

CHEMISTRY 101: MOLECULAR STRUCTURE AND PROPERTIES

Fall 2012

Prof. Margret J. Geselbracht

309 Chemistry, x7865, mgeselbr@reed.edu

Office Hrs: Tues 2-4 PM; Thurs 2-3 PM

LECTURE F01: MWF 10-10:50 AM (PSYCH 105)

AFFILIATED CONFERENCE SECTIONS

F11 Wed: 1:10–2:00 PM (Chem 105)

F12 Wed: 2:10–3:00 PM (Chem 105)

F13 Thurs: 11:00–11:50 AM (Chem 105)

F14 Thurs: 3:10–4:00 PM (Chem 105)

Lab coordinator: Dr. Wendy Breyer

308A Chemistry, x7893, breyerw@reed.edu

Office Hrs: Tues 11-noon; Fri 1-2

SAFETY LECTURES (Week 2)

Please sign up on the Moodle and attend ONE session.

These will last ~90 minutes.

Tues Sept 4: 11 AM (Eliot Chapel)

Wed Sept. 5: 1:30 PM (Bio 19)

Wed Sept. 5: 6:10 PM (Bio 19)

Fri Sept. 7: 2:10 PM (Bio 19)

Prof. Julie Fry

318 Chemistry, x7951, fry@reed.edu

Office Hrs: Mon & Tues 3-4:30 pm

LECTURE F02: MWF 11-11:50 AM (VLH)

AFFILIATED CONFERENCE SECTIONS

F21 Wed: 3:10–4:00 PM (Chem 105)

F22 Wed: 4:10–5:00 PM (Chem 105)

F23 Thurs: 1:10–2:00 PM (Chem 105)

F24 Thurs: 2:10–3:00 PM (Chem 105)

LABORATORY SECTIONS

This semester, all labs will begin in Chem 301.

FL1 Mon: 2:10–5:00 PM

FL2 Tues: 9:00–11:50 AM

FL3 Tues: 1:10–4:00 PM

FL4 Wed: 1:10–4:00 PM

FL5 Thurs: 9:00–11:50 AM

FL6 Thurs: 1:10–4:00 PM

FL7 Fri: 2:10–5:00 PM

REQUESTS FOR SECTION CHANGES:

Your choice of conference section must match the lecture section listed above it! If you need to change conference and/or lecture sections, *please bring a Change of Section form, available from the Registrar's Office, to Maggie or Julie* (the instructor that you wish to switch to). If you need to change lab sections, *please see Wendy with a Change of Section form*. We will do our best to accommodate your requests, but bear with us as we do have a maximum enrollment cap allowed per section.

CHEM 101 MOODLE: If you are enrolled in the course, you will automatically be enrolled in the Chem 101 Moodle (<https://moodle.reed.edu>). The Moodle acts as “the command center” for the course. Here you will find electronic copies of all course documents, assignments, weekly announcements, reading assignments, suggested book problems, discussion forums, and links to helpful external resources. Periodically, we will post class announcements to the News Forum, and you will all receive copies of News Forum posts by e-mail. *We will assume you will be checking your Reed e-mail account regularly.*

There is also a Chem 101 Questions and Discussions Moodle forum where anyone can post questions or comments about lecture, conference, problem sets, lab reports, etc. We will be monitoring this Forum to answer questions or post tips in a timely fashion, but feel free to comment on what your fellow classmates are writing as well. If you have a question, consider posting it to the Forum rather than e-mailing us personally as it is very likely that someone else may be puzzled by the same thing.

TEXTS:

CHEMISTRY: *Atoms First* by Julia Burdge and Jason Overby (Required)

There are 5 copies on library reserve.

***Chemical Bonding* by Mark I. Winter** (Recommended)

This book in the Oxford Chemical Primers series is a nice companion text that reviews atomic structure, Lewis structures, molecular geometry, and simple bonding models. There are 5 copies on library reserve.

Problem-Solving Workbook with Selected Solutions for CHEMISTRY: Atoms First. (On reserve)

This resource is a self-paced tutorial working through selected problem types for each chapter in the text. There are 3 copies on library reserve.

Module Student Manuals (On reserve)

Much of our curriculum this fall was inspired by two “Module Student Manuals,” used in the past as companion texts. Printed copies of the “What’s in a Star?” and “Would You Like Fries With That?” module student manuals are available on library reserve. These student manuals provide additional background information and many activities that we have adapted for lecture, conference, or labs.

CHEM 101 LABORATORY:

We have designed activities for the Chem 101 laboratory that complement the topics that we will be covering in lecture. Labs will meet weekly **beginning this week, Monday, August 27**. Attendance at lab is mandatory. *If illness or another emergency prevents you from attending lab, please contact your lab instructor by phone or e-mail as soon as possible.* If your reason for missing lab is a documented valid excuse (oversleeping is not a valid excuse), we will try to arrange a make-up lab during the same week.

CHEM 101 LAB MANUAL:

The **Chem 101 Lab Manual** will be available for purchase from the Chemistry stockroom (Chem 212) for \$5. Each week, please read the experiment and complete the pre-lab preparation before coming to lab. You will also need to purchase a BOUND laboratory notebook (we recommend a quad-ruled Composition Book). Each week, you need to bring the lab manual and your lab notebook with you to your lab section.

LABORATORY SAFETY LECTURE:

Everyone must sign up to attend one of the safety lectures next week; times and locations are listed on the first page of this syllabus and sign-up is on the Chem 101 Moodle. Additionally, you must pick up a SAFETY MANUAL (available from the Chemistry stockroom, Chem 212) **and read Chapters 1–3 and 6–9**. *You must complete the safety quiz on page 47 of the Safety Manual and bring it to lab the week of Sept 10th. Do not sign the backside of the form until lab;* your lab instructor will act as the witness.

CHEM 101 CONFERENCE:

Conference is a crucial component of this course. It is an opportunity to engage the course material more actively through discussion, small group problem solving, computer modeling, and hands-on activities. It is also a great place to interact with faculty and to get help when you are having difficulties. We expect regular attendance and participation.

CLICKERS IN CHEM 101:

We will be using course response systems or “clickers” in Chem 101. Our goals in using this technology are: (1) to provide a more active and engaged experience for students in lecture, (2) to gain real-time assessment of your learning in the course, and (3) to provide immediate feedback to faculty on which concepts need more discussion. Each student will be expected to purchase and register their clicker and bring it with them to every lecture. Several clicker questions will be distributed throughout each lecture and you will receive participation points for registering your answers. Not choosing to participate or repeatedly forgetting your clicker may have a detrimental effect on your semester grade. These are points that are entirely under your control. Take charge of your learning!

Each student must purchase a clicker for use in Chem 101 by Thursday, August 30. Clickers are available at the bookstore for purchase or rental (in the past, clickers have been used in Chem 101/102, Chem 201, and Chem 212). It is your responsibility to make sure your clicker is functional. The bookstore will be handling battery replacement and all clicker repair issues. If you have borrowed or purchased a clicker from a friend, please e-mail Maggie or Julie the serial number, located under the bar code on the back. This way, your responses will be registered in our software.

A FEW WORDS ABOUT OUR GOALS FOR CHEM 101:

We recognize that you are an extremely diverse group of students in Chem 101. You have a wide range of backgrounds and prior experience with chemistry. You vary in the reasons for taking this class. Some of you are potential science majors, some of you have ambitions of medical school, some are motivated by a basic curiosity about chemistry, and yes, some of you just need the credit for Group C. Because of this, you all have different goals for what you would like to take away from this course.

Our goals for Chem 101 are simple. We hope that all of you succeed and that you enjoy the experience! But here are some more specifics:

Learning Goals. By the end of Chem 101, you should be able to:

- Make connections between observations of the macroscopic natural world and behavior at the atomic and molecular level.
- Use theories and models as unifying principles to understand and make predictions about natural phenomena.
- Analyze complex, multi-step problems that connect symbolic quantitative relationships with atomic and molecular level descriptions of chemical behavior and determine appropriate problem-solving strategies.
- Collect and analyze observations and quantitative data in the laboratory and communicate findings in the appropriate scientific format.
- Describe the fundamental chemical principles behind astronomy, global warming, and health concerns about fats in our diet and understand the unique perspective a chemist contributes to these multidisciplinary fields of interest.
- Evaluate the credibility, use, and misuse of scientific and quantitative information in reports to the general public on scientific research and public-policy issues.

EVALUATION:

To *succeed* in this course, you need to exhibit sustained effort and achievement in all of the following:

3 In-Class Exams (Friday, **September 21**, Friday, **October 26**, and Friday, **November 30**)

These will be 50 minutes long to be taken in class with closed books and notes.

Final Exam (Dec 10–13, Date and time scheduled by the Registrar's Office)

This will be a comprehensive exam reviewing the entire semester (again closed book, closed notes). Do NOT make travel arrangements for winter break before the final exam is scheduled. You must take the final exam when it is scheduled for your lecture section.

End-of-Module Assessments – The semester is divided into three thematic modules (Stars, Global Warming, Fats) described in more detail below. Each module will conclude with an end-of-module assessment activity. Our goal is to offer additional ways beyond the in-class exams for you to demonstrate your understanding of the material. The format of these assessments will vary depending on the module, but will likely include an on-line quiz and a take-home portion. You will be expected to complete these assessments on your own with no outside assistance.

Problem Sets – Handed out on Wednesdays, due in lecture on Wednesday the following week or to the box in Kathy Kennedy's office (Chem 303) by 1 pm. **No late problem sets (after 1 pm) will be accepted without a documented medical excuse.** So, hand in whatever you have done even if it is incomplete. Some credit is better than no credit!

Clicker and Conference Participation – Regular attendance at lecture and conference and participation in clicker questions is expected.

Lab Reports – Lab reports throughout the semester will consist of less formal worksheets and more formal lab reports. Instructions for each lab report are provided in the Lab Manual. Reports and/or worksheets will be due on your scheduled lab day, typically one week after completion of the experiment. There is a 5% per day penalty for late reports, and no reports will be accepted more than one week past the due date. *Note: If you do not turn in a majority of the laboratory reports, you will not pass this course, regardless of your exam scores.*

Practice Problems On Your Own – Learning Chemistry is akin to learning a language or learning to play a musical instrument. Practice, practice, practice is required to hone your skills! This means not simply reading the book and attending lecture, but working problems that apply your knowledge. *For most students*, just working the problem sets each week will not provide enough practice for you to succeed under the time pressures of an exam. We recommend that you work *many* more practice problems on your own to gain confidence and stretch your mind. In lecture, we will be suggesting end-of-chapter problems to work through on your own. These will not be collected. You should plan to set aside *several hours per week* to work extra problems.

ACADEMIC SUPPORT: (http://web.reed.edu/academic_support/)

At any point in the course, if you feel you need some extra help, there is a wide range of support available. We encourage you to come to office hours for help or arrange another time to meet with us that fits with your schedule. Individual tutors for Chem 101 are available and drop-in tutoring will be available at the DoJo from 5-11 pm on most days. (For details, see <http://dojo.reed.edu/schedule>)

ACADEMIC COLLABORATION IN CHEM 101:

Your work and your behavior in Chem 101 are bound by the Honor Principle. All work submitted is expected to reflect the effort of the individual whose name appears at the top of the page.

You are encouraged to work with friends, tutors, and instructors on problem sets and lab reports. However, when the time comes to write this work up for submission, it must be your work, written in your own words and reflecting your understanding of the problems at hand. In lab, you will be working with a lab partner to complete the experiments. We hope you will discuss the meaning of the data you collect and the observations you make together with your partner. However, you will write up individual lab reports, reflecting your understanding of the experiment. Using the same words as your partner to answer a question on a worksheet is not acceptable. Composing a lab report at the computer together and submitting two copies with different names at the top is not acceptable. Creating tables and plots in Excel together that are identical or sharing files with someone else to use as their own is not acceptable. We consider these are all forms of academic misconduct and/or dishonesty. ***Please note: Our policy on laboratory reports is different from that of Bio 101/102.*** If you have any questions about how much collaboration is acceptable or when the line of acceptable behavior is crossed, please ask your instructor!

All exams are to be taken closed book, closed notes and without any collaboration. In using a calculator, you may only use it for arithmetic and for simple algebraic and trigonometric functions. You may not use programmed equations or graphing functions during the exam period. You may not use a calculator on a smart phone during exams. Remember that full credit is given for demonstrating the thought process that leads to a correct response, not for simple answers without any demonstrated logic.

CHEM 101 COURSE OUTLINE:

The content of Chem 101 will be organized into 3 thematic modules. The purpose of each module is to place the chemistry content within the overall context of larger questions that may reach across several disciplines and/or have societal impact. Each module will be driven by a series of questions, and the chemistry will be taught on a need-to-know basis. The main consequence of this approach is that we will not move through the textbook in a linear fashion. The textbook will not guide the organization of the course; rather the modules will. The underlying chemical theme of the fall semester is molecular structure

and properties. Here is the contextual motivation and development of this theme, outlining the three modules:

1. WHAT'S IN A STAR? (AUG 27 – SEPT 30)

- What is starlight?
 - Electromagnetic spectrum, dual nature of light
- What do star colors tell us?
 - Blackbody radiation, color, and temperature
- What do stellar spectra tell us?
 - Periodic trends in atomic properties and basic atomic structure
 - Quantum mechanical wave model of atomic structure
 - Using atomic spectroscopy to identify elements
- What is the energy source behind a star?
 - Mass and energy, fission, fusion
- What is the origin of the universe?
 - The Big Bang, nucleosynthesis

2. WHAT SHOULD WE DO ABOUT GLOBAL WARMING? (OCT 1 – OCT 28)

- Is the climate changing?
- What is the relationship between CO₂ and temperature?
- The global carbon cycle
- What determines whether a gas is a greenhouse gas?
 - Lewis structures, VSEPR, polarity, and infrared activity
- How much are greenhouse gas concentrations changing?
 - Atmospheric concentrations, global warming potentials
- Why are greenhouse gas concentrations rising?
 - Chemical equations and stoichiometry

3. WHAT'S ALL THIS FUSS ABOUT FATS IN OUR DIET? (OCT 29 – NOV 30)

- Is it unhealthy to eat fat?
- What makes fats different from other nutrients?
 - Chemical structures and properties of fats, carbs, proteins, vitamins
- Why is fat a necessary nutrient?
 - Molecular polarity and solubility
- What kind of fat should we eat? Good fats vs. bad fats
 - What's an omega-3?
 - Geometric consequences of chemical bonding
- Should we eat fake fat?
 - The story of margarine, partial hydrogenation, and the evil trans-fats!
- How is fat a concentrated energy source?
 - Thermochemistry

4. BONUS MATERIAL: FROM BLUE JEANS TO BODY ARMOR

- Why are blue jeans made out of cotton and not polyester?
 - Natural and synthetic polymers
- How do I use chemistry to stop a speeding bullet?
 - Polymer structure/property relationships

This semester, we will cover Chapters 1–10, 12, 20, and 24 in *Chemistry: Atoms First* although not necessarily in that order. We also may skip sections in these chapters that are not relevant or that you will return to in Chem 102. Background information will also be provided in various course handouts. Each week, we will update the Moodle with specific reading assignments and suggested practice problems that match the topics and the storyline of each thematic module.

LABORATORY SCHEDULE FALL 2012

Week of:	Experiment:	Report Due:
8/27	Exp 1: Introduction to Light, Color, and Spectroscopy	In-class worksheet due at the end of lab
9/3	<i>SAFETY LECTURES</i>	Exp 1 Take-home worksheet in your Instructor's mailbox
9/10	Exp 2: Atomic Spectroscopy	
9/17	Exp 3A: Discovering Beer's Law	Exp 2 Take-home worksheet In-class worksheet due at end of the lab
9/24	Exp 3B,C: Discovering Beer's Law	
10/1	Exp 4: Phosphate in Crystal Springs Creek	Exp 3 report
10/8	Discussion of Exp 4 Results Set-up for Exp 5	Exp 4 plots and data tables
10/15	<i>FALL BREAK</i>	
10/22	Exp 5: Quantifying CO ₂ Production from Leaf Decay	
10/29	Exp 6: Separation and Identification of Leaf Pigments	Exp 5 worksheet
11/5	Exp 7: Hydrogenation of Canola Oil, Part I	Exp 6 report
11/12	Exp 7: Hydrogenation of Canola Oil, Part II	
11/19	<i>THANKSGIVING WEEK – NO LAB</i>	
11/26	Exp 8: Synthesis of Indigo	Exp 7 report
12/5	<i>NO LAB</i>	Exp 8 report
