Program Review

Austin Community College (ACC) was established in December 1971 by voters of the Austin Independent School District (AISD). In the fall of 1973, ACC registered 2,363 students, and classes began on September 17, 1973.

Chemistry courses were among the first offered by ACC. Dr. James Archer, the only full-time chemistry faculty at the time, led the Chemistry Department during its early years. By the 1974-75 academic year, ACC offered eleven different chemistry courses: Essentials of General and Biological Chemistry (1604), Fundamentals of Chemistry I & II (1614, 1624), General Chemistry I & II (1634, 1644), Organic chemistry I & II (2614, 2624), Quantitative Analysis I & II (2634, 2644), Nuclear Chemistry (2643, and Directed Study (2991/2992/2993). However, the curriculum was still evolving, and only six courses were offered during the 1976-77 school year (Fundamentals of Chemistry I & II, General Chemistry I & II and Organic Chemistry I & II). General Organic Chemistry (1643) with a Pharmacology emphasis was added during 1978-79, and these seven courses formed the core chemistry curriculum for the next several years. Fundamentals of Chemistry I & II (1614, 1624) were cut from the curriculum in 1982, and Introduction to Chemistry (1614) was subsequently added in 1985. The curriculum has remained fixed since that time, and the Chemistry Department today offers five courses: Introduction to Chemistry, General Chemistry I & II, and Organic Chemistry I & II.

The Chemistry Department has grown dramatically over the past twenty years, paralleling the expansion of ACC as a whole. When Austin Community College first began, Chemistry was offered only at the Rio Grande and Ridgeview campuses. Today, chemistry courses are offered at all major campuses. The number of students, class sessions, and faculty has similarly expanded. In 1980, there were 643 students registered in 18 lecture sessions and 685 students enrolled in 30 lab sessions. Today (Fall 2006) there are approximately 1400 students in 95 16-week combined lecture/lab sessions and 27 students enrolled in two 12-week sessions. The ACC Chemistry Department now has ten full-time faculty, who teach almost half of all classes, and seventeen adjunct faculty as well.

ACC students have traditionally taken chemistry courses to fulfill degree requirements for other disciplines, and the number of students pursuing Associate Degrees in Chemistry has remained low. Most chemistry students eventually transfer to 4-year colleges to pursue degrees in engineering, health science or computer science, rather than chemistry or other physical sciences.

Chemistry is a quantitative science with a heavy emphasis on laboratory experience. Our lab facilities, equipment, and overall safety have improved significantly over the years. The Chemistry Department now has a dedicated safety officer, and all faculty and lab personnel undergo periodic safety/hazardous waste training. Waste disposal procedures have been streamlined and posted in each lab, and MSDS and WACI, which provide standardized chemical safety and inventory information, are now routine features in the lab.

The Chemistry program at Austin Community College is designed to provide students with the first two years of college chemistry education, from introductory general chemistry through organic chemistry. The Chemistry Department has made tremendous progress in the last two decades but is continuously striving to serve its students and the local community more effectively.

Statement of Purpose for the Chemistry Task Force

The general purpose of all chemistry courses is to provide instruction and laboratory experience for students. These courses should enable the student to think critically and scientifically.

The purpose of Introduction to Chemistry is to prepare the student for success in college-level chemistry courses. It should also serve as a preparatory course for other science and health related courses.

The purposes of the college credit chemistry courses are:

- to prepare the students in the fundamentals of chemistry so that they transfer on to baccalaureate programs

- to give the student a general education in general chemistry and organic chemistry

- to prepare students in two-year degree programs

Vision for Chemistry

The South Austin Campus opened for Fall 2006, and the new building at Cypress Creek will be open for Spring 2007, giving more lab and classroom space.

We envision improved safety measures within our labs. Standard safety and emergency procedures that are used by staff, instructors, and students at all campuses are major priorities. We hope to have functional safety equipment such as eyewashes, showers, and hoods at all campuses. We will keep our chemical supply lists and Material Safety Data Sheets current.

We want to form a closer alliance with UT, Austin with the formation of a Peer Teaching Assistant Program. In this program, students interested in science education can work as peer teachers for students at ACC.

More full-time professors are needed. We would also like to have more technical lab support. Lab safety and ease of operation would be greatly improved with a larger technical staff.

The Chemistry Department would like to have more technological support. We want more computers and room for the computers. In conjunction, we would like to have programs that simulate concepts taught in the lectures and labs (for example, Nuclear Magnetic Resonance and Infrared simulation programs, and programs which illustrate mechanisms in organic reactions). These programs would greatly enhance student learning and would be less expensive than the actual equipment.

Another important aim is labs that are equipped with reasonably state-of-the-art equipment, such as computer-driven Gas Chromatographs and Infrared Spectrophotometers. This equipment would be maintained with adequate funds or with service contracts.

We envision a chemistry department empowered to budget for big-ticket equipment over several years, able to write and pass out their own lab materials, and also able to schedule and staff their own discipline.

We look forward to a higher percentage of students successfully completing our courses and more students successfully transferring to four-year colleges. We hope to obtain with greater ease, information about the success of our transferring students from these institutions.

CHEM 1305
Introductory Chemistry
Course Objectives

This is a list of topics to be taught in Introduction to Chemistry. It does not reflect the order in which the topics need be taught.

I. Introduction to Chemistry

II. Matter and Energy
- a. Matter, Macroscopic, Microscopic and Particulate
- b. States of Matter: Solid, Liquid and Gas
- c. Elements, Compounds and Mixtures
- d. Energy: Kinetic and Potential Energy, Endo- and Exothermic Processes
- e. Physical and Chemical Properties and Changes
- f. Conservation Laws

III. Measurement and Chemical Calculations
- a. Scientific Notation
- b. Significant Digits
- c. SI Units
- d. Conversions
- e. Density

IV. Atomic Theory
- a. Atomic Theories (Dalton, Nuclear Atom, Bohr, some Quantum)
- b. Isotopes and Atomic Mass
- c. Electron Configuration
- d. Trends in the Periodic Table

V. Chemical Bonding
- a. Noble Gas Configuration of Ions
- b. Ionic Bonds
- c. Covalent Bonds
- d. Valence Electrons
- e. Lewis Dot Structures and the Octet Rule
- f. Molecular Geometries, through Tetrahedral (hybridizations not included)

VI. Chemical Nomenclature
- a. Nomenclature of Ionic Compounds
- b. Nomenclature of Acids
- c. Nomenclature of Covalent Compounds

VII. Chemical Formula Problems
- a. Molecular Mass and Formula Mass
- b. The Mole
- c. Molar Mass
- d. Conversion between Units
- e. Percent Composition

f. Empirical and Molecular Formulas

VIII. Reactions and Chemical Equations
- a. Balancing Chemical Equations
- b. Reaction Types (acid-base, single and double replacement, combination, decomposition, and combustion)
- c. Molecular, Total and Net Ionic Equations

IX. Stoichiometry of Balanced Chemical Equations
- a. Mole Relations from a Balanced Chemical Equation
- b. Mass Calculations
- c. Limiting Reactants
- d. Percent Yield

X. Gas Laws
- a. Explanation of Pressure
- b. Boyle's Law
- c. Charles' Law
- d. Combined Gas Law
- e. Ideal Gas Law

XI. Solutions
- a. Molarity Calculations
- b. Dilution of Solutions

Any other topic the instructor wishes to teach is optional and in addition to the information presented above.

Objectives for CHEM 1311
General Chemistry I

This is a list of topics to be taught in General Chemistry I. It does not reflect the order in which the topic need be taught. The required text is Chemistry, 8th edition, by Whitten, Davis, Peck, and Stanley.

The Foundation of Chemistry
Matter and Energy-Basic Concepts of Chemistry
Measurements
Significant Figures
Metric System
Scientific Notation
Dimensional Analysis

Chemical Formulas and Stoichiometry
Atoms, Ions, Molecules and Compounds
Nomenclature of Inorganic Compounds
The Mole Concept
Percent Composition
Empirical Formula
Molecular Formula

Chemical Equations and Reaction Stoichiometry
Balancing of Chemical Equations
Calculations Based on Chemical Equations-moles/masses of reactants/products
Limiting Reagent Calculations
Percent Yield and Theoretical Yield Calculations
Sequential Reactions
Concentration of Solutions-Calculations Involving Mass % and Molarity
Dilution of Solutions: Calculations Involving $V_1M_1=V_2M_2$
Calculations Involving Solution Stoichiometry

Chemical Reactions
Organization of the Periodic Table
Aqueous Solutions-Strong and Weak Electrolytes
Reactions in Aqueous Solutions
Oxidation Numbers

The Structure of the Atom
Experiments that led to the discovery of the fundamental particles of the atom
Subatomic Particles, Isotopes, Atomic Weight
Development of Quantum Mechanics
Quantum Mechanical Model of the Atom
Electronic Configuration and the Relationship to the Periodic Table
Orbital Diagrams
Quantum Numbers
Chemical Periodicity

Theory of Ionic and Covalent Bonding
Lewis Dot Formulas of Atoms
Formation of Binary Ionic Compounds-Coulomb's Law, Lattice Energy

Formation of Covalent Compounds
Lewis Structures for Molecules and Polyatomic Ions and the Octet Rule
Resonance and Formal Charges
Exceptions to the Octet Rule for Lewis Structures
Polar and Nonpolar Covalent Bonds

Molecular Structure
Valence Shell Electron Pair Repulsion Theory (VSEPR)
Electronic and Molecular Geometry and Molecular Dipole Moments
Valence Bond Theory and Hybridization of Orbitals
Molecular Orbital Theory

Gases
Gas Laws and Ideal Gas Law
Density and Molar Mass
Stoichiometry of Reactions Involving Gases
Kinetic Molecular Theory-Molecular Speeds
Real Gases

Liquids and Solids
Intermolecular Attractions and Phase Changes
Physical Processes and Properties of Liquids
Melting Point/Boiling Point
Phase Changes of Matter and Phase Diagrams
Molar Heat of Vaporization and Molar Heat of Fusion

Solutions
Dissolution Process for Solids, Liquids and Gases
Factors Affecting Solubility
Saturated, Unsaturated and Supersaturated Solutions
Other Units of Concentration
Colligative Properties

1. Vapor Pressure Lowering
2. Boiling Point Elevation
3. Freezing Point Depression
4. Osmotic Pressure

Any other topic the instructor wishes to teach is optional and in addition to the information presented above.

Objectives for CHEM 1312
General Chemistry II

This is a list of topics to be taught in General Chemistry II. It does not reflect the order in which the topics need be taught. The required text is Chemistry, 8th edition, by Whitten, Davis, Peck, & Stanley.

1 Chemical Kinetics: Chapter 16

Rate of a reaction
Factors that affect reaction rates
a. Nature of reactants
b. Concentration of reactants: Rate-law expressions & Reaction order
c. Concentration vs. time: Integrated rate equations and half-life
Collision theory, activation energy
Transition state theory
Mechanisms and Rate-law expressions
Arrhenius equation: temperature and rate
Catalysts

2 Chemical Equilibria: Chapter 17

Dynamic equilibria
Equilibrium constant Kc
Reaction quotients
Calculations with Kc
Heterogeneous equilibria
Kp and Kc
Le Chatelier's Principle: factors affecting equilibria

3 Acid-Base Theories: Chapter 10

Arrhenius Acid-base theories
Bronsted-Lowry Acid-base theories
Strength of acids: binary and ternary acids
Lewis Acid-base theories

4 Acid-Base Equilibria: Ch. 10, 18, 19

Ionization of water
pH and pOH
Ka and Kb for weak acids and bases, % ionization
Polyprotic acids
Hydrolysis of salts: Relationship between Ka and Kb
Hydrolysis of metal ions
Common ion effect and Buffer solutions, Henderson-Hasselbalch equation
Buffering action and preparation of buffer solutions
Acid-base indicators
Acid-base titrations

5 Ionic equilibria: Solubility: Chapter 20

Ksp and solubility
Common ion effect of solubility Reaction quotients
Predicting precipitate formation
Fractional precipitation
Simultaneous Equilibria: Ksp & Kb/Ka
Dissolving precipitate, complex formation

6 Thermodynamics: Chapter 15

The First Law of Thermodynamics
Enthalpy, ΔH
Calorimetry (constant-pressure and constant volume)
Thermochemical equations
Internal energy, ΔE
Relationship between ΔE and ΔH
Hess' Law
Standard enthalpies of formation and reaction
Bond energy and ΔH
The Second Law of Thermodynamics & Spontaneity
Entropy and Third Laws of Thermodynamics
Gibb's free energy
Relationship between ΔG and K

7 Electrochemistry: Chapter 21
Balancing redox reactions
Electrical conduction & electrodes
Electrolysis
Faraday's law of Electrolysis
Voltaic cells
Standard electrode potentials
Nernst equation
Concentration cells
Relationship of ε°, ΔG° and K

8 Coordination Compounds: Chapter 25
Basics: ligands, coordination number
Nomenclature
Structural Isomers
Stereoisomers: geometric & optical isomers
*** Crystal field theory: high spin, low spin
*** Color & spectrochemical series

9 Nuclear Chemistry: **Chapter 26**
n/p ratio and nuclear stability
Nuclear binding energy & nuclear stability
Radioactive decay
Nuclear equations
Kinetics
Nuclear fission, fusion and reactors

10 Introduction to Organic Chemistry: Chapter 27
Types of hydrocarbons
Functional groups: halides, alcohols, ethers, aldehydes, ketones, amines, carboxylic acids & derivatives
Nomenclature
Typical reactions: substitution, addition, elimination & polymerization
Isomers

CHEM 2323 Course Objectives
Organic Chemistry I

Chapter numbers reference the required text, Organic Chemistry, 6^{th} edition, by Francis A. Carey

Chapter 1 – Structure Determines Properties

Chapter 2 – Hydrocarbon Frameworks: Alkanes

Chapter 3 – Conformations of Alkanes and Cycloalkanes

Chapter 4 – Alcohols and Alkyl Halides

Chapter 5 – Structure and Preparation of Alkenes: Elimination Reactions

Chapter 6 – Reactions of Alkenes: Addition Reactions

Chapter 7 – Stereochemistry

Chapter 8 – Nycleophilic Substitution

Chapter 9 – Alkynes

Chapter 10 – Conjugation in Alkadienes and Allylic Systems

Chapter 11 – Arenes and Aromaticity

Chapter 12 – Reactions of Arenes: Electrophilic Aromatic Substitution

CHEM 2325 Course Objectives
Organic Chemistry II

Chapter numbers reference the required text, Organic Chemistry, 6th edition, by Francis A. Carey.

Chapter 13 – Spectroscopy

Chapter 15 – Alcohols, Diols, and Thiols

Chapter 16 – Ethers, Epoxides, and Sulfides

Chapter 17 – Aldehydes and Ketones: Nucleophilic Addition to the Carbonyl Group

Chapter 18 – Enols and Enolates

Chapter 19 – Carboxylic Acids

Chapter 20 – Carboxylic Acid Derivatives: Nucleophilic Acyl Substitution

Chapter 21 – Ester Enolates

Chapter 22 – Amines

Chapter 23 – Aryl Halides

Chapter 24 – Phenols

Chapter 25 – Carbohydrates

Chapter 26 – Lipids

Chapter 27 – Amino Acids, Peptides, and Proteins