CHM 151: GENERAL CHEMISTRY I
Spring 2010
Northern Arizona University

Section	Course No.	Time	Room
1	4882	MTWTh 9:10 - 10:00 a.m.	Building 20 Room C-106
3	4886	MTWTh 11:30 - 12:20 p.m	Building 20 Room C-224

Instructor: Dr. Wayne A. Hildebrandt **Office:** Chemistry Room 201 **Phone:** 523-7310
E-mail: Wayne.Hildebrandt@nau.edu

Office Hours: Monday, Tuesday, Wednesday, and Thursday, 10:00-11:00 a.m. or BY APPOINTMENT

Supplemental Instructor: Melody Satvat
E-mail: ms596@nau.edu
Offices: To be Announced

Course Information Web Page: **www.CHM151.com** Or **www.CHM151.org** Or **http://jan.ucc.nau.edu/~wahi**

Optional Recitation Help Session: The current CHM 151 lecture course relies heavily on problem solving. This optional recitation course parallels the material covered in the 151 lecture. The concepts of lecture will be demonstrated and discussed and students will actively apply learned techniques to solve problems in class. The Pass/Fail grade in this one credit hour course is based on attendance and participation. There are two Recitations affiliated with the lecture sections listed above, both sections meet on Wednesdays for a combined time of 3:00-5:00 p.m. You can register for either section: Wednesday 3:00-3:50 p.m. (Class No. 4924) or Wednesday 4:10-5:00 p.m. (Class No. 4926). Both sections meet in Building 20 Room C-224. Official Enrollment in recitation and failure to attend results in a failing grade. However, you are always welcome to attend the recitations without registering for them but no credit will be awarded.

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

Text & Calculator:
- ***CHEMISTRY***, Raymond Chang; McGraw-Hill, Inc., 9th edition (2007)
  ISBN-13 9780073301709
  (Alternative less-expensive electronic download/web-based versions of the text are available. See the class web page for details.)
- You will need a scientific calculator for the homework, quizzes, and exams.

Recommended Supplemental Text
- ***Student Solutions Manual to Accompany CHEMISTRY***,
  9th Edition, Brandon J. Cruickshank & Raymond Chang; McGraw-Hill (2007)
  ISBN-13 9780072980615

Reading: It is of utmost importance that you read the text as assigned. The lectures alone will not suffice. You will be held accountable for the reading materials and a question from the readings will typically be asked on each quiz.

Important Dates:

January 11	First Day of Instruction
January 18	Martin Luther King Day (no class)
January 22	Deadline to add a class, Last day to file for grade replacement
	Deadline to change from audit to credit, or from credit to audit
February 5	Deadline to drop a class (delete from transcript)
March 12	Deadline to drop with a "W"
March 15-19	Spring Break (no class)
April 26-30	End of Term Week
May 4	Final Exam (Tuesday 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, March 12th***.

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

3. CHM 151, the laboratory course CHM 151L, and the recitation course CHM 151R, are separate courses. Dropping CHM 151 does **NOT** automatically remove you from CHM 151L or CHM 151R.

GRADING POLICY

Homework: Homework problems will be assigned each week, but will ***not*** be collected. However, typically ***two*** problems on each quiz will come directly from the homework. The ability to understand chemistry is directly related to your effort on the homework and the time spent will help on quizzes and exams.

Quizzes: There will be eleven 15-20 minute quizzes. A quiz will be given at the end of the class period on **each** Thursday of the semester except during the week of an hour exam. The lowest quiz score of the eleven quizzes will be discarded. **There will be NO make-up quizzes**. The quizzes will count 25 points each and will be given on the following Thursdays:

January 21, 28; February 4, 18, 25; March 4, 11; April 1, 8, 15, 29

Exams: Three 60 minute exams will be given on the following dates:

Thursday, February 11 Thursday, March 25 Thursday, April 22

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

Make-up Quizzes and Exams: **No make-ups will be given for missed quizzes or exams**.

One of the complaints of students, instructors, and administrators concerning University education is that it lacks relevance. One of the relevant features of chemical information is that it is often "timed". That is, if it is late or missing it is worthless. Therefore, missed quizzes and exams count as zeros. Institutional excuses and documentable illnesses will be considered on an individual basis. If an absence was for illness, family emergency, religious holiday, or institutional excuse (University sponsored trip) AND if the instructor was notified BEFORE the absence (call Dr. Hildebrandt at 523-7310 or 523-3008 or e-mail), then the average of the other quizzes or exams will be recorded. If the instructor was not notified in advance, a zero will be recorded. Please note that routine medical or dental appointment (except in an emergency) is not an acceptable reason for missing a quiz or an exam (don't make appointments for these times). You may NOT take a quiz or exam in another section of the course (regardless of instructor).

Final Exam: The final exam, which will count 150 points, is scheduled from 10:00 a.m. to 12:00 p.m. on Tuesday, May 4. The final exam will be multiple choice format and will be comprehensive.

Grading Scale:

	Best 10 of 11 quizzes		
Quizzes	(10 25 pts each)	250 pts	*These point percentages represent*
Exams	(3 100 pts each)	300 pts	*"guaranteed" grades.*
Final Exam		150 pts	
		700 pts	

A 90% B 80% C 60% D 50% F < 50%

University Classroom Management Statement: Membership in the academic community places a special obligation on all members to preserve an atmosphere conducive to a safe and positive learning environment. Part of that obligation implies the responsibility of each member of the NAU community to maintain an environment in which the behavior of any individual is not disruptive.

It is the responsibility of each student to behave in a manner which does not interrupt or disrupt the delivery of education by faculty members or receipt of education by students, within or outside the classroom. The determination of whether such interruption or disruption has occurred has to be made by the faculty member at the time the behavior occurs. It becomes the responsibility of the individual faculty member to maintain and enforce the standards of behavior acceptable to preserving an atmosphere for teaching and learning in accordance with University regulations and the course syllabus.

At a minimum, students will be warned if their behavior is evaluated by the faculty member as disruptive. Serious disruptions, as determined by the faculty member, may result in immediate removal of the student from the instructional environment. Significant and/or continued violations may result in an administrative withdrawal from the class. Additional responses by the faculty member to disruptive behavior may include a range of actions from discussing the disruptive behavior with the student to referral to the appropriate academic unit and/or the Office of Student Life for administrative review, with a view to implement corrective action up to and including suspension or expulsion.

NOTE: THE INFORMATION ON THIS SYLLABUS IS CONSIDERED PART OF THE COURSE MATERIAL AND MAY BE ASKED ON THE FIRST QUIZ OR EXAM.

CHM 151: GENERAL CHEMISTRY I
DESCRIPTION

Course Description: CHM151 is the first semester of a 1-year sequence appropriate for pre-professional, science, and engineering majors. As a Liberal Studies course, CHM151 provides a foundation in chemistry --- the science of change. The course presents the fundamental chemical principles that allow students to better understand the chemical processes of change in the world around them. Liberal Studies Distribution Block: 4-hours of Science/Applied Science credit (CHM151) or 5-hours of Laboratory Science credit if taken with the lab (CHM151, CHM151L)

Thematic Foci: CHM151 builds the foundation required for understanding chemistry. The structure and properties of matter are the key foci of this course. Students will learn to apply their mathematical skills in order to solve problems relating to changes in the state, and composition of matter. These principles are presented in a context that stimulates

the student to consider how chemical change influences their everyday life. Examples of chemical change are drawn from many areas. Students will be challenged to apply their chemical knowledge to situations of significant concern in today's world. Themes which will help students to connect their learning experience in chemistry, with that of their personal experience, will include, but are not limited to, the following:

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 CHM151. The student learns to name chemical compounds, recognize periodic trends of the elements, and predict the products of chemical reactions. With this background, students can begin to interpret the physical and chemical processes of the natural world. Some topics that illustrate these processes include reactions in aqueous solutions, critical for understanding the nature of water quality, and the process of combustion (i.e. the mechanism of heat release to the atmosphere, when fossil fuels are burned). Students will learn to associate these processes with their effect on the environment.

Technology and its Impact: Chemistry has had a profound impact on the technological developments of the 20th century. Many chemical discoveries have improved the quality of life (pharmaceutical drugs, magnetic resonance imaging, laser technologies, and the semi-conductor industry), while others have threatened it (CFCs, pesticides, and PCBs). Whenever possible, faculty will illustrate how modern technology has been influenced by the fundamental science taught in CHM 151.

Essential Skills:

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

Course Objective	Theme/Skill
1. based on empirical observations, distinguish between chemical and physical processes, and chemical and physical properties of matter.	**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 solution	**Quantitative Analysis**
4. use standardized symbols to represent atoms, molecules, ions, and chemical reactions	**Scientific Inquiry**
5. describe the intermolecular forces which influence the properties of gases, liquids, and solids, and quantitatively determine the physical state of materials.	**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 the context of environmental situations and technological applications.	**Environmental Consciousness Technology and its Impact Critical Thinking**

Course Structure and Approach: CHM151 will address the composition and behavior of matter through lecture, discussion, and demonstration. Audio-visual materials and computer-based activities will be utilized as supplemental materials. Readings and problems provided in the course text and in other supplemental information will support the learning efforts of the student.

Assessment of Outcomes: Assessment of student learning outcomes will be evaluated using examinations and quizzes. These evaluation methods will test the student's knowledge of scientific principles, their application to identifying and

solving problems, and the ability to analyze scientific data. They will provide the opportunity for students to demonstrate the problem solving technique necessary to derive an answer.. 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 appropriate hypotheses or conclusions. (Learning Objectives 1 and 6) (Scientific Inquiry, Critical Thinking);
(2) Perform multi-step calculations using appropriate equations and formulas. Short answer problems will allow students to demonstrate problem-solving techniques, choice of formulas, and dimensional analysis skills. (Learning Objectives 2, 3, and 5) (Quantitative Analysis, Critical Thinking);
(3) Identify proper symbolic representation of atoms, molecules, ions, and chemical reactions (Learning Objective 4) (Scientific Inquiry)
(4) Determine the products and heat exchange of chemical reactions. Short answer questions will require students apply appropriate chemical reasoning. Multiple choice questions will require students to discriminate between several "correct" answers (but only one will be correct in this context). (Learning Objective 5) (Quantitative Analysis, Critical Thinking)
(5) Based on the physical properties of gases, liquids and solids deduce the nature of the underlying intermolecular forces (Learning Objective 7) (Critical Thinking, Scientific Inquiry)
(6) Apply your knowledge to the chemistry of the natural world/environment. Exams and quizzes will include questions that link acquired chemical knowledge to environmental scenarios (e.g. calculate the ion concentration of a lake, the PCB concentration of a soil sample, the heat released by burning fossil fuels, or the number of moles of CFCs in the Earth's atmosphere). (Learning Objective 8) (Environmental Consciousness) (Technology and its Impact)

Learning Portfolio: Students are encouraged to retain their exams and quizzes as evidence that they have 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.

NORTHERN ARIZONA UNIVERSITY
POLICY STATEMENTS

Safe Environment Policy

NAU's Safe Working and Learning Environment Policy seeks to prohibit discrimination and promote the safety of all individuals within the university. The goal of this policy is to prevent the occurrence of discrimination on the basis of sex, race, color, age, national origin, religion, sexual orientation, disability, or veteran status and to prevent sexual harassment, sexual assault or retaliation by anyone at this university.

You may obtain a copy of this policy from the college dean's office. If you have concerns about this policy, it is important that you contact the departmental chair, dean's office, the Office of Student Life (523-5181), the academic ombudsperson (523-9368), or NAU's Office of Affirmative Action (523-3312).

Students with Disabilities

If you have a learning and/or physical disability, you are encouraged to make arrangements for class assignments/exams so your academic performance will not suffer because of the disability or handicap. If you have questions about special provisions for students with disabilities, contact the Counseling and Testing Center (523-2261).

It is your responsibility to register with the Counseling and Testing Center. Application for services should be made at least eight weeks before the start of the semester.

If the Counseling and Testing Center verifies your eligibility for special services, you should consult with your

instructor during the first week in the semester so appropriate arrangements can be made. Concerns related to noncompliance with appropriate provisions should be directed to the Disabilities Support Services coordinator in the Counseling and Testing Center.

Institutional Review Board

Any study involving observation of or interaction with human subjects that originates at NAU-including a course project, report, or research paper-must be reviewed and approved by the Institutional Review Board (IRB) for the protection of human subjects in research and research-related activities.

The IRB meets once each month. Proposals must be submitted for review at least fifteen working days before the monthly meeting. You should consult with your course instructor early in the course to ascertain if your project needs to be reviewed by the IRB and/or to secure information or appropriate forms and procedures for the IRB review. Your instructor and department chair or college dean must sign the application for approval by the IRB. The IRB categorizes projects into three levels depending on the nature of the project: exempt from further review, expedited review, or full board review. If the IRB certifies that a project is exempt from further review, you need not resubmit the project for continuing IRB review as long as there are no modifications in the exempted procedures.

A copy of the IRB Policy and Procedures Manual is available in each department's administrative office and each college dean's office. If you have questions, contact the Office of Grant and Contract Services, at 523-4889.

Academic Integrity

The university takes an extremely serious view of violations of academic integrity. As members of the academic community, NAU's administration, faculty, staff, and students are dedicated to promoting an atmosphere of honesty and are committed to maintaining the academic integrity essential to the education process. Inherent in this commitment is the belief that academic dishonesty in all forms violates the basic principles of integrity and impedes learning. Students are therefore responsible for conducting themselves in an academically honest manner.

Individual students and faculty members are responsible for identifying instances of academic dishonesty. Faculty members then recommend penalties to the department chair or college dean in keeping with the severity of the violation. The complete policy on academic integrity is in Appendix F of NAU's *Student Handbook*.

Academic Contract Hour Policy

The Arizona Board of Regents Academic Contact Hour Policy (ABOR Handbook, 2-206, Academic Credit) states: "an hour of work is the equivalent of 50 minutes of class time…at least 15 contact hours of recitation, lecture, discussion, testing or evaluation, seminar, or colloquium as well as a minimum of 30 hours of student homework is required for each unit of credit. "

The reasonable interpretation of this policy is that for every credit hour, a student should expect, on average, to do a minimum of two additional hours of work per week; e.g., preparation, homework, studying.

Chm 151 Lecture Topics

Part 1: ***The Basic Tools of Chemistry***

1 Matter and Measurement
- 1.1 Classifying Matter
- 1.2 Elements and Atoms
- 1.3 Compounds and Molecules
- 1.4 Physical Properties
- 1.5 Physical and Chemical Changes
- 1.6 Units of Measurement
- 1.7 Making Measurements: Precision, Accuracy, and Experimental Error
- 1.8 Mathematics of Chemistry

2 Atoms and Elements
- 2.1 Protons, Electrons, and Neutrons: Development of Atomic Structure
- 2.2 Atomic Number and Atomic Mass
- 2.3 Isotopes
- 2.4 Atomic Weight
- 2.5 Atoms and the Mole
- 2.6 The Periodic Table
- 2.7 An Overview of the Elements, Their Chemistry, and the Periodic Table
- 2.8 Essential Elements

3 Molecules, Ions, and Their Compounds
- 3.1 Molecules, Compounds, and Formulas
- 3.2 Molecular Models
- 3.3 Ionic Compounds: Formulas, Names and Properties
- 3.4 Molecular Compounds: Formulas Names, and Properties
- 3.5 Formulas, Compounds, and the Mole
- 3.6 Describing Compound Formulas
- 3.7 Hydrated Compounds

4 Chemical Equations and Stoichiometry
- 4.1 Chemical Equations
- 4.2 Balancing Chemical Equations
- 4.3 Mass Relationships in Chemical Reactions: Stoichiometry
- 4.4 Reactions in Which One Reactant Is Present in Limited Supply
- 4.5 Percentage Yield
- 4.6 Chemical Equations and Chemical Analysis

5 Reactions in Aqueous Solution
- 5.1 Properties of Compounds in Aqueous Solution
- 5.2 Precipitation Reactions
- 5.3 Acid and Bases
- 5.4 Reactions of Acid of Bases
- 5.5 Gas-forming Reactions
- 5.6 Classifying Reactions in Aqueous Solution
- 5.7 Oxidation-reduction Reactions
- 5.8 Measuring Concentrations of Compounds in Solution
- 5.9 pH, a Concentration Scale for Acids and Bases
- 5.10 Stoichiometry of Reactions in Aqueous Solution

6 Principles of Reactivity: Energy and Chemical Reactions
- 6.1 Energy: Some Basic Principles
- 6.2 Specific Heat Capacity and Heat Transfer
- 6.3 Energy and Changes of State
- 6.4 The First Law of Thermodynamics
- 6.5 Enthalpy Changes for Chemical Reactions
- 6.6 Calorimetry
- 6.7 Hess's Law
- 6.8 Standard Enthalpy of Formation
- 6.9 Product- or Reactant-favored Reactions and Thermochemistry

Part 2: ***The Structure of Atoms and Molecules***

7 Atomic Structure
- 7.1 Electromagnetic Radiation
- 7.2 Plank, Einstein, Energy and Photons
- 7.3 Atomic Line Spectra and Niels Bohr
- 7.4 The Wave Properties of the Electron
- 7.5 Quantum Mechanical View of the Atom
- 7.6 The Shapes of Atomic Orbitals
- 7.7 Atomic Orbitals and Chemistry

8 Atomic Electron Configurations and Chemical Periodicity
- 8.1 Electron Spin
- 8.2 The Pauli Exclusion Principle
- 8.3 Atomic Subshell Energies and Electron Assignments
- 8.4 Atomic Electron Configurations
- 8.5 Electron Configurations of Ions
- 8.6 Atomic Properties and Periodic Trends
- 8.7 Periodic Trends and Chemical Properties

9 Bonding and Molecular Structure: Fundamental Concepts
- 9.1 Valence Electrons
- 9.2 Chemical Bond Formation
- 9.3 Bonding in Ionic Compounds
- 9.4 Covalent Bonding and Lewis Structures
- 9.5 Resonance
- 9.6 Exceptions to the Octet Rule
- 9.7 Molecular Shapes
- 9.8 Charge Distribution in Covalent Compounds
- 9.9 Molecular Polarity
- 9.10 Bond Properties: Order, Length, and Energy
- 9.11 The DNA Story - Revisited

10 Bonding and Molecular Structure: Orbital Hybridization and Molecular Orbitals
- 10.1 Orbitals and Bonding Theories
- 10.2 Valence Bond Theory
- 10.3 Molecular Orbital Theory

Part 3: ***States of Matter***

12 Gases and Their Properties
- 12.1 The Properties of Gases
- 12.2 Gas Laws: the Experimental Basis
- 12.3 The Ideal Gas Law
- 12.4 Gas Laws and Chemical Reactions
- 12.5 Gas Mixtures and Partial Pressures
- 12.6 The Kinetic-molecular Theory of Gases
- 12.7 Diffusion and Effusion
- 12.8 Some Applications of the Gas Laws and Kinetic-molecular Theory
- 12.9 Non-Ideal Behavior: Real Gases

13 Intermolecular Forces, Liquids, and Solids
- 13.1 States of Matter and the Kinetic-molecular Theory
- 13.2 Intermolecular Forces
- 13.3 Hydrogen Bonding
- 13.4 Summary of Intermolecular Forces
- 13.5 Properties of Liquids
- 13.6 The Solid State: Metals
- 13.8 Other Kinds of Solid Materials
- 13.9 The Physical Properties of Solids
- 13.10 Phase Diagrams

14 Solutions and Their Behavior
- 14.1 Units of Concentration
- 14.2 The Solution Process
- 14.3 Factors Affecting Solubility: Pressure and Temperature
- 14.4 Colligative Properties