier’s Principle
   c. Solubility
   d. Acid-base reactions and buffers
   e. Thermodynamics
   f. Electrochemistry
   g. Coordination chemistry
   h. Qualitative Analysis
5. Inclusive communication and teamwork:
   a. Collaborative learning
   b. Small-group problem-solving activities
   c. Respect for diverse perspectives
   d. Equitable participation

Methods of Instruction

Method

Discussion

Integration

In class group discussions and assignments will be carried out to involve students in peer-interactions, critical thinking, and active learning. The discussions can be used for gaining a better understanding of theories in chemical equilibrium, thermodynamics, electrochemical cells and discuss the effect of distinct perspectives or cultural backgrounds on research and problem-solving approaches in chemistry.

DE Adaptations for MOI

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

Method

Film/video Viewing and Discussion

Integration

Videos, animations, and simulation tools can be used to assist the visual analysis of chemistry concepts. Examples include (1) exploring chemical equilibrium and kinetics using interactive plots, (2) interactive simulations for carrying out acid/base titrations and determining the pH of solution.

DE Adaptations for MOI

Accessible video tutorials can be used to reinforce key chemical concepts. All content will be designed to incorporate Culturally Responsive Teaching and Universal Design strategies and will be made available through the MSJC CMS.

Method

Lab Activities

Integration

Lab activities will be used to (1) conduct experiments that include wet, dry, and computer assisted learning activities, (2) collect scientific data while performing lab experiments, (3) Format and complete lab reports using scientific methods including an organized presentation of data and results, (4) Demonstrate application of knowledge by generating responses to post-laboratory questions. Lab activities will be designed to reinforce key content areas including chemical kinetics, chemical equilibrium, qualitative analysis, thermodynamics and acid base chemistry.

DE Adaptations for MOI

Lab activities will be in-person. DE adaptations are not applicable.

Method

Lecture

Integration

Use of presentation software (Microsoft office, WebMO, document visualizer, etc.) and whiteboard will be used to present the topics of chemical kinetics, rate laws, chemical equilibrium, colligative properties, acids and bases, entropy and free energy, electrochemistry, organic chemistry, coordination chemistry, and nuclear chemistry. Learning assessment activities like periodic quizzes may be used to help assess student progress.

DE Adaptations for MOI

Accessible lecture videos covering key topics will be provided to accompany lecture notes uploaded to the MSJC CMS.

Method

Observation and Demonstration

Integration

The instructor will use demonstration of reactions and calculations to facilitate content mastery related to key learning objectives like chemical kinetics, chemical equilibrium, acid-base chemistry, thermodynamics and electrochemical cells.

DE Adaptations for MOI

Accessible tutorials and interactive web-based computer simulations can be used to facilitate content mastery related to key learning objectives. All content or links to content will be made available in the CMS.

Methods of Evaluation

Method

Exams/Tests

Integration

Lecture examinations (midterms and final exams) requiring critical analysis and integration of information presented in the lectures, tutorials, case studies, and the textbook can be used to assess student learning. The exam will assess content knowledge associated with reaction rates, activation energy, radioactive decay, equilibrium and thermodynamics. Exams should constitute no more than 35% to 50% of the course grade. Final exams should constitute no more than 20% to 30% of the course grade. The ACS general chemistry exam may be used as the final exam.

DE Adaptations for MOE

The lecture exams will be given in-person. DE adaptations are not applicable.

Method

Homework

Integration

Homework assignments can be used to assess how students are learning the concepts covered during the course. Assigned homework will cover key course objectives including rate laws, the spontaneity of electrochemical cells, and the application of LeChatelier's principle to predict a shift in direction of a chemical reaction with changes to the reaction conditions. Homework should constitute no more than 0% to 15% of the course grade.

DE Adaptations for MOE

Regular assessment of student learning can be carried out using homework activities directly integrated into the CMS that will also provide the students with rapid feedback. All homework assignments will adhere to accessibility standards.

Method

Class Performance

Integration

Pre-laboratory assignments and laboratory reports will be used to assess safe and effective use of glassware, equipment, chemical supplies while monitoring preparedness, organizational skills, and data analysis. Topics can include titration curves, chemical kinetics, chemical equilibrium, and thermodynamics. Additionally, students will demonstrate inclusive communication and teamwork skills during lab and group problem-solving activities, fostering respect for diverse perspectives and equitable participation. Laboratory exercises should constitute no more than 30% to 40% of the course grade.

DE Adaptations for MOE

The laboratory assignments must be performed in-person. However, lab reports may be submitted directly to the instructor during the face-to-face laboratory meetings or electronically using the MSJC CMS as directed by instructor. Laboratory assignments will be graded by the instructor and returned to the student within reasonable timeframe.

Method

Quizzes

Integration

Quizzes can be used to assess student comprehension and academic progress to improve the learning experience. This will allow students low-stakes opportunities to check their understanding. Quizzes may account for no more than 15 - 20% of the overall course grade. Optional ungraded practice quizzes can be made available to help students prepare and self-assess.

DE Adaptations for MOE

Quizzes can be delivered through the CMS. Time limits and randomized question banks can be used to ensure academic integrity. All quizzes will adhere to accessibility standards.

Assignments

Assignment Type

Reading

In-class and/or outside of class

In-class

Formative or Summative

Summative

Assignment

In this laboratory assignment you will determine the solubility product of silver acetate, and observe the effect of common ion on solubility. Review the following paragraph to gain some background about solubility product of silver acetate.

Silver acetate, though moderately soluble, has a much lower solubility than many common salts. Its solubility can be represented by the equilibrium:
AgC2H3O2(aq) -> Ag+(aq) + C2H3O2-(aq)
The solubility product constant, Ksp, can be determined by measuring the concentration of Ag+ ions in a saturated solution. Ksp for silver acetate will be determined both in water, and in solutions in which a common ion is present. The concentration of silver ion in the silver acetate solutions will be determined by a precipitation titration of a standard potassium chloride solution (Mohr method), using potassium chromate as indicator. Silver acetate and potassium chloride react according to the following equation:

AgC2H3O2(aq) + KCl(aq) -> AgCl(s) + KC2H3O2(aq)

From the volume of silver acetate solution required to titrate a given sample of standard KCl, the concentration of the silver acetate solution may be calculated by usual solution stoichiometric methods. When a common ion such as Ag# from AgNO# is present, the solubility of AgC#H#O# decreases due to the common ion effect. Comparing Ksp values under both conditions will demonstrate this principle.

Remember to follow these safety precautions during lab:
- wear safety glasses at all times while in the laboratory.
- Silver compounds can stain the skin if spilled. The stain is due to the reduction of silver ion to metallic silver on the skin and is not dangerous. The stain will wear off in 2-3 days.
- Chromium and nitrate compounds are toxic. Wash hands after use.
- Dispose of all reagents in the proper “waste container”

Follow this procedure to determine solubility and solubility product of silver acetate in distilled water:
Record all data and observations directly in your notebook. Rinse the buret twice with tap water then once with distilled water. A clean buret will have no water spots clinging to the insides of it. In order to be certain that the silver acetate solutions are saturated with silver acetate, an excess quantity of solid silver acetate has been added to each solution, which must be removed before the solutions are used in the titrations that follow. The solutions will be filtered by the lab tech before coming out into the lab, but if any residue remains you must filter the solution again. Obtain approximately 70 ml of saturated silver acetate (in distilled water) and filter through a gravity funnel/filter paper to remove any cloudiness/solid. Rinse the buret with small portions of the filtered silver acetate solution; then fill the buret and record the initial reading to the nearest 0.02 ml (reading the bottom of the meniscus). Pipet 10 ml of the standard 0.0500 M KCl solution into a clean Erlenmeyer flask. Then add 15 ml of distilled water. Add approximately 1 ml of 5% potassium chromate solution. The color change of this indicator is rather subtle, form bright lemon yellow to a “dirty” yellow/brown color. Titrate the KCl solution with the silver acetate until the indicator changes color. Record the final volume of silver acetate solution in the buret. Repeat the determination again for consistent results. From the concentration of the KCl and from the pipet and

buret volumes, calculate the concentration, in moles per liter, of silver ion in the saturated solution of silver acetate in distilled water. Using the mean concentration of silver ion for your three determinations, calculate the solubility product of silver acetate.

Follow this procedure to determine solubility of Silver Acetate in 0.100 M silver Nitrate:
Obtain approximately 70 ml of saturated silver acetate solution containing 0.100 m silver nitrate. Silver nitrate is an ionic solute that contains an ion common to the silver acetate solubility equilibrium. Filter the solution to remove cloudiness/solid. Rinse the buret with the filtered solution; then fill the buret and record the initial volume to the nearest 0.02 ml. Pipet a 25-ml portion of the standard 0.0500 M KCl solution into an Erlenmeyer flask and add approximately 1 ml of the 5% potassium chromate solution. Titrate the KCl sample with silver acetate solution until the indicator changes from lemon yellow to "dirty" yellow/brown. Repeat the determination steps again for consistent results. From the concentration of the standard potassium chloride solution, and from the pipet and buret volumes, calculate the concentration of silver ion, in moles per liter, in the saturated silver acetate solution that also contains 0.100 M silver nitrate. Using the mean concentration of silver ion for your three trials, calculate the solubility product of silver acetate.

Lab Report Completion and Submission:

To complete lab report, record all your collected data, show step-by-step calculations of solubility and Ksp values, and discuss results including the observed effect of the common ion on solubility in the lab report section of the lab manual. Additionally, complete any assigned post-lab questions. Submit the completed lab report (with pre-lab) to your instructor during lab or through the CMS, as directed. Reports will be graded for completeness, data accuracy, analysis, and clarity and feedback will be returned within a reasonable timeframe.

How assignment will be adapted in online format

The assignment cannot be completed in online format however, lab report submission and feedback can happen via CMS.

Assignment Type

Writing

In-class and/or outside of class

In-class
Outside of class

Formative or Summative

Formative

Assignment

Solve the following questions. Show all your calculations and submit work to your instructor during face-to-face meetings or via CMS (as instructed). The assignment will be graded for completeness and accuracy, and feedback will be provided in reasonable time.
1. Chemical Kinetics
a. Consider the reaction
4PH3(g) -----> P4(g) + 6H2(g)
If 0.0048 mol of PH3 is consumed in a 2.0-L container each second of reaction, what are the rates of production of P4 and H2?
b. The decomposition of ethanol (C2H5OH) on an alumina (Al2O3) surface C2H5OH(g) ------> C2H4(g) + H2O(g) was studied at 600 K. Concentration versus time data were collected for this reaction, and a plot of [A] versus time resulted in a straight line with a slope of -4.00 X 10-5 mol/L.sec.
1. Determine the rate law, the integrated rate law, and the value of the rate constant for this reaction.
2. If the initial concentration of C2H5OH was 1.25 X 10-2 M, calculate the half-life of this reaction.
3. How much time is required for all the 1.25 X 10-2 M C2H5OH to decompose?
c. The radioactive isotope 32P decays by first-order kinetics and has a half-life of 14.3 days. How long will it take for 95% of a sample of 32P to decay?
d. It took 143 seconds for 50% of a particular substance to decompose. If the initial concentration was 0.060 M and the decomposition reaction follows second-order kinetics, what is the value of the rate constant?
e. A first-order reaction has rate constants of 4.6 X 10-2 sec-1 and 8.1 X 10-2 sec-1 at 0oC and 20oC, respectively. What is the value of the activation energy?
f. The mechanism for the reaction of nitrogen dioxide with carbon monoxide to form nitric oxide and carbon dioxide is thought to be:
NO2 + NO2 ----------> NO3 + NO slow
NO3 + CO -----------> NO2 + CO2 fast
Write the rate law expected for this mechanism. What is the overall balanced equation for the reaction? Is there an intermediate in this mechanism? Is there a catalyst in this mechanism?

2. Acids and Bases : General Properties

a. Write the dissociation reaction and the corresponding Ka equilibrium expression for each of the following acids in water.
1. $HC_2H_3O_2$
2. $Co(H_2O)_6^{3+}$
3. $CH_3NH_3^+$

b. Place the species in each of the following groups in order of increasing acid strength. Explain the order you chose for each group.
1. HIO_3 , $HBrO_3$
2. HNO_2 , HNO_3
3. HOCl, HOI
4. H_3PO_4, H_3PO_3

c. Calculate the [OH-] of each of the following solutions at 25oC. Identify each solution as neutral, acid or basic.
i). [H+] = 1.0 X 10-7 ii) [H+] = 6.7 X 10-4. iii) [H+] = 1.0 X 10-7 iv) [H+] = 1.0 X 10-7

d. Arrange the following 0.10 M solutions in order of most acidic to most basic. KOH, KCl, KCN, NH_4Cl, HCl

e. Using the Ka values supplied in the text, calculate the percent dissociation in a 0.20M solution of each of the following acids.
1. nitric acid (HNO_3)
2. nitrous acid (HNO_2)
3. phenol (HOC_6H_5)
4. how is the percent dissociation related to the Ka and acid structure.

f. Will the following oxides give acidic, basic or neutral solutions when dissolved in water? Write reactions to justify your answer.
1. CaO
2. SO_2
3. Cl_2O

g. Use the Lewis acid-base model to explain the following reaction.
$CO_2(g) + H_2O(l) \longrightarrow H_2CO_3(aq)$

How assignment will be adapted in online format

Similar assignments can be designed to integrate in CMS as a Quiz allowing for auto-grading of objective questions and instructor review of problem-solving/short answers. All quizzes will adhere to accessibility standards.

Assignment Type

Writing

In-class and/or outside of class

Outside of class

Formative or Summative

Formative

Assignment

Choose a chemist whose work, values, or life experiences resonate with you, and delve into their contributions to the field. Write an essay (1000-1500 words) to highlight the scientist's significant achievements and reflect on the reasons behind your personal connection to their work. Analyze how their gender, background and ethnicity might have influenced their research and discuss the impact of their research on the field of chemistry. Grades will be based on clarity of writing, depth of analysis, accuracy of scientific content, and personal reflection. 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.

Assignment Type

Writing

In-class and/or outside of class
Outside of class

Formative or Summative
Summative

Assignment
Write an essay (1000-1500 words) / discussion post (via CMS) to highlight development of modern nuclear chemistry through the contributions of chemists from diverse cultural, ethnic, and gender backgrounds, highlighting the discovery of radioactivity and progress in isotopic and nuclear research. Grades will be based on the depth of research, 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
Zumdahl S. S., Zumdahl S. A., DeCoste D. J. (2024). Chemistry, 11th Edition, Cengage. ISBN: 9780357850671
Beran J. A., Lassiter M. (2022). Laboratory Manual for Principles of General Chemistry, 11th Edition, Wiley. ISBN: 978-1-119-57768-3
Tro N. J. (2022). Chemistry: a molecular approach, 6th Edition, Pearson. ISBN: 13: 9780137493616
Brown T. E., LeMay E., Bursten B., B. Murphy, C., Woodward, P., Stoltzfus M. E. (2022). Chemistry: the Central Science, 15th Edition, Pearson. ISBN: 13: 9780137493609.

Class Size Information

Class Size
28

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.

Diversity and inclusion are intentionally integrated into both the laboratory and online lecture components of this course. Students from diverse backgrounds are encouraged to collaborate and engage meaningfully with one another throughout the semester. In the laboratory, students complete hands-on assignments in collaborative groups, fostering respectful communication, teamwork, and problem-solving in an inclusive environment. This allows students to interact with peers, helping to build a sense of community and mutual respect. Laboratory experiments are often contextualized with real-world applications that highlight contributions from scientists of diverse genders, cultures, and ethnicities, illustrating how chemistry advances impact communities worldwide.
In the online lecture setting, discussion assignments (administered vis CMS) are intentionally designed to give every student the opportunity to share their unique perspectives and experiences. These discussions promote an environment where diverse voices are acknowledged, valued, and appreciated further encouraging engagement and mutual respect among students.
The course also recognizes that students have different learning styles and accessibility needs. Lecture materials are provided in multiple formats including video recordings, transcripts, and. accessible documents to support students with varying learning preferences.
This is a sample assignment that can be utilized to help student understand the effect of diversity and inclusion in scientific development. Write an essay (1000-1500 words) / discussion post (via CMS) to highlight development of modern nuclear chemistry through the contributions of chemists from diverse cultural, ethnic, and gender backgrounds, highlighting the discovery of radioactivity and progress in isotopic and nuclear research.

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

Several formats of assignments are included in both online and in-person sessions including discussions, quizzes, exams, homework and lab assignments etc to evaluate student’s performance. All assignments are developed with flexibility and accessibility in mind to encourage critical thinking and emphasize fairness and equity. Multiple teaching modalities are integrated during instruction, including recorded lecture videos, lecture notes, and supplemental textbook readings, to accommodate different learning preferences such as visual, auditory, and kinesthetic learning. Clear instructions and examples are provided to reduce barriers and help all students understand expectations. Course content is designed to illustrate how the concepts learnt in chemistry can impact people across cultures, and environments. Representation of scientists from varied genders, ethnicities, and backgrounds is integrated throughout lectures and assignments to foster a sense of belonging (example included in assignment). Interactions in both lab and online settings are designed to be inclusive and respectful. In labs, collaborative group work encourages peer learning and values contributions from all team members. The use of structured discussion boards promotes positive, professional dialogue and create an equitable space for participation in the online setting.

Interactions

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

The course will incorporate multiple opportunities for student-to-student interaction to enhance learning and build a collaborative environment in both in-person and online modalities. During in-person lab meetings, students will work in groups to complete experiments, encouraging teamwork, problem-solving, and respectful communication. Group lab activities also allow students to share ideas, troubleshoot challenges together, and develop stronger interpersonal and collaborative skills.
In addition, the course will utilize online discussions through CMS to promote interaction beyond the lab setting. These discussions provide a platform for students to engage in meaningful conversations, exchange diverse perspectives, and support one another in understanding complex concepts. Here is a sample assignment that can help achieve this- Write an essay (1000-1500 words) / discussion post (via CMS) to highlight development of modern nuclear chemistry through the contributions of chemists from diverse cultural, ethnic, and gender backgrounds, highlighting the discovery of radioactivity and progress in isotopic and nuclear research.

Here is another example. Choose a chemist whose work, values, or life experiences resonate with you, and delve into their contributions to the field. Write an essay (1000-1500 words) / discussion post (via CMS) to highlight the scientist’s significant achievements and reflect on the reasons behind your personal connection to their work. Analyze how their gender, background and ethnicity might have influenced their research and the impact their research had on the field of chemistry.

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

Regular announcements will be posted to keep students informed about upcoming deadlines, lab schedules, and important course updates. The course on CMS will serve as a central hub where students can access lecture materials, assignments, and additional resources at any time. Additionally, in-person lab meetings will provide valuable opportunities for direct interaction, where students can ask questions, seek clarification, and receive immediate feedback during hands-on activities. Additionally, lecture materials and supplemental resources will be made available online, allowing students to review content at their own pace and come prepared with questions for deeper discussions. Beyond these structured interactions, the instructor will maintain open lines of communication through email, and CMS messaging to support students individually. For instance, instructor will use varied presentation softwares (PowerPoint, WebMO, document visualizer, etc.) and whiteboard to present key topics of general chemistry to students during in-person lectures where students can ask questions for immediate clarifications. Similarly accessible lecture videos can be used to deliver the same in online format via CMS and student queries can be answered via announcements/emails.

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

The course can incorporate multiple strategies to promote meaningful student-to-content interaction, ensuring that students actively engage with the material. Students will interact with the content through hands-on lab experiments, where they will apply theoretical concepts to practical situations, reinforcing their understanding through experiential learning. Lecture materials and interactive modules will be available online through CMS, allowing students to review lessons and engage with content at their own pace. Periodic assessments (online and/or in-person) will be utilized to further encourage students to think critically and apply concepts in various contexts and evaluate their learning. For instance, Quizzes (no more than 15 - 20% of the overall course grade) can be used to evaluate student comprehension and academic progress to improve the learning experience. This will allow students low-stakes opportunities to check their understanding. Optional ungraded practice quizzes can be made available to help students prepare and self-assess.

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

Throughout the semester, students will engage in activities that encourage self-assessment and critical reflection. For example, completing lab reports, analyzing data will require students to analyze their methods, evaluate their results, and identify areas for improvement. Reflective assignments, such as discussion posts, quizzes, exams etc with timely feedback will allow students to monitor their progress and adjust their study strategies accordingly

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