

CHEM 102, Fall, 2025

General, Organic, and Biological Chemistry

Lectures times: Tuesday, Thursday, and Friday 14:00-15:15

Mode of Delivery: In person lectures in NE 60

Instructor: Rachel Staley

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During the week, I usually respond to emails within 24 hours.

Office hours: Tuesday, Thursday, and Friday 11:00-12:30

Office hour location: CSL 226

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This course in your degree:

This course fulfills a requirement for nursing students

Course description

This course gives an overview of the concepts in general, organic, and biological chemistry that are necessary to understand human biochemistry and pharmacology. These include measurements, use and conversion of units, significant figures, chemical bonding, stereochemistry, acidity, functional groups, thermodynamics, carbohydrates, lipids, nucleotides, nucleic acids, amino acids, proteins, enzymes, and metabolic pathways.

Course materials

An introduction to General, Organic, and Biological Chemistry, 14th edition (Pearson) by Timberlake, available through Day1Ready.

Homework, needs to be purchased from Pearson and is available through Day1Ready.

Student learning outcomes

Students that have completed this course should be able to:

Define the term chemistry and identify substances as chemicals. Describe the activities that are part of the scientific method. Use place values, positive and negative numbers, percentages, solve equations, interpret graphs, and write numbers in scientific notation.

Use metric or SI units in measurements, including length, volume, mass, temperature, and time. Distinguish measured and exact numbers and determine the number of significant figures in a measured number. Adjust calculated answers to give the correct number of significant figures. Use the numerical values of metric prefixes. Write and use conversion factors. Calculate the density, the mass, and the volume substances.

Distinguish pure substances and mixtures. Identify the states, the physical, and the chemical properties of matter. Interconvert temperatures of different scales. Distinguish potential and kinetic energy and convert between units of energy. Calculate the energy content of various foods. Use specific heat to calculate heat loss or gain. Describe the changes of state between solids, liquids, and gases. Calculate the loss or gain of energy associated with these changes of state.

Focusing on elements relevant to biology, write the correct symbol for a given element and write the correct name for a symbol. Use the periodic table to identify the group and period of an element and identify elements as metals, nonmetals, or metalloids. Describe the electrical charge and location in an atom for protons, neutrons, and electrons. Determine the number of protons, electrons, and neutrons in specific isotopes of elements. Calculate the atomic mass of elements using the percent abundance and the mass of the naturally occurring isotopes. Describe the electron arrangement of each of the first 20 elements in the periodic table. Use the electron arrangement of elements to explain the trends in periodic properties.

Describe the nature of alpha, beta, positron, and gamma radiation. Write balanced nuclear equations for radioactive decay. Describe the detection and measurement of radiation. Calculate the amount of radioisotope remaining after one or more half-lives. Describe the use of radioisotopes in medicine. Explain the processes of nuclear fission and fusion.

Write the symbols for simple ions of the representative elements. Using charge balance, write the correct formulas and give the names of ionic compounds. Name and give formulas of molecular compounds. Use electronegativity to determine the polarity of a bond. Predict the three-dimensional structure of molecules, and classify them as polar or nonpolar. Describe the attractive forces between ions, polar and nonpolar molecules.

Use Avogadro's number to determine the number of particles in a given number of moles. Calculate the molar mass for a given substance and use molar mass to convert between grams and moles. Write balanced chemical equations for reactions using the formulas of the reactants and products and determine the number of atoms in reactants and products. Classify reactions as combination, decomposition, single replacement, double replacement, or combustion reactions. Define the terms oxidation and reduction and identify the reactants that are oxidized and reactants that are reduced. Use mole-mole factors from balanced chemical equations to calculate the number of moles of reactants or products in a reaction. Use mole-mole and molar-mass factors to carry out mass calculations for reactions. Describe exothermic and endothermic reactions and factors that affect the rate of a reaction.

Describe the kinetic molecular theory of gases and the units of measurement used for gases. Use the pressure-volume relationship (Boyle's law), the temperature-volume relationship (Charles's law), the temperature-pressure relationship (Gay-Lussac's law), the combined gas law, Avogadro's law, and Dalton's law of partial pressures in calculations regarding gasses.

Describe the formation of a solution and identify the solute and solvent in a solution. Identify solutes as electrolytes or nonelectrolytes. Define solubility and distinguish unsaturated and saturated solutions. Identify a salt as soluble or insoluble. Calculate the concentration and the amount of a solute in a solution. Describe the dilution of a solution and calculate the final concentration or volume of a diluted solution. Identify a mixture as a solution, a colloid, or a suspension. Describe how the number of particles in a solution affects its osmotic pressure.

Name and identify Bronsted-Lowry acids and bases. Write equations for the ionization of acids and bases. Use the concept of reversible reactions to explain acid-base equilibrium. Use Le Chatelier's principle to determine the effect on equilibrium concentrations when reaction conditions change. Use the ion product for water to calculate the $[H_3O^+]$ and $[OH^-]$ in an aqueous solution. Calculate the pH or the H_3O^+ concentration of a solution. Write balanced equations for reactions of acids and bases. Calculate the molarity or volume of an acid from information obtained in a titration. Describe the role of buffers in maintaining the pH of a solution.

Identify characteristics of organic and inorganic compounds. Give the IUPAC names and draw the structural, and skeletal formulas for alkanes, cycloalkanes, and alkanes with

substituents. Identify the properties of alkanes and write balanced chemical equations for their combustion. Identify structural formulas as alkenes, cycloalkenes, and alkynes, and give their IUPAC names. Draw structural formulas and give names for the cis-trans isomers of alkenes. Draw structural formulas and give names of the products of alkene hydrogenation and hydration. Describe the bonding in benzene; name aromatic compounds and draw their structures.

Give the IUPAC and common names for alcohols and phenols and give the common names for thiols and ethers. Draw structural and skeletal formulas of these compounds. Describe the classification of alcohols and the solubility of alcohols in water. Write the IUPAC and common names for aldehydes and ketones and draw their structural formulas. Describe the solubility of aldehydes and ketones in water. Write balanced chemical equations for the combustion, dehydration, and oxidation of alcohols. Write balanced chemical equations for the oxidation and reduction of thiols, aldehydes, and ketones.

Classify monosaccharides based on the number of carbons and the presence of a carbonyl as an aldehyde or a ketone. Identify chiral and achiral carbon atoms in organic molecules. Use Fischer projections to draw the D or L stereoisomers for glucose, galactose, and fructose. Draw and identify the Haworth structures for monosaccharides. Identify the products of oxidation or reduction of monosaccharides. Determine whether polysaccharides are reducing or non-reducing. Describe the monosaccharide units and linkages in disaccharides. Describe the structural features of amylose, amylopectin, glycogen, and cellulose.

Give the IUPAC and common names for carboxylic acids and draw their structural and skeletal formulas. Describe the solubility, ionization, and neutralization of carboxylic acids. Give the IUPAC and common names for esters and write balanced chemical equations for ester formation. Draw the structural formulas for the products of acid and base hydrolysis of esters. Give the common names and draw structural formulas for amines. Classify amines as primary, secondary, or tertiary. Describe the solubility, ionization, and neutralization of amines. Give the IUPAC and common names for amides and draw the structural formulas for the products of their formation and hydrolysis.

Describe the classes of lipids. Draw the structural formulas of saturated and unsaturated fatty acids. Draw the condensed structural formulas for waxes and triacylglycerols produced by the reaction of a fatty acid and an alcohol or glycerol. Draw the structural formulas of the compounds produced during hydrogenation, hydrolysis, or saponification of triglycerides. Describe the structure of phospholipids containing glycerol or sphingosine. Describe the structures of steroids. Describe the composition and function of the lipid bilayer in cell membranes.

Classify proteins by their functions. Give the names, abbreviations, and draw the structures of amino acids at various pH values. Name and draw structural formulas for peptides. Describe the primary, secondary, tertiary and quaternary structure of proteins. Describe protein denaturation. Describe enzymes and their role in enzyme-catalyzed reactions. Describe the effects of temperature, pH, and the presence of inhibitors on enzyme activity.

Describe the bases and ribose sugars that make up the nucleic acids DNA and RNA. Describe the primary structures of RNA and DNA. Describe the double helix of DNA and the process of DNA replication. Identify the different types of RNA and describe the synthesis of mRNA. Describe the process of protein synthesis from mRNA. Describe some ways in which DNA is altered to cause mutations. Describe the methods by which a virus infects a cell.

Describe three stages of catabolism and the role of ATP in metabolism. Give the sites and products of digestion for carbohydrates, triacylglycerols, and proteins. Describe the components and functions of the coenzymes NAD^+ , FAD, and coenzyme A. Describe the conversion of glucose to pyruvate in glycolysis and the subsequent conversion of pyruvate to acetyl-CoA or lactate. Describe the oxidation of acetyl-CoA in the citric acid cycle. Describe electron transport and the process of oxidative phosphorylation; calculate the ATP from the complete oxidation of glucose. Describe the metabolic pathway of β oxidation; calculate the ATP from the complete oxidation of a fatty acid. Describe the reactions of transamination, oxidative deamination, and the entry of amino acid carbons into the citric acid cycle.

Assignments and assessments

Homework: Through Pearson Mastering

Lab reports and worksheet: 11 lab reports and one work sheet, 15 points each, drop the lowest grade.

Midterm 1: Tuesday, September 30th: Chapters 1-6. Midterm is composed of 40 multiple choice questions.

Midterm 2: Thursday, November 13th: Chapters 7-12. Midterm is composed of 40 multiple choice questions.

Midterm 3: Thursday December 11th: Chapters 13-18. Midterm is composed of 40 multiple choice questions.

Final: Tuesday December 16th, 1-3 pm: Chapters 1-18. The final exam is comprehensive and will cover all 18 chapters. The final exam will be composed of 55 multiple-choice questions.

LECTURE SCHEDULE

Lecture will be delivered live in NE 60.

Assignments listed on Pearson include Reading Assignments, Homework, and Dynamic Study Modules. Only the Homework is worth points. Reading Assignments are listed as reminders for when you should finish reading those sections. Dynamic Study Modules are listed as a resource to provide extra practice problems in case you need extra practice for exam preparation.

Date	Lecture Activity	Pre-Lecture Reading
Tue Aug 26 L1	Introduction	
Thu Au 28 L2	Chemicals; Scientific method; Math skills; Scientific notation	Chapter 1.1-1.5
Fri Aug 29 L3	Units; Measured numbers and significant figures; Significant figures in calculations; Prefixes and equalities; Conversion factors; Problem solving with unit conversions; Density	Chapter 2.1-2.7
Tue Sept 2 L4	Classification of matter; States and properties of matter; Temperature; Energy	Chapter 3.1-3.4
Thu Sept 4 L5	Energy and nutrition; Specific heat; Changes of state; Elements and symbols	Chapter 3.5-3.7 Chapter 4.1-4.2
Fri Sept 5 L6	Periodic table; The atom; Atomic and Mass numbers;	Chapter 4.3-4.5
Tue Sept 9 L7	Isotopes and Atomic Mass; Electron energy levels;	Chapter 4.6-4.7
Thu Sept 11 L8	Periodic trends Natural radioactivity	Chapter 5.1-5.2

Date	Lecture Activity	Pre-Lecture Reading
Fri Sept 12 L9	Nuclear reactions; Measuring radiation; Half-life; Medical applications; Fission and fusion	Chapter 5.3-5.6
Tue Sept 16 L10	Ions; Formulas; Naming ionic compounds;	Chapter 6.1-6.3
Thu Sept 18 L11	Polyatomic ions; Molecular compounds;	Chapter 6.4-6.6
Fri Sept 19 L12	Electronegativity; Shapes and polarity; Attractive forces	Chapter 6.7-6.8
Tue Sept 23 L13	Mole; Molecular mass calculations; Equations for chemical reactions	Chapter 6.9 Chapter 7.1-7.3
Thu Sept 25 L14	Types of reactions	Chapter 7.3-7.5
Fri Sept 26 L15	Oxidation-reductions reactions; Mole relationships; Mass calculations; Activation energy and reaction rates	Chapter 7.5-7.9
Tue Sep 30	Midterm 1	Chapters 1-6
Thu Oct 2 L16	Properties of gasses; Pressure and volume; Temperature and volume; Temperature and pressure; Combined gas law; Volume and moles; Partial pressure	Chapter 8.1-8.2
Fri Oct 3 L17	Solutions; Electrolytes	Chapter 8.3-8.7 Chapter 9.1
Tue Oct 7 L18	Solubility; Concentration	Chapter 9.2-9.3
Thu Oct 9 L19	Dilution; Properties of solutions Acids and bases; Bronsted Lowry Acids and bases	Chapter 9.4-9.6

Date	Lecture Activity	Pre-Lecture Reading
Fri Oct 10 L20	Strengths of acids and bases; Acid-Base equilibrium; Dissociation of water	Chapter 10.1-10.4
Tue Oct 14 L21	pH scale; Reactions of acids and bases	Chapter 10.5-10.6
Thu Oct 16 L22	Buffers Organic compounds; Alkanes	Chapter 10.7-10.8 Chapter 11.1-11.2
Fri Oct 17 L23	Substituted alkanes; Properties of alkanes; Alkenes and alkynes;	Chapter 11.3-11.4
Tue Oct 21 L24	Cis-trans isomers; Addition reactions; Aromatic compounds	Chapter 11.5-11.8
Thu Oct 23 L25	Alcohols; Phenols; Thiols; Ethers; Properties of alcohols; Aldehydes and ketones	Chapter 12.1-12.2
Fri Oct 24 L26	Reactions of alcohols, thiols, aldehydes and ketones	Chapter 12.3-12.4
Tue Oct 28 L27	Carbohydrates; Chiral molecules	Chapter 13.1-13.3
Thu Oct 30 L28	Fisher projections; Haworth structures; Chemical properties of Monosaccharides	Chapter 13.3-13.4
Fri Oct 31 L29	Disaccharides; Polysaccharides	Chapter 13.5-13.7
Tue Nov 4 L30	Carboxylic acids and their properties;	Chapter 14.1-14.2

Date	Lecture Activity	Pre-Lecture Reading
Thu Nov 6 L31	Esters; Hydrolysis of esters; Amines	Chapter 14.3-14.5
Fri Nov 7 L32	Amides; Lipids;	Chapter 14.5-14.6
Tue Nov 11	Veteran's Day	NA
Thu Nov 13	Midterm 2	Chapters 7-12
Fri Nov 14 L33	Fatty acids; Waxes and triglycerols	Chapter 15.1-15.3
Tue Nov 18 L34	Reactions of triglycerides; Phospholipids	Chapter 15.3-15.5
Thu Nov 20 L35	Sterols; Cell membranes	Chapter 15.5-15.7
Fri Nov 21 L36	Amino acids	Chapter 16.1
Tue Nov 25 L37	Primary, secondary, tertiary, and quaternary structure of proteins	Chapter 16.2-16.3
Thu Nov 27	Thanksgiving Break	NA
Fri Nov 28	Thanksgiving Break	NA
Tue Dec 2 L38	Enzymes and their activity	Chapter 16.4-16.5
Thu Dec 4 L39	Building blocks of nucleotides and nucleic acids; Replication	Chapter 17.1-17.4
Fri Dec 5 L40	Transcription; Translation; Mutations; Recombinant DNA; Viruses	Chapter 17.4-17.8
Tue Dec 9 L41	Metabolism and ATP; Digestion; Coenzymes	Chapter 18.1-18.3
Th Dec 11	Midterm 3	Chapters 13-18

Week	Laboratory Activity
Aug 25 – Aug 29	Significant figures, scientific notation worksheet
Sept 1 – Sep 5	Solubility (Tuesday, Wednesday and Thursday sections)
Sept 8 – Sep 12	Specific heat
Sept 15 – Sep 19	Flame test, spectra, absorbance of light
Sept 22 – Sep 26	Magnesium oxide
Sept 29 – Oct 3	Introduction to acids and bases
Oct 6 – Oct 10	Titration part A
Oct 13 – Oct 17	Titration part B
Oct 20 – Oct 24	Synthesis of aspirin
Oct 27 – Oct 31	Properties and preparation of esters and soap
Nov 3 – Nov 7	Determination of protein concentration
Nov 10 – Nov 14	No lab
Nov 17 – Nov 21	Enzyme catalysis
Nov 24 – Nov 28	Thanksgiving (Monday labs do Solubility)
Dec 1 – Dec 5	Check out

Laboratory safety

All persons present in a chemistry laboratory must wear approved eye protection, lab apron, pants or skirts that are mid-calf or longer, and closed-toe and closed heel shoes. Gloves are optional for many experiments but should be worn whenever working with concentrated acids and bases. Gloves are mandatory for the Synthesis of Aspirin and the Preparation of Esters and Soap labs. Long hair must be confined securely. Proper protective equipment must

be must be worn by everybody whenever anyone in the room is working with chemicals. Anyone not in compliance will be asked to leave and will not be allowed to return until properly attired.

For some of the laboratory exercises you will need a non-programmable calculator (e.g., TI-30Xa or Casio fx-300ms plus), Matches or butane lighter, safety glasses and an apron (available at the Bookstore).

Grading policy

Homework	135 points
Labs	165 points
Midterm 1	160 points
Midterm 2	160points
Midterm 3	160 points
Final	220 points
Total	1000 points

Changes to the syllabus

Consistent with University policy, I retain the right to adjust course design, including assignments, assessments and deadlines. Major departures from the syllabus shall be made only for compelling reasons. "Any major changes to the course syllabus will be announced in class, communicated to all students electronically, and incorporated into an updated and posted version of the syllabus."

Letter grades

Points	Percentage	letter grade
930-1000	93.0-100%	A
900-929	90.0-92.9%	A-
870-899	87.0-89.9%	B+
830-869	83.0-86.9%	B
800-829	80.0-82.9%	B-
770-799	77.0-79.9%	C+
730-769	73.0-76.9%	C
700-729	70.0-72.9%	C-
670-699	67.0-69.9%	D+
639-669	63.0-66.9%	D
600-629	60.0-62.9%	D-
below 600	below 60%	F

UNIVERSITY POLICIES

Accommodations: If you are a student with a disability and are in need of accommodations for this class, please contact Student Ability Success Center at (619) 594-6473 as soon as possible. Please know accommodations are not retroactive, and I cannot provide accommodations based upon disability until I have received an accommodation letter from Student Ability Success Center.

Student Privacy and Intellectual Property: The [Family Educational Rights and Privacy Act](#) (FERPA) mandates the protection of student information, including contact information, grades, and graded assignments. I will use Canvas to communicate with you, and I will not post grades or leave graded assignments in public places. Students will be notified at the time of an

assignment if copies of student work will be retained beyond the end of the semester or used as examples for future students or the wider public. Students maintain intellectual property rights to work products they create as part of this course unless they are formally notified otherwise.

Religious observances: According to the University Policy File, students should notify the instructors of affected courses of planned absences for religious observances by the end of the second week of classes.

Resources for students: A complete list of all academic support services--including the [Writing Center](#) and [Math Learning Center](#) --is available on the Student Affairs' [Academic Success](#) website. [Counseling and Psychological Services](#) (619-594-5220) offers confidential counseling services by licensed therapists; you can Live Chat with a counselor at http://go.sdsu.edu/student_affairs/cps/therapist-consultation.aspx between 4:00pm and 10:00pm, or call San Diego Access and Crisis 24-hour Hotline at (888) 724-7240.

SDSU Economic Crisis Response Team: If you or a friend are experiencing food or housing insecurity, or any unforeseen financial crisis, visit sdsu.edu/ecrt, email ecrt@sdsu.edu, or walk-in to Well-being & Health Promotion on the 3rd floor of Calpulli Center.

Academic Honesty: The University adheres to a strict [policy prohibiting cheating and plagiarism](#). Examples of academic dishonesty include but are not limited to:

- copying, in part or in whole, from another's test or other examination;
- obtaining copies of a test, an examination, or other course material without the permission of the instructor;
- collaborating with another or others in work to be presented without the permission of the instructor;
- falsifying records, laboratory work, or other course data;
- submitting work previously presented in another course, if contrary to the rules of the course;
- altering or interfering with grading procedures;
- assisting another student in any of the above;
- using sources verbatim or paraphrasing without giving proper attribution (this can include phrases, sentences, paragraphs and/or pages of work);
- copying and pasting work from an online or offline source directly and calling it your own;

- using information you find from an online or offline source without giving the author credit;
- replacing words or phrases from another source and inserting your own words or phrases.

The California State University system requires instructors to report all instances of academic misconduct to the Center for Student Rights and Responsibilities. Academic dishonesty will result in disciplinary review by the University and may lead to probation, suspension, or expulsion. Instructors may also, at their discretion, penalize student grades on any assignment or assessment discovered to have been produced in an academically dishonest manner.

Classroom Conduct Standards: SDSU students are expected to abide by the terms of the Student Conduct Code in classrooms and other instructional settings. Violation of these standards will result in referral to appropriate campus authorities. Prohibited conduct includes:

- Willful, material and substantial disruption or obstruction of a University-related activity, or any on-campus activity.
- Participating in an activity that substantially and materially disrupts the normal operations of the University or infringes on the rights of members of the University community.
- Unauthorized recording, dissemination, or publication (including on websites or social media) of lectures or other course materials.
- Conduct that threatens or endangers the health or safety of any person within or related to the University community, including
 1. physical abuse, threats, intimidation, or harassment.
 2. sexual misconduct.

Medical-related absences: Students are instructed to contact their professor/instructor/coach in the event they need to miss class, etc. due to an illness, injury or emergency. All decisions about the impact of an absence, as well as any arrangements for making up work, rest with the instructors. [Student Health Services](#) (SHS) does not provide medical excuses for short-term absences due to illness or injury. When a medical-related absence persists beyond five days, SHS will work with students to provide appropriate documentation. When a student is hospitalized or has a serious, ongoing illness or injury, SHS will, at the student's request and with the student's consent, communicate with the student's instructors via the Vice President for Student Affairs and may communicate with the student's Assistant Dean and/or the [Student Ability Success Center](#).

Sexual violence / Title IX mandated reporting: As an instructor, one of my responsibilities is to help create a safe learning environment on our campus. I am a mandated reporter in my role as an SDSU employee. It is my goal that you feel able to share information related to your life experiences in classroom discussions, in your written work, and in our one-on-one meetings. I will seek to keep the information you share private to the greatest extent possible. However, I am required to share information regarding sexual violence on SDSU's campus with the Title IX coordinator, Jessica Rentto 619-594-6017. She (or her designee) will contact you to let you know about accommodations and support services at SDSU and possibilities for holding accountable the person who harmed you. Know that you will not be forced to share information you do not wish to disclose and your level of involvement will be your choice. If you do not want the Title IX Officer notified, instead of disclosing this information to your instructor, you can speak confidentially with the following people on campus and in the community. They can connect you with support services and discuss options for pursuing a University or criminal investigation. Sexual Violence Victim Advocate 619-594-0210 or Counseling and Psychological Services 619-594-5220, psycserv@sdsu.edu. For more information regarding your university rights and options as a survivor of sexual misconduct or sexual violence, please visit titleix.sdsu.edu or sdsutalks.sdsu.edu [Links to an external site.](#).