CHM 151: GENERAL CHEMISTRY I

Department of Chemistry and Biochemistry
College of Engineering and Natural Sciences
Northern Arizona University
Fall 2006

Instructor: Dr. Brandon Cruickshank ***Office:*** Chem: Rm 121 ***Phone:*** 523-9602
Web site: http://jan.ucc.nau.edu/~bjc ***E-mail:*** brandon.cruickshank@nau.edu

Section	Class No.	Time	Room
4	3434	MTWTh 11:30 – 12:20 p.m.	Bldg 88–130

Office Hours:

Monday and Thursday, 4:00-5:00 p.m., Chemistry, Room 121
Tuesday and Wednesday, 3:00-4:00 pm, Chemistry Room 121
or BY APPOINTMENT

Recitation Session:

Wednesday, 4:10-5:00 p.m., Room 130, Bldg. 88 (Wettaw Bldg.), Class No.: 3460 (Section 4)

Prerequisites:

MAT 102x (Intermediate Algebra) or equivalent
One year of high school chemistry or CHM 100

Distribution Block:

4-hours of Science/Applied Science credit (CHM 151 only)
5-hours of Laboratory Science credit if taken with the lab (CHM 151 and CHM151L)

Texts:

Required: *CHEMISTRY & CHEMICAL REACTIVITY*, John Kotz, Paul Treichel, Gabriela Weaver; Thomson Brooks/Cole, 6th edition (2006).
Course Pack to Accompany CHM 151, Brandon J. Cruickshank (2006)
E-instruction response pad

Optional: *Student Solutions Manual to Accompany CHEMISTRY & CHEMICAL REACTIVITY*, Alton Banks; Thomson Brooks/Cole (2006).

Reading:

It is of utmost importance that you read the text as assigned. The lectures alone will not suffice.

Time Expectations:

The typical student will need to spend 2 hours studying for every hour in class. That amounts to an average of 8 hours of studying each week for a 4-credit class. This number will vary depending on ability, and the material covered that week. Weeks with exams will require more study time. You should organize your schedule to study in small time blocks (approx. 1 hour each) throughout the week, particularly focusing on reviewing material immediately following lecture. Studying in groups is highly recommended. Homework that relates to material covered in a particular lecture should be completed as soon as possible. It is not recommended to study in one huge time block or to complete the homework in one long session shortly before the deadline.

Supplemental Instruction:

The SI program is designed to provide academic assistance to all students in various courses on this campus. Rebecca Fega is the SI leader for this class. Her office hours and help sessions will be announced and posted.

Course Description

CHM 151 is the first semester of a 1-year sequence appropriate for pre-professional science and engineering majors. As a liberal studies course, CHM 151 provides a foundation in chemistry – the science of change. The course addresses the following liberal study themes and essential skills.

Themes:

Environmental Consciousness. Chemical change is of key importance in understanding the behavior of the Earth's hydrosphere and atmosphere. The chemical and physical properties of gases, liquids and solids are presented in CHM 151. The student learns to name chemical compounds, recognize periodic trends of the elements and predict the product of chemical reactions. With this background, students can begin to interpret the physical and chemical processes of the natural world. Topics that illustrate these processes include aqueous reactions (critical for understanding water quality) and combustion processes (critical for understanding heat release to the atmosphere). Students will learn to associate these processes with their effect on the environment.

Technology and its Impact. Chemistry has a profound impact on the technological developments of the 20th and 21st centuries. Many chemical discoveries have improved the quality of life (drugs, laser technologies and the semiconductor industry) while others have threatened it (CFCs and pesticides). Whenever possible, this course will illustrate how modern technology has been influenced by the fundamental science taught in CHM 151.

Essential Skills:

Scientific Inquiry: Chemistry is an empirical science. What is taught in CHM 151 represents knowledge that has been acquired over the past 3 centuries through application of the scientific method, a systematic approach to research. Scientific theories will be examined in light of this process which includes the formulation of a hypothesis, observations, symbolic representation of data, interpretation and conclusions.

Quantitative Analysis: Quantitative Analysis is at the root of the physical sciences. Specific skills the student will learn include writing and balancing chemical equations, dimensional analysis, and the application of algebra in the quantification of chemical change.

Critical Thinking: Successful chemical problem solving requires the ability to follow a logical, sequential thought process, understand abstract and symbolic language, discriminate between relevant and superfluous data and question underlying assumptions about cause and effect relationships.

Course Outcomes (linked to theme and skills)

Following successful completion of this course, students will be able to:

1. Distinguish between chemical and physical processes **(Critical Thinking, Scientific Inquiry)**
2. Utilize mathematical skills to solve chemical problems in mass relationships and stoichiometry **(Quantitative Analysis)**
3. Determine the solubility, concentrations and ionic properties of compounds dissolved in aqueous solutions **(Quantitative Analysis)**
4. Use standardized symbols to represent atoms, molecules, ions and chemical reactions **(Scientific Inquiry)**
5. Describe intermolecular forces which influence the properties of gases, liquids and solids **(Critical Thinking, Quantitative Analysis)**
6. Predict atomic structure, chemical bonding or molecular geometry based on theoretical models and results of empirical studies **(Critical Thinking, Scientific Inquiry)**
7. Apply chemical principles to the understanding of the physical and natural world **(Critical Thinking, Scientific Inquiry)**

8. Recognize the influence of chemical change in environmental situations and its impact on technology **(Environmental Consciousness/Technology and its Impac**t)

Assessment of Outcomes (linked to themes and skills)

Assessment of student learning outcomes will be evaluated using examinations, quizzes and/or homework. These evaluation methods will test the student's knowledge of scientific principles, their ability to identify and solve problems, and their ability to analyze scientific data. Quiz and exam questions will require students to:

1. Analyze data presented in graphs or tables, theoretical models, or results from empirical studies to draw correct hypotheses or conclusions **(Scientific Inquiry, Critical Thinking)**
2. Perform multi-step calculations using appropriate equations and formulas **(Quantitative Analysis, Critical Thinking)**
3. Identify proper symbolic representation of atoms, molecules, ions and chemical reactions **(Scientific Inquiry)**
4. Determine the products and heat exchange of chemical reactions **(Quantitative Analysis, Critical Thinking)**
5. Based on the physical properties of gases, liquids and solids deduce the nature of the underlying intermolecular forces **(Critical Thinking, Scientific Inquiry)**
6. Apply your knowledge to the chemistry of the natural world/environment. Exams, quizzes and/or homework will include questions that link acquired chemical knowledge to environmental scenarios (e.g. the ion concentration of a lake, the heat released by burning fossil fuels, or the moles of CFCs in the atmosphere) **(Environmental Consciousness/Technology and its Impact)**

Learning Portfolio:

Students are encouraged to retain their exams and quizzes as evidence that they developed skills in scientific inquiry, critical thinking and quantitative analysis. Students also are encouraged to write a reflective essay that describes how the principles of introductory chemistry have increased their awareness of the environment.

Important Dates:

September 4	Labor Day (no classes)
September 8	Deadline to add a class
	Deadline to change audit to credit, credit to audit, and file for grade replacement
September 22	Deadline to drop a class
October 27	Deadline to drop with a "W"
November 10	Veteran's Day (no classes)
November 23-24	Thanksgiving holiday (no classes)
December 4-8	Reading Week
December 12	Final Exam (10:00 a.m. – 12:00 p.m.)

Notes:

1. You may drop a course through the ninth week of the semester with the approval of your academic advisor. If you drop a course through the fourth week, the course is deleted from your permanent record; between the fourth and ninth weeks, a grade of W (withdrawal) is recorded. The university deadline to drop with a "W" is Friday, October 27th.

2. Remember, a drop/add is not complete until it has been processed through the Registrar's office.

GRADING POLICY

Homework: On-line homework assignments will be given each week. Homework will count 12.5% of your grade. (**http://loncapa.chm.nau.edu**)

Quizzes: There will be ***ten*** quizzes. Quizzes will be given during the final 20 minutes of the class period on the following Thursdays.

9/7, 9/14, 9/21, 10/5, 10/12, 10/19, 11/2, 11/9, 11/16, 12/7

Each quiz will count 25 pts.

Class Participation: In most class meetings, questions will be posed in which you will respond using the class response system. For incorrect responses, you will receive 70% credit to encourage participation and attendance. Your lowest four class participation percentage grades will be dropped at the end of the semester.

Exams: 60 minute exams will be given *in class* on the following dates:

Thursday, September 28
Thursday, October 26
Thursday, November 30

Each exam will concentrate on material covered since the previous exam. Each exam will count 100 points.

Re-Tests: Re-tests will be given on Thursday evening (7:00-8:00 p.m., Rm. 225, Chemistry, Bldg. 20), **1** week after the original exam. Re-tests are ***optional*** (e.g., if you are happy with your score on the first exam, you do not have to take the re-test). Your best score from the two exams will count for your grade. Make sure to mark the following dates on your calendar. There are ***no*** make-ups of re-tests.

Thursday, October 5
Thursday, November 2
Thursday, December 7

My number one goal is to have all of my students succeed in this course. My objectives with re-tests are to have you take course feedback seriously and to learn from your mistakes. After taking the original exam, you will have one week to learn the material that you did not understand on the first exam. I will hold a special help session on Monday evening following the original exam. We will work through any questions that you have about the exam. Take the original exam seriously; do not rely on the re-test to determine your grade.

Make-up Quizzes: There are none. Scores for quizzes missed for legitimate reasons will be generated from the average of all of your other quizzes. Legitimate reasons include:

(1) Personal or Family Emergency.
(2) University institutional excuse.

Final Exam: The final exam is scheduled from 10:00 a.m. to 12:00 p.m. on Tuesday, December 12. The final exam will be multiple-choice format and will be comprehensive.

Grading Scale:

	Best 9 of 10		% of grade
Quizzes	(9 × 25 pts each)	225 pts	28.1%
Homework		100 pts	12.5%
Class Participation		25 pts	3.1%
Exams	(3 × 100 pts each)	300 pts	37.5%
Final Exam		150 pts	18.8%
		800 pts	

A ≥ 90%	D ≥ 50%
B ≥ 80%	F < 50%
C ≥ 65%	

CHM 151 Lecture Topics

I. *Introduction & Atomic Structure*

Ch. 1: *Matter and Measurement*
Classifying Matter, Mixtures, Elements and Compounds, Physical and Chemical Changes, SI Units, the Metric System, Accuracy and Precision, Significant Figures, Dimensional Analysis

Ch. 2: *Atoms and Elements*
Atomic Theory, Structure of the Atom, the Periodic Table, Atomic Mass, the Mole, Molar Mass

Ch. 3: *Molecules, Ions, and Their Compounds*
Molecules, Ionic Compounds, Ions, Naming Compounds, Molecular Mass, Mole Conversions, Percent Composition, Empirical and Molecular Formulas, Hydrates

II. *Stoichiometry & Chemical Reactions*

Ch. 4: *Chemical Equations and Stoichiometry*
Writing and Balancing Chemical Equations, Amounts of Products and Reactants, Limiting Reagent, Percent Yield.

Ch. 5: *Reactions in Aqueous Solution*
Electrolytes/Nonelectrolytes, Precipitation Reactions, Molecular, Ionic, and Net Ionic Equations, Acid-Base Reactions, Oxidation-Reduction Reactions, Assigning Oxidation Numbers, Concentration and Dilution of Solutions, pH, Titrations.

Ch. 6: *Principles of Reactivity: Energy and Chemical Reactions*
Energy Changes, Enthalpy, Constant-pressure Calorimetry, Standard Enthalpy of Formation and Reaction, Hess's Law, Heating Curve.

III. *Electronic Structure and Periodic Properties*

Ch. 7: *Atomic Structure*
Electromagnetic Radiation, The Photoelectric Effect, Emission Spectra, Dual Nature of the Electron, Atomic Orbitals, Quantum Numbers

Ch. 8: *Atomic Electron Configurations and Chemical Periodicity*
Paramagnetism and Diamagnetism, Electron Configurations, Orbital Diagrams, Atomic and Ionic Radius, Ionization Energy, Electron Affinity.

IV. *Chemical Bonding*

Ch. 9: *Bonding and Molecular Structure: Fundamental Concepts*
Lewis Dot Symbols, The Covalent Bond, Electronegativity, Lewis Structures, Resonance, Exceptions to the Octet Rule, Molecular Shapes, Formal Charge, Bond and Molecular Polarity, Bond Energies.

Ch. 10: *Bonding and Molecular Structure: Orbital Hybridization and Molecular Orbitals*
Hybridization of Atomic Orbitals, Hybridization in Molecules Containing Double and Triple Bonds, Resonance.

V. *States & Properties of Pure Matter*

Ch. 12: *Gases & Their Properties*
Pressure, The Gas Laws, The Ideal Gas Equation, Density and Molar Mass, Gas Stoichiometry, Dalton's Law, The Kinetic Molecular Theory of Gases, Diffusion and Effusion, Deviation from Ideal Behavior.

Ch. 13: *Intermolecular Forces, Liquids & Solids*
Intermolecular Forces, The Liquid State, Crystal Structures, Bonding in Solids, Phase Diagrams.

VI. *Solutions*

Ch. 14: *Solutions and Their Behavior*
Types of Solutions, Molecular View of Solution Process, Concentration Units, Effect of Temperature and Pressure on Solubility, Colligative Properties.