

Course Syllabus

Chemistry 31B, Summer 2023: Chemical Principles II: Structure & Energetics

Dr. Joshua Visser

Course Overview

The science of chemistry evolves through a process of observation, hypothesis, modeling, and experimentation. This course is structured to develop your skills to participate in this process while building your understanding of how chemical phenomena shape our world.

Course Objectives:

Develop your ability to analyze and solve chemical problems through improved critical thinking.

- *Improve your ability to use conceptual models to qualitatively explain a wide range of chemical phenomena and to make quantitative estimations focusing on the following areas:*
 - *Kinetics:* Determine what forces influence the rate of a chemical reaction
 - *Equilibria:* Determine the direction of a reaction and the changes in concentration that will occur as a reaction comes to equilibrium
 - *Thermodynamics:* Predict whether a reaction is likely to be spontaneous and describe the relationship between free energy, temperature, and equilibrium constants
 - *Electrochemistry:* Identify redox reactions and calculate their reduction potentials based on conditions. Describe to build a voltaic cell.
- Be prepared to study how structure influences chemical reactivity and equilibria in Chem 33

Contact Information & Office Hours

Instructor: Dr. Joshua Visser

Email: jvisser@stanford.edu

OH: Tues, 11:30am – 12:30 pm (STLC 212D)

Lecture TA: Laura Leibfreid

Email: lleibfri@stanford.edu

OH: Mon-Wed: 2:30 – 3:00 pm

Thurs: 11:30 am – 12:30 pm

See calendar for locations

NOTE: for all general, administrative, or accommodations related course questions please contact the Lecture TA.

TAs: Laura Weiler:

lweiler@stanford.edu

Max Moncada Cohen

moncadac@stanford.edu

Important Dates (<https://summer.stanford.edu/admissions/dates-and-deadlines>):

- First Day of Class: Monday, July 24, 2023
- Preliminary Study List Deadline: Monday, June 26, 5 pm (**and deadline to enroll in Chem31B**)
- Final Study List deadline (last day to drop classes): Saturday, July 29, 5 pm
- Term Withdrawal & Last Day for Partial Refund: Tuesday, August 8, 5 pm
- Course Withdrawal/Change of Grading Basis deadline: Friday, July 14 (for 1/2-term courses)
- **Midterm 1:** Tuesday, August 1, 9:30-10:20 am
- **Midterm 2:** Thursday, August 10, 9:30-10:20 am
- **Final Exam:** Thursday, August 17, 9:30-11:20 am (last day of Chem31B)

Attendance and Course Pace: We have intentionally crafted a course structure that builds in many opportunities to interact with the material and turn things in online. There is flexibility in grading to account for missing a lecture or lab or missing a homework deadline. **HOWEVER**, the summer quarter moves **extremely** quickly. Labs are every Monday and Wednesday, and we will have a quiz or exam every Tuesday and Thursday. Missing one lecture during the summer is equivalent to missing nearly a week's worth of material in a normal 10-week quarter.

For this reason we do not accept new enrollments after the first lab on July 24, 2023.

If you end up missing lecture and/or lab, please let the Lecture TA know and make sure you are attending office hours to ensure you are staying abreast of the material. If you know you will be missing multiple days of class during the course, this may not be the right quarter for you. Please reach out to Dr. Visser if you have questions about the schedule.

Required Items

Text: Tro, "Principles of Chemistry: A Molecular Approach" 4th Edition (etext is fine)
Free: OpenStax, Atoms First 2e: <https://openstax.org/details/books/chemistry-atoms-first-2e>

Problem Set: All Chem 31B students must have a valid license* for the web-based
Software "**Mastering Chemistry**" program (based on our Tro textbook). You can access (and purchase) Mastering Chemistry & etext through Canvas.

*You may purchase the required access code for MasteringChemistry as part of a package with an electronic version of the textbook (for Mastering Chemistry and the e-book together) **through Canvas**. You may also purchase an access code bundled with your textbook in the bookstore. See the FAQs and instructions to register for the Mastering Course – **only apply your access code through the Canvas link. Mastering Chemistry is required for Chem31B. An 18-week license will be enough to make it through both 31A and 31B in summer 2023. If you are entertaining the idea of retaking 31B during the academic year, you might consider purchasing the 24-month license.**

Poll Everywhere: All Chem 31B students must register for a FREE Poll Everywhere account and log in during lecture to answer in-class questions drawn from assigned readings. Questions provide immediate feedback as to your understanding of the current material. **Register on Poll Everywhere by Monday 7/24** by going to Stanford's Poll Everywhere page and click on "Access your free Stanford Poll Everywhere account". Make sure your Wifi device is enabled on the Stanford network before class ([Wireless Network and Services | University IT \(stanford.edu\)](#))

Gradescope: All exams and pre-labs are returned *via* Gradescope. Before the first day of class you will receive an invitation to Gradescope – sign into gradescope with your Stanford email credentials and you will be able to access the Chem31B Summer 2023

Course Structure

Lectures: Lectures are held **daily from Monday-Thursday each week from 9:30-11:20 am in STLC 111** (no lecture on July 4). Lecture attendance is compulsory. Readings assigned for each lecture are expected to be completed **before** that associated lecture.

Students who miss lecture due to illness should reach out to the Head TA as soon as possible, and make sure they attend office hours when they are recovered in order to make sure they are able to stay in touch with the pace of the course. If you know you will miss a lab or exam due to illness, please reach out to the head TA IMMEDIATELY to discuss your options. Given the pace of the course and the need to provide timely feedback to students, makeup exams are rarely offered and require special circumstances. Makeup labs are not available.

Office hours Office hours (**OH**) are designated times available to further clarify lecture concepts or assist students in developing an approach towards tackling chemistry problems. Students are highly encouraged to rework misunderstood problems from returned exams and Mastering Chemistry and bring them to office hours.

Labs: **In addition to lecture, you must enroll in a lab section on Axess by Monday, June 26th.** Lab provides hands-on, guided-inquiry experiments to build your conceptual understanding and problem-solving skills with group learning. Attend **ONLY** the lab time for which you signed up on Axess. Due to lab availability and logistics, we cannot hold make-up labs, and additional sections other than those currently open on Axess will only be opened if enrollment requires it. **Lab Sections 2 & 3: Every Monday and Wednesday, 12:30-2:20 pm**

Personal Protective Equipment Students entering the Sapp teaching laboratories must wear appropriate **Personal Protective Equipment (PPE)**, which includes department-specific laboratory safety glasses and laboratory coat, a face mask, and appropriate street clothes (**PPE**), which includes long pants, socks, and solid shoes that cover your entire foot. See PPE Guidelines and announcements on Canvas for more details. **Students must always wear their safety glasses/goggles and lab coat during the entire lab section.**

****PPE will be provided to all students before the first lab on Monday, July 24th****

Course Web Site: <https://canvas.stanford.edu/courses/175735>

The Chem 31B Canvas website contains all course materials, course announcements, and your scores on graded work. This is also where you will access "Mastering Chemistry" to complete and turn in problem sets (PLPs) for the course. "Mastering Chemistry" registration instructions can be found in the "Files" section of the canvas site in the "General Course Information" folder.

****All course communication will occur through the Chem 31B Canvas website.****

Assignments and Graded Work: All due dates can be found on the course calendar and Canvas Calendar.

Graded Work The grading scheme for Chem 31B is designed to reward students who engage actively with the course. There are many opportunities to earn credit. This course is graded on a 1000-point basis in 4 components: Quizzes and Course Engagement (max 120 pts.), Labs (max 120 pts.), Midterm Exams (360 pts.), and Final Exam (400 pts.). Details of these components are below:

1. Course Engagement: Course participation points can be accumulated through **any combination** of poll questions, quizzes, and pre-lecture problems (PLPs) *to a maximum* of 120 pts. Details of course engagement components are below:

- **Lecture Participation: Poll questions: (At least 35 points available)**

In-lecture poll questions will be posed throughout the quarter, related to the assigned reading, Pre-Lecture Problems, labs, and lecture discussion. **Each correct answer is worth 1 point.**

- **Quizzes (10 points each - 50 points available)**

Every Tuesday and Thursday at the beginning of lecture (9:30 am) there will be a closed-book, 10-minute quiz based on material from the previous lectures. On exam days (August 1st and 10th) there will be no quiz. Quizzes will be graded for correctness out of 10 points

- **Pre-Lecture Problems: (3 pts. each; 42 total pts. available)**

The night before each lecture, you must complete your Pre-Lecture Problems (PLP) through the web-based *MasteringChemistry* system by 11:59pm. You are allowed and encouraged to work on the problems with others, but you must compose your final answers to each problem set on your own. Late assignments will receive partial credit (no matter how late) as long as they are submitted prior to the last Wednesday of the course (Aug 16). No additional work will be scored after this point. Note: all PLPs will be scaled to out of 3 points at the end of the quarter.

2. Labs: Each week there will be 2 labs that will engage with the material discussed in lecture through prelab assignments, attendance and participation, and post-lab questions. You can count a *maximum* of 120 points. There are a total of 144 points available, allowing flexibility for missed assignments or attendance.

If you are ill or will be missing lab for any reason, please email the Head TA BEFORE the start of lab.

Prelab: (6 pts. each; 48 pts available):

Before each lab, students are expected to read the pre-lab assignment and answer any questions posed.

****You must bring your completed pre-lab to lab in order to attend lab****

Lab Participation and Safety Adherence: (6 pts. each; 48 pts available):

Because Labs are based on participation in groups and will begin with important safety information, it is critical to arrive on time. Students who are more than 5 minutes late will forfeit their participation points, as will students who are dismissed from lab for not adhering to safety policies or failing to help clean up after the experiment.

Post-Lab: (6 pts. each; 48 pts available):

At the end of each lab, students will be expected to turn in their post-lab assignment, verifying proper clean-up protocols have been followed and summarizing the main ideas or skills learned in the lab.

3. Midterm exams (Total of 360 pts.): There are two 50-minute midterm exams (180 pts. each) held at the beginning of class (9:30 am) on **Tuesday, August 1**, and **Thursday, August 10**. We will start immediately at 9:30 am and continue class once the exam is finished (following a short break).

4. Final exam (Total of 400 pts.): **A cumulative final exam will be held on the last day of class (Thursday, August 17) from 9:30 am – 11:20 am** and will be worth 400 pts. **Make sure that you are available for this time before enrolling.**

Exam Times: It is Department of Chemistry policy that exams & quizzes are not given earlier than scheduled.

Grade: Your final grade is determined on an absolute scale according to the total number of points you have accumulated for course engagement & labs (max 120pts. each), top two midterms (360 pts.) and the final (400 pts.):

A/A- \geq 900pts B/B+/B- \geq 750pts C/C+/C- \geq 600pts D/D+/D- \geq 450pts CR \geq 600pts

Final cut-offs for +/- scores within each grade bucket will be determined at the end of the quarter.

To be more equitable and ease student stress **we have built in grading flexibility up front** rather than having students request exceptions for temporary illness or other one-off issues (*e.g.* late PLPs, technical issues, late arrival at labs or absences due to travel/illness, exam conflicts) in the moment. Our best advice is to be prompt in arriving at lectures, labs, and exams, be prompt in delivering assignments, and to prepare for and participate in labs. Special exceptions that are accommodated include documented disabilities (thru OAE), University sanctioned absences and extraordinary life events. Such accommodations should be requested from the Lecture TA **as soon as possible** in advance.

Return of Work: All exams are returned via Gradescope the day following the exam. PLPs are automatically graded, and solutions shown on *MasteringChemistry*. As timely feedback and reflection is critical to effective learning, we encourage all students to promptly review their graded work and bring questions to office hours.

Regrades: A regrade request clearly explaining what was overlooked in grading should be made on Gradescope no later than 5:00 pm the day following the exam. When an exam is submitted for a regrade, the entire exam will be reevaluated, with the possibility of a net gain or loss of points.

Generally, successful regrades require minimal explanation because it should only need point out specific pieces in the original work submitted. Additional work or explanation that was not already on the exam cannot be considered.

Students with Documented Disabilities Students who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty dated in the current quarter in which the request is being made. Students should contact OAE (<https://oae.stanford.edu/students>) as soon as possible since timely notice is needed to coordinate accommodations. In addition, please inform the Chem31B Head TA as soon as possible. At least one week lead time is needed to set-up exam accommodations.

Names & pronouns In this classroom, we endeavor to refer to people using their preferred names and personal pronouns. You are invited (not required) to use NameCoach to record the correct pronunciation of your name, as well as add preferred pronouns. A link to NameCoach can be found under the "Student" tab on Axess (<https://registrar.stanford.edu/staff/student-services-administrators/name-coach>).

CHEM 31B Summer 2023 Course Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday
July 23 Dr. Visser runs a marathon	24 – Classes Start - PLP 1 Due [11:59PM] <ul style="list-style-type: none"> ● Lecture 1 <ul style="list-style-type: none"> - Kinetics: Rates of Reaction - Rate Laws <p><u>Reading Due:</u></p> <ul style="list-style-type: none"> ● Chapter 15.1 – 15.3, 15.6 <p><u>Lab 1: 12:30 – 2:20 pm (Pre-Lab 1 Due)</u> Kinetics of Iodine Clock reaction</p> <ul style="list-style-type: none"> ● Laura L OH: <ul style="list-style-type: none"> - 2:30 pm- 3:30 pm (STLC 118) 	25 - Quiz #1 - PLP 2 Due [11:59PM] <ul style="list-style-type: none"> ● Lecture 2 <ul style="list-style-type: none"> - Integrated Rate Laws - Mechanisms and Catalysis <p><u>Reading Due:</u></p> <ul style="list-style-type: none"> ● Chapter 15.4 – 15.5, 15.7 <ul style="list-style-type: none"> ● Dr. Visser OH: <ul style="list-style-type: none"> - 11:30 am- 12:30 pm (STLC 212D) ● Laura L OH: <ul style="list-style-type: none"> - 2:30 pm- 3:30 pm (STLC 118) 	26 - PLP 3 Due [11:59PM] <ul style="list-style-type: none"> ● Lecture 3 <ul style="list-style-type: none"> - Dynamic Equilibrium and EQ Constants - Heterogenous and gaseous Equilibria <p><u>Reading Due:</u></p> <ul style="list-style-type: none"> ● Chapter 16.1 – 16.3 <p><u>Lab 2: 12:30 – 2:20 pm (Pre-Lab 2 Due)</u> Kinetics and Qualitative Equilibrium</p> <ul style="list-style-type: none"> ● Laura L OH: <ul style="list-style-type: none"> - 2:30 pm- 3:30 pm (STLC 114) 	27 - Quiz #2 <ul style="list-style-type: none"> ● Lecture 4 <ul style="list-style-type: none"> - Calculating Reaction Quotients and EQ concentrations - System Response to Perturbations in EQ: Le Châtelier's Principle <p><u>Reading Due:</u></p> <ul style="list-style-type: none"> ● Chapter 16.7 – 16.9 <ul style="list-style-type: none"> ● Laura L OH: <ul style="list-style-type: none"> - 11:30 am- 12:30 pm (STLC 118)
July 30 PLP 4 Due [11:59PM]	31 – Week 2 - PLP 5 Due [11:59] <ul style="list-style-type: none"> ● Lecture 5 – 10:30 am-11:20 am <ul style="list-style-type: none"> - Intro to Acids and Bases - Calculating pH <p><u>Reading Due</u></p> <ul style="list-style-type: none"> ● Chapter 17.1 – 17.7 <p><u>Lab 3: 12:30 – 2:20 pm (Pre-Lab 3 due)</u> Introduction to Acid/Base Reactivity</p> <ul style="list-style-type: none"> ● Laura L OH: <ul style="list-style-type: none"> - 2:30 pm- 3:30 pm (STLC 118) 	August 1 – PLP 6 Due [11:59PM] <ul style="list-style-type: none"> ● Midterm Exam #1 9:30-10:20 am ● Lecture 6 – 10:30 am-11:20 am <ul style="list-style-type: none"> - Acid/Base Properties of Salts <p><u>Reading Due</u></p> <ul style="list-style-type: none"> ● Chapter 17.8 <ul style="list-style-type: none"> ● Dr. Visser OH: <ul style="list-style-type: none"> - 11:30 pm- 12:30 pm (STLC 212D) ● Laura L OH: <ul style="list-style-type: none"> - 2:30 am- 3:30 pm (STLC 118) 	2 – PLP 7 Due [11:59PM] <ul style="list-style-type: none"> ● Lecture 6 <ul style="list-style-type: none"> - Buffers - Titrations <p><u>Reading Due</u></p> <ul style="list-style-type: none"> ● Chapter 18.1 – 18.4 <p><u>Lab 4: 12:30 – 2:20 pm (Pre-Lab 4 due)</u> Buffers/Milk of Magnesia & Solubility</p> <ul style="list-style-type: none"> ● Laura L OH: <ul style="list-style-type: none"> - 2:30 pm- 3:30 pm (STLC 114) 	3 - Quiz #3 <ul style="list-style-type: none"> ● Lecture 7 <ul style="list-style-type: none"> - Titrations and Polyprotic Acids - Solubility Equilibria <p><u>Reading Due</u></p> <ul style="list-style-type: none"> ● Chapter 17.9, 18.4 – 18.6 <ul style="list-style-type: none"> ● Laura L OH: <ul style="list-style-type: none"> - 11:30 am- 12:30 pm (STLC 118)
August 6 PLP 8 Due [11:59PM]	7 – Week 3 - PLP 9 Due [11:59PM] <ul style="list-style-type: none"> ● Lecture 8: <ul style="list-style-type: none"> - Entropy and the 2nd Law of Thermodynamics - Gibbs Free Energy <p><u>Reading Due</u></p> <ul style="list-style-type: none"> ● Chapter 19.1 – 19.7 <p><u>Lab 5: 12:30 – 2:20 pm (Pre-Lab 5 due)</u> K_{sp}</p> <ul style="list-style-type: none"> ● Laura L OH: <ul style="list-style-type: none"> - 2:30 pm- 3:30 pm (STLC 118) 	8 – Quiz #4 - PLP 10 Due [11:59PM] <ul style="list-style-type: none"> ● Lecture 9: <ul style="list-style-type: none"> - Calculating ΔS and ΔG - Relating Free Energy to Equilibrium <p><u>Reading Due</u></p> <ul style="list-style-type: none"> ● Chapter 19.8 – 19.10 <ul style="list-style-type: none"> ● Dr. Visser OH: <ul style="list-style-type: none"> - 11:30 am- 12:30 pm (STLC 212D) ● Laura L OH: <ul style="list-style-type: none"> - 2:30 pm- 3:30 pm (STLC 118) 	9 - PLP 11 Due [11:59PM] <ul style="list-style-type: none"> ● Lecture 10: <ul style="list-style-type: none"> - Introduction to Redox Reactions - Voltaic Cells <p><u>Reading Due</u></p> <ul style="list-style-type: none"> ● Chapter 20.1 – 20.3 <p><u>Lab 6: 12:30 – 2:20 pm (Pre-Lab 6 due)</u> Entropy and Gibb's Free Energy</p> <ul style="list-style-type: none"> ● Laura L OH: <ul style="list-style-type: none"> - 2:30 pm- 3:30 pm (STLC 114) 	10 <ul style="list-style-type: none"> ● Midterm Exam #2 9:30-10:20 am ● Lecture 11: <ul style="list-style-type: none"> - Relating Cell Potential to Gibbs Free Energy and K <p><u>Reading Due</u></p> <ul style="list-style-type: none"> ● Chapter 20.4 – 20.5 <ul style="list-style-type: none"> ● Laura L OH: <ul style="list-style-type: none"> - 11:30 am- 12:30 pm (STLC 118)
August 13 PLP 12 Due [11:59PM]	14 – Week 4 - PLP 13 Due [11:59PM] <ul style="list-style-type: none"> ● Lecture 12: <ul style="list-style-type: none"> - Building Batteries – Cell Potential and Concentration - Electrolysis <p><u>Reading Due</u></p> <ul style="list-style-type: none"> ● Chapter 20.6 – 20.9 <p><u>Lab 7: 12:30 – 2:20 pm (Pre-Lab 7 due)</u> Voltaic Cells</p> <ul style="list-style-type: none"> ● Laura L OH: <ul style="list-style-type: none"> - 2:30 pm- 3:30 pm (STLC 118) 	15 – Quiz #5 - PLP 14 Due [11:59PM] <ul style="list-style-type: none"> ● Lecture 13: <ul style="list-style-type: none"> - Nuclear Decay - Kinetics of Nuclear Decay <p><u>Reading Due</u></p> <ul style="list-style-type: none"> ● Chapter 21.1 – 21.3, 21.6 – 21.8 <ul style="list-style-type: none"> ● Dr. Visser OH: <ul style="list-style-type: none"> - 11:30 am- 12:30 pm (STLC 212D) ● Laura L OH: <ul style="list-style-type: none"> - 2:30 pm- 3:30 pm (STLC 118) 	16 - All late PLPs due before 5 pm <ul style="list-style-type: none"> ● Lecture 14: <ul style="list-style-type: none"> - Catchup day - Review <p><u>Lab 8: 12:30 – 2:20 pm (Pre-Lab 8 Due)</u> Electrolysis of Water</p> <ul style="list-style-type: none"> ● Laura L OH: <ul style="list-style-type: none"> - 2:30 pm- 3:30 pm (STLC 114) 	17 – Last Day of Class <ul style="list-style-type: none"> ● Final Exam: 9:30-11:20 am