

**Instructor:** Prof. Rory Waterman  
Cook A-129  
656-0278  
rory.waterman@uvm.edu

**Lecture:** MWF 11:45–12:35, Angell B-106

**Office hours:** M 12:35–2:00 pm and T 1:00–3:00 pm or feel free to make an appointment.

**Course description:** The first half a two-semester sequence that covers topics that impact all of chemistry and many other sciences including atomic structure, bonding, mass balance, gases, thermodynamics, quantum mechanics, and basic reactivity.

**Text:** *Chemistry: A Molecular Approach* (2nd Ed) by Nivaldo Tro (ISBN 0-321-65178-2) and solutions manual. The purchase of the text also includes access to the Mastering Chemistry on-line resource, which will be used for homework.

The Department of Chemistry has negotiated a substantial price decrease as compared to the same text last year if you purchase through the bookstore. However, you can also search for a better deal through other vendors. Please note that the bookstore bundle includes the instructor's version of the solution manual, which is not widely available, as well as access to the Mastering Chemistry on-line resource, which is required.

**Web content:** Course materials will be available through Blackboard (bb.uvm.edu), and homework assignments and practice problems will be available through the Mastering Chemistry Web page (masteringchemistry.com).

**Academic Honesty:** As UVM students, you are expected to conduct yourself in accordance with the Code of Academic Integrity [uvm.edu/policies/student/acadintegrity.pdf](http://uvm.edu/policies/student/acadintegrity.pdf).

| <b>Exam dates</b>                                           | <b>Projected content</b> |
|-------------------------------------------------------------|--------------------------|
| Wednesday, September 21, Exam 1                             | Chapters 1–3             |
| Wednesday, October 12, Exam 2                               | Chapters 4–5; part of 6  |
| Wednesday, November 9, Exam 3                               | Chapters 6–8             |
| Wednesday, November 30, Exam 4                              | Chapters 9–11            |
| Final exam: Friday, December 16, 7:30–10:15 AM <sup>‡</sup> | cumulative               |

**Problem sessions:** Monday prior to exams 1–4 at 4:30 pm in Angell B-112.

**Important dates:** Monday, September 12, add/drop deadline  
Monday, October 31, withdrawal deadline

**No class:** Monday September 5 (Labor Day)  
Monday 11/21 – Friday 11/25 (Thanksgiving break)

---

<sup>‡</sup> This is the Registrar-scheduled exam date for this section. I have no ability to change this.

Coursework

**Lectures:** This is the venue where new material is covered. My goal in class is to help you understand the concepts of the course and show you the skills to solve problems using or related to those concepts. It is in your best interest to read ahead in the book and come to class having seen the material. I will not be presenting the textbook. That is your resource to read outside of class. Class time will be for presenting a different perspective.

Each class will operate with the same basic format. There will be a brief overview of the previous class, goals for the current day, the content (including background information context as well as examples), and time to answer questions.

Attendance I do not take attendance, nor attach any part of your grade to your attendance. However, UVM policy is that you attend all scheduled classes, and my observation is that two activities correlate well with course grade: Attendance and homework.

Below is a *tentative* schedule\* for the semester

| Dates       | Chapter           | Representative topics                                                                                                                                        |
|-------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8/31–9/2    | 1                 | matter, states, mixtures, physical/chemical change, units of measure, significant figures, precision/accuracy, conversions                                   |
| 9/7–9/12    | 2                 | atomic structure, periodic table, simple periodic trends, atomic mass, mole concept                                                                          |
| 9/14–9/19   | 3                 | chemical bonds and structure, basic nomenclature, chemical equations, mass balance, formula mass and composition                                             |
| 9/21–9/28   | 4                 | stoichiometry, oxidation/reduction (redox), yields, concentration, aqueous reactions                                                                         |
| 9/30–10/7   | 5                 | behavior of gases, ideal gas law, real gases, partial pressure, kinetic theory, van der Waals                                                                |
| 10/10–10/14 | 6                 | First Law of Thermodynamics, heat, work, enthalpy, heat of reaction ( $\Delta H$ )                                                                           |
| 10/17–10/24 | 7                 | quantum mechanics, atomic structure (revisited), light, waves, spectroscopy                                                                                  |
| 10/26–11/2  | 8 and section 9.6 | periodic table in detail, electronic configuration, effective nuclear charge ( $Z$ ), periodic trends                                                        |
| 10/4–11/14  | 9 & 10            | Chapters 9 and 10 will be treated as a continuous unit. Chemical bonding: Lewis and VSEPR theory, valence bond theory, molecular orbital theory and diagrams |
| 11/16–end   | 11                | intermolecular forces and related properties, phase diagrams, treatment of state changes, basic solid state                                                  |

\*This basic schedule is likely to be subject to change..

Below is a list of key skills for the course. Please keep these in mind as you proceed through the semester.

- Apply a scientific way of thinking to solving problems.
- Use the periodic table as a predictor of chemical and physical properties.
- Manipulate known relationships to predict chemical or physical properties.
- Use chemical information to solve problems.

- Demonstrate proficiency in simple laboratory manipulations.
- Express data clearly and accurately while in the correct unit of measure.
- Apply the mole concept to reactions.
- Balance chemical reactions.
- Apply various theories (bonding, gases, thermodynamics, etc.) from class to problems.
- Describe atomic and molecular structure with respect to orbitals.
- Analyze data and to arrive a rational, justifiable conclusion.

**Grading:** Grades will be based on exams (70%), problem sets (5%), and laboratory work (25%). The mean course score will be set to a grade between C (“average” according to UVM) and C+, then use the standard distribution to determine grades above and below.

**Exams:** Exams are held from 6:15–9:15 pm on the Wednesdays noted above (Important dates), in B-106, and the final exam is scheduled by the Registrar. These exams are scheduled such that there are no conflicts in your schedule. Therefore, **there will be no make up exams.**

Each exam is equally weighed, and the comprehensive final exam is worth twice the value of a single semester exam. The final exam is cumulative, but it will cover slightly more material from the last week of class, as that material will have not appeared on a semester exam. Your lowest exam score, which is either one semester exam or one-half of the final exam, will be dropped from your course grade. This is illustrated below.

$$\begin{array}{rcl} \text{semester exams} & = & 4 \text{ grades} \\ \text{final exam} & = & +\underline{2} \text{ grades} \\ & & 6 \text{ grades} - \text{lowest grade} = 5 \text{ exam scores} \end{array}$$

**Important:** Department of Chemistry policy prohibits the use of calculators that can be programmed, cell phones, and all other electronic devices during examinations. Violation of this policy will result in a grade of zero for that exam.

**Problem Sets:** Problems will be provided through the Mastering Chemistry Web page. There will be a limited number of assignments for credit through Mastering Chemistry. Copious additional problems that will allow you to practice skills and better understand content are also available at this site.

We have provided in the textbook package the complete, instructor’s solution manual. This version, as opposed to the standard solution manual, provides the answer and notes on how to solve the problems.

**Laboratory:** A weekly laboratory section is also included in the course, and your work in that section (reports, quizzes, etc.) comprise 25% of your course grade. Most students were initially scheduled into a laboratory section. You can change your laboratory section at MyUVM to another section with space (fewer than 22 students enrolled) before September 12.

*Laboratory experiments begin in the second week of classes (starting Monday, September 12).*

Attendance Attending the lab section you are registered for is mandatory. Make-up labs will be given only for documented, university-approved reasons and only during the same week of your lab section. *Unexcused absence from your laboratory section will result in a zero grade for that experiment.*

Be aware: **Missing more than two labs (even for legitimate reasons!) will result in failing the course.** Please note that an incomplete (grade of I) can only be granted for circumstances beyond your control by your academic dean. If a foreseeable conflict arises, you must obtain the permission of the laboratory supervisor, Dr. John Sharp (john.sharp@uvm.edu), a week in advance to attend a different lab section. Make it easy for Dr. Sharp to help you: Tell him why you need to switch, what your scheduled section and who your TA is, and some other lab section days and times that might work for you.

Laboratory manual Prior to the first laboratory, you must purchase a laboratory manual from the first floor stockroom, A-143 Cook, for \$10.

Breakage Card Prior to the first lab, you must purchase a breakage card, which is also available at the first floor stockroom (\$40). This sum is refundable if you do not damage any equipment. Never leave your card at home on lab days because *you can not start any experiment without it.*

Safety Eyewear OSHA-approved safety glasses or goggles, which can be obtained at the UVM bookstore, must be worn by everyone once an experiment has started in any area of the laboratory. Students not observing this rule will be given a zero for that experiment. Contact lenses are potentially a serious health hazard in a chemical laboratory and are not permitted in the lab. Prescription glasses may be worn under the safety goggles.

Footwear and dress This is a chemical laboratory—dress appropriately! No open shoes will be permitted. If you arrive at lab with shoes that do not cover your toes, you will be sent home to change. Be aware that laboratories are places with an inherent fire hazard. Tie back long hair, do not wear very loose sleeves, and note that some synthetic fibers are highly flammable. Finally, you will handle potentially dangerous chemicals. Beside the personal risk, you can also potentially damage your clothing.

Lab Notebook A notebook with duplicate pages (“carbon copy”) is required. Such notebooks can be obtained at the bookstore. All data must be recorded in ink.

Demonstration Videos The Department produced videos detailing the operations for each experiment of the semester (uvm.edu/~chem/?Page=31Videos.html). By taking several minutes to watch each video before the corresponding experiment, you will be prepared to quickly execute your experiment in a safe and correct fashion. This is an additional, free resource to help you.

**Go to lab prepared:** Read the experiment, watch the demonstration videos on line, prepare your lab notebook, and dress for the occasion (no open toe shoes, tie back long hair, etc.). If you spend a little time preparing for the lab, you will complete the experiments faster, obtain better results, and perform better in the course.

Grading Each experiment will be graded in four parts: notebook/prelab (15%), Lab report (40%), quizzes (32%), and technique (13%). Students typically average ~80% on the laboratory component of CHEM 31.

**Laboratory schedule** Below is the expected schedule of laboratory experiments, starting the week of September 13.

| Dates           | Experiment | Description                                                |
|-----------------|------------|------------------------------------------------------------|
| Sept. 12–17     | 1          | A. Laboratory Safety I (I–IV in WSWC)<br>B. Density        |
| Sept. 19–24     | 2          | A. Laboratory Safety II (V–XI in WSWC)<br>B. Hydrated Salt |
| Sept. 26–Oct. 1 | 3          | Mole Ratio                                                 |
| Oct. 3–8        | 4          | Acid Content of a Food Product                             |
| Oct. 10–15      | 5          | Gas Law Determination of Molecular Weight                  |
| Oct. 17–22      | 6          | Heat Capacity of a Calorimeter                             |
| Oct. 24–29      | 7          | Heat of Formation                                          |
| Oct. 31– Nov. 4 | 8          | Emission Spectra of Metals                                 |
| Nov. 7–11/14–18 | 9          | Qualitative Analysis                                       |
| Nov. 21–25      | No Labs    | Thanksgiving break                                         |
| Nov. 28–Dec. 3  | 10         | Synthesis and Identification of a Coordination Complex     |
| Nov. 28–Dec. 3  |            | Checkout                                                   |

### Sources of help

There is a team of people ready and willing to help you understand the course material and help you better to use that information to solve problems. Take advantage of these resources.

The professor I am more than the person at the front of B-106—I have a vested interest in seeing you understand the material. My office hours are listed above and if those times are inconvenient, I am also willing to schedule appointments. You can also reach me by e-mail or phone with your questions. It is often very convenient to take couple of minutes after class to ask questions as well. I would like you to feel like I am an accessible resource for you to understand the course material.

The teaching assistants You will have a teaching assistant (TA) in charge of your laboratory section. This is “your TA,” and you should know that person’s full name. This TA will be a great resource to you including soon-to-be scheduled office hours. All CHEM 31 TAs have open office hours, so you have a total 48 office hours times that you can get help from people who know this material. TA office hours times will be determined soon and posted on Blackboard.

**Supplemental instruction** There will be weekly sessions (schedule posted soon on Blackboard) where you can ask questions of a supplemental instruction leader. The SI leader does not teach new material and has no impact on your grades. This is purely to review and help you understand material. The SI leaders this year are Justin Paluba (Justin.Paluba@uvm.edu) and Dan Schwartz (Daniel.L.Schwartz@uvm.edu).

**Learning Co-Op** If you feel that me, the TAs, and the SI sessions are not the correct kind or enough help for you, then the Learning Co-Op organizes tutors for students. Contact that office directly to get set up with a tutor as needed. The Department of Chemistry office also maintains a list of tutors for hire.

**Miscellaneous:** For those issues not explicitly noted in these documents, the instructor may set or change policies during the semester. However, no part of this course does or is meant to supersede the policies of the University of Vermont and the College of Arts and Sciences.

**Learning Goals:** The Department of Chemistry has a set of learning goals for all chemistry majors. The specific learning objectives of this class are meant to directly address some of these goals as part of the broader program for students taking chemistry courses.

1. Students will demonstrate general knowledge in chemistry and will be able to apply chemical and physical principles in the solution of qualitative and quantitative chemical problems.
2. Students will understand the interplay of observational data, hypotheses, and hypothesis-driven experimentation through application of the scientific method.
3. Students will become proficient in chemical laboratory techniques and be able to apply these to practical and current problems in research.
4. Students will be able to read and critically evaluate the chemical and scientific literature.
5. The students will learn to present scientific data clearly and effectively through both written and verbal communication.

Parts of CHEM 31 specifically addresses goals 1, 2, 3, and 5.

*The instructor reserves the right to make changes, with notice.*