

Chemistry 25: Prep for General Chemistry

Lecture:	M/W	9:30 – 11:20 AM	G6
Lab-1	M	11:30 AM – 2:20 PM	SC 2208
Lab-2	W	11:30 AM – 2:20 PM	SC 2208

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Office Hours: M/W: 9:00AM – 9:30 AM

This course syllabus is a contract:

One purpose of this syllabus is to provide you with the guiding principles upon which the class runs. Another purpose is to make sure that you have, at your fingertips, answers to common questions that might arise. This document is available at all times on the class website. Make sure you read it in its entirety before you ask me any questions about the course schedule, requirements, grading, etc... It is also a contract between you the student, and I, the instructor of record. Make sure that you understand its contents fully, especially the parts that pertain to testing and the computation of your grade, because so long as you remain enrolled in the course, you are implicitly agreeing to abide by these terms.

Course Description: Chemistry 25 is meant to serve as an introduction to and grounding in the core theory and problem-solving techniques of chemistry as a preparation for a General Chemistry course (Chem 1A) and other science related fields. Conceptual topics include modern atomic and molecular theory, the mole and stoichiometry, behavior of gases, thermochemistry, and an exploration of the standard classes of chemical reactions. Laboratory topics covered include an introduction to gravimetric and volumetric analysis, introductory lab equipment and techniques, and keeping a laboratory notebook. Throughout all topics we will stress both conceptual and mathematical problem-solving techniques in order to prepare students to tackle these topics more in depth in following classes.

Prerequisites: MATH 114A or equivalent

Course Materials (Required):

1. **Text Book:** *Introduction the Chemistry, 5e*, by Bauer, Birk, Marks (McGraw Hill: 2019; ISBN 978-1-307-23515-9)
2. **Lab Text:** *Lab Manual for Preparation for General Chemistry, Chem 25*, by *Applegate*. (McGraw Hill: 2017; ISBN 978-1-308-68037-8)
3. OSHA-approved Safety Goggles (Indirect Vent, Z87)
4. Scientific Calculator
5. **Carbonless copy Lab notebook:** 100 page carbonless copy spiral bound notebook. (or similar) ISBN: 978-1930882003

Course Materials (Optional):

1. Lab Coat
2. Disposable Nitrile Gloves

Resources

Tutoring: De Anza's tutorial center is in S43. This and many other campus services can be found as part of the student success center: <http://www.deanza.edu/studentsuccess>

Disability Support Program and Services: DSPS can help you get the right tools to succeed. Their website is <http://www.deanza.edu/dsps/>

Grading Scheme:	Percentage
Homework	10
Laboratory Work	27
Chapter Exams (3)	40
Final Exam	20
Subjective Lab and Lecture	3
Total	100%

Homework (10%): Homework will consist of 15-20 problems per assignment and will be posted on the class website or emailed to you. Homework will be graded based on completeness and accuracy. As we learn by doing, "practice makes perfect" and as exam questions may be similar to the homework, it is obviously to your advantage to take the homework seriously. Copying another student's homework problems is counterproductive. If you're not working it out, you won't get the benefit. **Plagiarism of homework assignments will result in a score of Zero** being assigned to all involved students. Feel free to work in groups, but be sure to show all your own work and not just copy answers. Your lowest homework assignment will be dropped from your grade at the end of the quarter.

Laboratory Work (27%): You will be expected to participate in lab, complete lab reports, and pass lab quizzes. More details on these items can be found on the laboratory section.

Chapter Exams (40%): There will be 3 chapter exams worth 13.3% of your grade each. Exams will be a combination of any of the following: multiple choice, short synthesis or mechanisms, and vocabulary questions. Early and late exams are not administered. Missing an exam **will result in a zero** for that exam without proof of an excused absence (doctor's note, police report, etc...)

Final Exam (20%): The Final Exam is cumulative and will have the same format as the chapter exams. The exam will be given **Monday (March 23rd) from 9:15 AM – 11:15 AM**. If you cannot make this time, you should consult me asap..

Subjective Grade (3%): A subjective evaluation will be assessed by your instructor at the end of the quarter to reward you for: your good and punctual attendance; active participation, preparedness for the lecture and laboratory, ability to follow written and verbal instructions, adherence to the safety rules, cleanliness practices, and overall respect for the laboratory through the proper care and use of all laboratory apparatus and instruments. These are NOT free points and must be earned.

Special Note: If your average percentage is failing (<50%) in any **ONE** or more of the following portions of the course, you will not receive a passing grade:

exams or lab reports/assignments.

Additionally, you must complete **all** of the lab experiments/reports in order to pass the class.

Lab Score Breakdown (comprises 27% of final class grade)

Pre-Lab Assignments	20%	Lab Exam	25%
Lab Reports	50%	Lab Clean-up	5%

Lab Clean-up (5%): Each student is required to sign up for two labs during which they will be responsible for after-lab cleanup. Attention to clean-up policies and quality of work will determine your score in this section. If you are absent on your assigned cleaning day you may volunteer on a

future day to regain your lost points.

Pre-Lab Assignments (20%): Pre-lab assignments should be completed in your notebook prior to your arrival in class and turned in at the beginning of the lab period. Any changes to the procedure will be announced in advance.

Your lowest pre-lab will be dropped from your grade at the end of the quarter.

Laboratory Assignments/Reports (50%): Lab reports in this course will be a mixture of Worksheets and Discussion submissions. Laboratory reports are due one week after the completion of the lab, with the exception of the final lab, as specified in the class schedule. Please see the Lab Report guide for tips on this as well. *For some experiments you may be collecting and sharing data with a partner, however you must do your own calculations and formulate your own conclusions for each experiment.* **If students are found to have copied from one another, points will be deducted from the grade or a grade of zero will be given for ALL students involved!** The laboratory assignments will be collected **BEFORE** the start of the laboratory lecture on its due date. Not all lab reports are equally weighted.

Your lowest lab report will be dropped from your grade at the end of the quarter.

Lab Exam (25%):

There will be one lab exam in this course. It is **open lab notebook** (*not lab manual*) and will cover material and calculations related to your lab experiments. This includes the purpose of each experiment, safety and waste guidelines, the procedure, proper data recording, calculations and theoretical questions related to the technique or purpose of the lab.

Note on dropped assignments: Assignments that are assigned a score of zero due to unexcused absences will not be dropped at the end of the quarter. Please never plan on missing lab sessions and discuss any absences as soon as possible with your instructor.

Class Policies.

- A. Time Requirement:** This class includes appx. 4 hours of lecture and appx. 3 hours of lab per week. In order to receive a "C" or better grade, you should allow 8-12 hours of studying, reading, and preparing outside of class **PER WEEK**. Help yourself to do your best by making time to keep up with the reading and homework. *If this time commitment is not possible given your current situation, please consider taking this class at a later date when you do have more time available.*
- B. Lecture Attendance:** Attendance is a critical component of the learning process, and the lecture will cover material that may not appear in your text and help clarify the material that is. Learning Chemistry effectively depends on building up from a base of knowledge. If you do not set a firm foundation, you will not be able to build your understanding of the field effectively. In other words, miss too many classes and you'll likely fail the class.
- C. Class Behavior:** Be ready to start class at the scheduled time. Please arrive on time and plan on staying the entire session as late arrivals and early departures distract everyone. If you are unavoidably late, please enter quietly and find your seat as quickly and quietly. Please do not disrupt class with irrelevant conversations, either in the form of inappropriate comments or private conversations. I would always prefer you show up a little late as opposed to skipping the class entirely.
- D. Please turn OFF your cell phone when you enter the class or lab.** You may **NOT** take calls or texts during either, except for emergencies. Students caught abusing this rule may be docked points or expelled from class or lab.
- E. Academic Dishonesty:** Cheating or plagiarizing another student's work, in whole or part, will result in a zero for the assignment, a referral to the dean and my immense displeasure. Any case where you attempt to gain unfair advantage over other students or attempt to pass off another's work as your own **is cheating**. Please see me if you have any questions. You implicitly agree to abide by the Honor Code as a condition of enrollment in this class: <http://www.deanza.edu/studenthandbook/academic-integrity.html>
- F. Grading:** This class is not graded on a curve. Grade cut offs are as follows:
A+ (97), A (92), A- (90), B+ (87), B (82), B- (78), C+ (73), C (65),
D+ (60), D (55), D- (50), F (50-0)
- G. Extra Credit:** Extra credit assignments are not offered in this class on an individual basis. It is unfair to allow some students to improve their grade while not allowing others that same opportunity. Some extra credit problems may appear at the end of exams and in homework.
- H. Dropping the Class:** If you wish to drop the class after the first 2 weeks, it is your responsibility to do so. If you fail to drop the class you will be assigned a grade in keeping with your submitted work, usually an F.
- I. Questions/Help:** I am available to answer questions during office hours, by email, or during the lab sections. Please feel free to contact me with any problems or concerns that you have. Also remember that your fellow students are great resources.

Attendance Note

You are responsible for all the material covered in this course, and it is expected that you attend and participate in all of the lecture and laboratory sessions. *If you must be absent, then it is in your best interest to contact your instructor as soon as possible in order to find out what work you have missed.*

****Due to the high number of students wishing to enroll in this class, any unjustified absences during the**

****first two weeks of class will result in you being dropped.**

LAB POLICIES:

LABORATORY CHECK-IN

Locker check-in will take place the first day of lab. It is your responsibility to make sure that all glassware is present and unbroken at the time you check in. If at any point after the first day of lab you need to replace an item in your locker, your student account will get charged for it. *If you drop this course, then you must arrange to **check-out your locker with your instructor during your regularly scheduled lab period.*** The stockroom technician or other instructors WILL NOT check-out lockers for any students. **Any person who has not checked out by the end of the last scheduled lab period for the quarter will have an administrative fee added to their student account and a hold put on their registration.**

LABORATORY PROCEDURES AND POLICIES

All students are expected to arrive to lab on time and to come to lab prepared to carry out the experiment scheduled for that session. This means that you have studied the experiment for the day, have a basic understanding of its purpose and procedure, the chemistry involved and *have prepared your laboratory notebook for the experiment prior to the start of lab.* I ask that all students do a conscientious and thorough job of cleaning up after themselves, whether it is in their own work area in the lab, or shared areas such as the chemical supply table and balance room.

LABORATORY SAFETY

Laboratory safety is an everyday assignment. ***Being safe in the lab is a top priority.*** The importance of safety in the laboratory will be reviewed the first day of lab. *Any unsafe behavior, intentional or not, will be noted and may be cause for dismissal from the class.*

For your protection, **safety goggles** with indirect ventilation and an ANSI minimum rating of Z87 **must be worn AT ALL TIMES** in the laboratory. **ONE warning** will be issued to any student that is observed wearing their goggles on their forehead, hanging them around their neck, etc... instead of wearing over their eyes. If the **warning is disregarded, expulsion** from the lab and a zero on the assignment may result.

LABORATORY LECTURE

The beginning of each laboratory session is designated as a laboratory lecture period for which you **must be on time** in order to perform the scheduled experiment. The instructor will use this lecture period to outline important details of the procedure, overview theory and calculations, and to emphasize safety hazards and proper chemical disposal. *If you are more than **10 minutes** late for lab lecture, you will not be allowed to do the experiment for that day.*

ATTENDANCE

Attendance is required at all scheduled laboratory sessions. NEVER plan on missing a lab. *You will receive a zero on the second lab you miss and will fail the course on the third.* These absences include those in which you arrive too late for lab lecture and are thus not allowed to complete the experiment. I may allow for emergencies and other complications in life. Additionally, do not plan on leaving lab early. Labs will regularly take the total amount of time allotted.

CHEMICAL DISPOSAL

As a concern for the environment and to follow county, state and federal law, proper chemical disposal is essential. *Students who do not comply with directed procedures may be expelled from the lab or failed in the course for repeated offenses.* Check with the instructor if you have any questions.

LAB REPORTS

All lab reports must be completed and turned in to receive a passing grade in this class. **Using another student's data or making up data is plagiarism and data falsification and will result in a zero for the assignment and referral to the dean.** In cases where a student was unable to complete a lab, the instructor may direct you to use another's data in order to complete follow up quests at his discretion. The source of your data must always be cited in lab reports.

LATE ASSIGNMENTS

Due dates for assignments are listed on the class schedule. Late assignments will lose 20% of their value per period missed. Assignments in excess of 2 periods late will be graded as zeros

(All Labs must still be turned in to receive course credit).

It is the student's responsibility to know when labs are due based on the provided class schedule. Labs are always due 2 lab periods (usually 1 week) after the lab session in which they are completed.

EXCUSED ABSENCE

Every student gets one excused absence. To reflect this, your lowest pre-lab and lab report are dropped at the end of the quarter. Missing a 2nd lab will result on a score of zero on that lab. **Missing a third will result in failing the course.**

Tips for Success

- **Come to class having read the assigned chapter** and be ready with questions about the concepts you didn't understand.
- In case you didn't read the first one, really, come to class with the assigned chapter already read. I cannot stress how big a difference this will make for you.
- **Take notes during class and reread your notes before the next class.** If something is still unclear, write down your question so you can ask about it during the next class or in office hours.
- **Work every day.** The longer the time that passes between doing chemistry problems, the more knowledge you have to rebuild. Do some homework problems and some problems from the book every day as this will help you understand where you need help, and it will help prepare you for the exams. Schedule some time each day to work on chemistry. Treat this subject like a foreign language. Use it or lose it.
- **Do the suggested chapter problems in the book,** particularly for concepts you're having trouble with.
- **Don't try to memorize EVERYTHING.** This is a common trap that many students fall into. While there are certain topics that must be committed to memory, strive to develop an intuitive understanding of the underlying framework of the material. Once you have that you will often be able to derive answers from a much smaller pool of "memorized" data.
- **Join a study group,** exchange phone numbers of classmates whom you can call for help. In the group, take time to present concepts to one another. The BEST way to solidify a topic in your mind is to have to teach it to someone else.
- **Don't wait** until the night before to finish that lab report or homework assignment. You'll get more out of it (and do better) if you give yourself the time to understand the concepts and ask questions when you get stuck.
- Start studying for the exams **at least a week before.** Cramming for an exam is like playing Russian Roulette! Cramming is superficial knowledge only, and when you are nervous, superficial knowledge is very unreliable.
- Work through old quizzes and homework problems before exams.
- **Give yourself TIME!** Plan on spending at least 2 hours studying outside of class for each hour we spend together in class or lab lecture. Do this every week, not just the week before the exam. Start early and it will be much easier later.
- If you consider yourself a poor test-taker, then you should complete and turn in all of the labs on time in order to pass the class. Also, utilize any practice exams or chapter reviews as they contain the same types of questions which you will encounter on the exams.
- **Stay well rested and healthy.** This is always a challenge in college, but do not neglect your basic needs. Poor sleep and diet have been shown to have a temporary negative impact on I.Q. Schedule study breaks as needed to keep up your mental health as well. Sometimes a night off is the right answer. Just don't make blowing off your studying a habit.
- As you listen, take notes, read, or work problems, try to keep an open mind, be curious, and think about the implications of the concepts and problems. Chemistry makes the world around us work and understanding why the world works will impress your friends at parties and help you grasp the material. The more connections you can make between the material in the book and the world around you, the more sense this class will make.

Rules for Safe and Efficient Chemistry Laboratory Operations

Safety Rules:

1. *Prepare for each experiment by reading all of the directions before lab starts.*
2. *Locate the Safety Equipment.* Know the locations of the eye wash, safety shower, fire extinguishers, fire blankets, first aid kit, fume hoods, telephone and all exits that are to be used in an emergency. Your laboratory instructor will describe the use of the safety equipment.
3. *Protect your eyes.* Wear approved eye protection at all times. Your laboratory instructor will inform you which of these you must have. Goggles provide maximum safety. Prescription glasses, if you need them, must be worn under approved eye protection. Contact lenses should not be worn in the laboratory because fumes may accumulate under the lenses and injure your eyes and the lenses make it difficult to flush chemicals from your eyes.
4. *Tie long hair back.* This precaution will keep your hair out of burner flames and harmful chemicals.
5. *Do not wear clothing with loose, flowing sleeves.* This precaution will keep your sleeves out of burner flames and harmful chemicals.
6. *Wear shoes that cover all of your feet.* Broken glass on the laboratory floor and spilled chemical reagents are all too common. Shoes that cover your feet completely will protect them from broken glass and chemical splashes. The best types of shoes are closed-toe made out of leather.
7. *Wear clothes that cover your torso and your legs to the knees.* Clothing will give your body needed protection. Good clothing can be protected with a lab apron or coat.
8. *Do not eat or drink in the laboratory.*
9. *Do not taste any chemical reagent.*
10. *Do not smell chemical reagents directly.* When you are instructed to smell a chemical, do so by gently wafting the vapors toward your face. Do not inhale deeply.
11. *Do not pipette solutions by mouth.* Use a rubber suction bulb to fill the pipette.
12. *Do not work with flammable liquids near a flame.*
13. *Do not engage in games or horseplay in the laboratory.* Never run in the laboratory.
14. *Do not attempt unauthorized experiments in the laboratory.*
15. *Do not work in the laboratory in the absence of your instructor or his or her authorized representative.*
16. *Use a fume hood when required.*
17. *Handle glass tubing and thermometers carefully.* When inserting glass tubing or thermometers through a rubber stopper, always hold the glass close to the stopper and use a lubricant such as glycerin to help the glass slide through the stopper. Do not continue to try to force glass through a stubborn stopper, get a new stopper and/or get help. When inserting a pipette into a pipette bulb, hold the pipette near the bulb and GENTLY insert the pipette.
18. *When diluting, never pour water into concentrated reagents.* Always pour the reagent into the water.
19. *If you spill a chemical reagent on yourself, immediately flood the exposed area with water and then summon the laboratory instructor. Inform the instructor immediately about any other accidents or spills.*
20. *Be aware of your neighbors. Are they obeying the safety rules?* A neighbor's accident may injure you.
21. *Avoid touching your face and rubbing your eyes while in the laboratory.* If you must do so, first wash your hands.
22. *Wash your hands before leaving the laboratory.*
23. *Never heat a closed container.* Pressure build up can cause the container to explode.
24. *Assume any chemical is hazardous if you are unsure.*
25. *Do not violate any other safety rule issued by your laboratory instructor.*

Housekeeping Rules:

1. *Clean up broken glass immediately with a broom and dustpan. Do not use your hands.* Dispose of broken glass in the special container that is provided, never in a regular trash can.
2. *Chemical spills must be cleaned up immediately.* Immediately notify your instructor who will advise you how to clean it up and/or assist you. Dispose of the collected contaminated chemical properly as instructed.
3. *Do not pour any chemical down into the sink or in the trash without authorization.* Clearly labeled disposal bottles will be provided when needed.
4. *Take containers to the stock of chemical reagents.* Do not bring stock chemicals to your laboratory bench.
5. *Read the label on a reagent bottle carefully.* Is it the correct chemical? Is it the correct concentration?
6. *Do not insert your own pipette, medicine dropper or spatula into a stock bottle.*
7. *Use special care with stoppers or tops of stock bottles.* Do not allow them to pick up contamination. Your instructor will provide additional instructions for handling the stoppers or tops found in your laboratory.
8. *Always replace the stopper or top of a stock bottle when you are finished taking some of the reagent.* Make sure that you put the stopper or top back onto the correct bottle.
9. *When pouring liquid from bottles, hold the bottle with the label against the palm of your hand so that the liquid is poured from the side opposite the label.* If any liquid runs down the outside of the label, immediately wipe off the liquid.
10. *Do not take any more of a reagent than is required.* Many of the chemicals used in the laboratory, including deionized water, are costly.
11. *Never return any unused reagent to a stock bottle.* If you take too much of a chemical, dispose of it as directed by your instructor or offer it to a classmate who needs it.
12. *Set up your glassware and apparatus away from the edge of your laboratory bench.*
13. *Thoroughly clean the area around your laboratory bench and the top of your laboratory bench before leaving lab.*
14. *Keep shared areas of the laboratory clean.* This includes areas such as the balance room and where the stock bottles are stored. It is especially important to keep the balances clean and free of chemical spills.
15. *Keep your laboratory equipment clean.* Good results depend on clean equipment.
16. *If a piece of equipment containing mercury is broken, inform your laboratory instructor immediately.* Keep the area blocked off to avoid scattering the mercury.
17. *Follow any other housekeeping rules given by your laboratory instructor.*

Tentative Lecture Schedule for Chem 25: Subject to Change
Winter 2020 De Anza College

Mr. Jimmy Li

Week	Date	Section	Topics	Suggested Problems
1	1/6 1/8	1.1-1.4 2.1-2.4	Classifying Matter and its Changes. Measurements Atomic Theory. Atomic Properties.	Ch 1:
2	1/13 1/15	2.5, 3.1-3.3 3.4-3.5	The Periodic Table. Ionic Compounds Naming ionic Compounds	Ch 2:
3	1/20 1/22	3.6-3.7, 4.1 4.2-4.4	Holiday Naming Acids and Bases. Percent Composition The mole: Calculations and Conversions. Solutions	Ch 3:
4	1/27 1/29	5.1-5.3 Exam 1	What is a Chemical Reaction? How do we identify them? How do we write them? Chapter 1, 2,3.	Ch 4:
5	2/3 2/5	5.4-5.5 6.1-6.3	Classifying types of chemical reactions. Equations and Moles: Stoichiometry and Conversions	Ch 5:
6	2/10 2/12	6.4-6.5 6.6-6.7, 7.1-7.2	Limiting Reactants and Percent Yield. Solutions. Changes in Energy and Heat. Energy and Atomic structure	Ch 6:
7	2/17 2/12	Exam 2	Holiday Chapter 4, 5,6.	Ch 7:
8	2/24 2/26	7.3-7.7 8.1-8.3 8.4-8.5, 9.1-9.2	Modern Atomic Theory. Electron configuration and the Periodic Law. Periodic Trends Ionic and Covalent bonds. Lewis Structures Hydrocarbons. Molecular Geometry. Intro to Gasses	Ch 8:
9	3/2 3/4	9.2-9.5, 10.1 10.1-10.3, 13.1-13.2	The Ideal Gas Law. Gasses in Chemical Reactions Intro to Phase Changes. Phase Changes and Intermolecular forces Intro to Acids and Bases	Ch 9:
10	3/9 3/11	13.1-13.2 Exam 3	Phase Changes and Intermolecular forces Intro to Acids and Bases Chapter 7,8,9.	Ch 10: Ch 13:
11	3/16 3/18	13.2-13.5, 11.5 14.1-2, 14.4 Review	Strong & Weak Acids. The pH Scale. Titrations Oxidation Numbers and Balancing Redox Reactions	Ch 14:
12	3/23		FINAL EXAM 9:15 AM-11:15 AM Cumulative	

***Homework:** Homework will go live on site on day listed. Due by day listed.

*****Important Dates:**

1/18/2020(Saturday): Last day to add classes

1/19/2020(Sunday): Last day to withdraw with no W on record

2/28/2020(Friday): Last day to withdraw with W on record

Tentative Lab Schedule for Chem 25: Subject to Change
Winter 2020 De Anza College

Mr. Li

Week	Date	Lab Topic	Due	Notes
1	1/6	Introduction, Safety, Check in. Significant Figures		
	1/8	Introduction, Safety, Check in. Significant Figures		
2	1/13	Lab 1: Measurements, Units and Conversions	Sig Figs	
	1/15	Lab 1: Measurements, Units and Conversions		
3	1/20	Holiday	Lab 1	
	1/22	Lab 2: Density & Specific Gravity		
4	1/27	Lab 3: Atomic Structure & Periodic Properties	Lab 2	
	1/29	Lab 3: Atomic Structure & Periodic Properties		
5	2/3	Lab 4: Ionic Compounds: Names and Formulas	Lab 3	
	2/5	Lab 4: Ionic Compounds: Names and Formulas		
6	2/10	Lab 5: Molecular Compounds: Names, Formulas, Shapes	Lab 4	
	2/12	Lab 5: Molecular Compounds: Names, Formulas, Shapes		
7	2/17	Holiday	Lab 5	
	2/19	Lab 6: Empirical Formulas of Compounds		
8	2/24	Lab 7: Chemical Reactions	Lab 6 (both sections)	
	2/26	Lab 7: Chemical Reactions		
9	3/2	Lab 8: Gas Laws	Lab 7	
	3/4	Lab 8: Gas Laws		
10	3/9	Lab 9: Titration of Acid Content in Vinegar	Lab 8	
	3/11	Lab 9: Titration of Acid Content in Vinegar		Lab 9 (@end of lab)
11	3/16	Lab Exam. Check Out of Lockers		
	3/18	Lab Exam. Check Out of Lockers		
12	M 3/23	FINAL EXAM 9:15 AM- 11:15 AM – Lecture Room Cumulative		No Lab – Finals Week

Student Learning Outcome(s):

*Assess the fundamental concepts of modern atomic and molecular theory.

*Evaluate the standard classes of chemical reactions.

*Demonstrate a fundamental understanding of mathematical concepts pertaining to chemical experimentation and calculations.