Chemistry 201

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Welcome to Chemistry 201 section FGH taught by Prof. J. Walker Fall 2014, Truman College. If you are enrolled in this section please check the website frequently for announcements and new information. Section FGH meets in Room 3833 Tuesday and in Room 3831 Thursday from 9:00 a.m. to 12:50 p.m. Class begins Tuesday, August 26th, 2014. You may always reach me by email: jwalker@ccc.edu

Course Catalog Description
Topics include the periodic table of the elements, atomic structure, basic concepts of quantum theory, bonding, stoichiometry of compounds and reactions, thermochemistry, the gaseous state, basic concepts of the liquid and solid states, solutions, acids and bases. Writing assignments, as appropriate to the discipline, are part of the course.

Prerequisite: Eligibility for Mathematics 140 or higher and either Grade of C or better in Chemistry 121 or one year of high school chemistry, or consent of department chair.

4 lecture and 4 lab hours per week in a 16 week semester. 5 credit hours

Students may take this course to meet concentration or elective requirements for an associates degree, to fulfill requirements for a career occupational degree, or to prepare for other careers in the physical sciences or healthcare professions.

Note: Chemistry 201 has an IAI code of CHM 911. You can learn more about IAI by visiting iTransfer.

Instructor

Prof J. Walker
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Office Hours: Monday, Tuesday, Wednesday, Thursday afternoons (1:00 p.m. to 5:00 p.m.) by appointment. You may call (872) 216-1317 to leave messages.

I've been teaching at Truman College in Uptown, Chicago since 1982. Around the year 2000 I spent six years in administration, a valuable experience but ultimately not the path I wanted to follow. During the time that I was in administration I continued to teach courses in web development. I then returned to my first love - physical sciences.

I have a Master's Degree in Chemistry from University of Illinois, Urbana-Champagne. I am self-taugh in programming and web development. I speak Spanish, French, Portuguese, Italian and some German. I am working on learning Arabic. My interests include: Chemsitry, Cooking, Education, Foreign Languages, Physical Sciences (all of them!) Urban Gardening and Web Development (Visual Display of Information).

My experience has taught me that the ways students learn best depend on many factors. It is my opinion that a teacher must find the best approach for each individual. I've found that a high-tech, high-touch approach is very effective. Various technologies are a great tools for learning but virtual reality is no substitute for tactile, hands-on learning that occurs when we make something for ourselves or experience the world through the visceral senses of smell and touch. My approach requires laboratory notebooks or journals in my classes. I love to involve students in classroom demonstrations. I think laboratory work is extremely important in science. What I recommend for every student is to remember what it felt like to have the curiosity of a child - and find that curiosity again! The world is truly amazing.

I believe we are reaching a very important crossroads in the evolution of our species and a knowledge of the physical sciences will be essential. We face serious challenges that are global in scope. We must learn to work together as humans for the greater good of our planet and humankind. What could be more important than understanding the nature of matter itself - what we all clearly have in common!

Textbook for Fall 2014
Chemistry: A Molecular Approach 3rd Ed.
by Nivaldo J. Tro
Pearson ©

Please note!
Any General Chemistry Textbook may be sufficient. Please do not purchase a second General Chemistry textbook. Bring the book you have to class the first day and I will help you decide if you can use it.

Mastering Chemistry

All laboratories will be available to download from this website. There is no laboratory textbook to purchase.

Laboratory Notebook

No specific brand is required but the pages **MUST BE BOUND**. Examples will be shown in class. Spiral notebooks may **NOT** be used.

Calculator
You will need a scientific calculator (includes log and trig functions) and should bring it with you to class.

Truman College Mission Statement
"Our Mission dedicates us to deliver high-quality, innovative, affordable and accessible educational opportunities and services that prepare students for a rapidly changing and diverse global economy."

FERPA
FERPA (Family Educational Rights and Privacy Act) is a federal law that protects the privacy of student educational records: http://www.ed.gov/policy/gen/guid/fpco/ferpa/index.html. Faculty cannot reveal information about students, or discuss student records over the phone or unsecure e-mail. CCC student e-mail meets FERPA requirements.

Student Services
The Student Services Department provides a broad range of services to assest students in achieving their academic and life goals.

Students with Disabilities
The Truman College Disability Access Center (DAC) verifies needs pursuant to the American Disabilities Act (ADA), determines student academic accommodations, and issues accomodation letters. Phone number: (773) 907-4725. Linda Ford is the director. The DAC is located in Room 1435, Main Bldg.

Tutoring Center
The tutoring center is located in room 177, Larry McKeon Student Services Building, (773) 907-4785 or (773) 907-4790.

TRIO Student Support Services
TRIO is for low-income students, first generation college students, or students with disabilities who need academic support: (773) 907-4797, Room 1435, Main Bldg. Registration is required at the start of each semester.

Student Success and Leadership Institute (SSLI)
SSLI is for students who need various other support services to achieve their educatinal goals: (773) 907-4737, Room 1435, Main Bldg.

Wellness Center

The Wellness Center provides a variety of services at no cost for students including counseling, crisis intervention, support groups and more. (773) 907-4786, Room 1946, Main Bldg.

Chemistry 201 Syllabus

Chemistry 201 covers material in Chapters 1 - 12 in Chemistry: A Moleculary Approach 3rd Edition by Tro

Course Outline

Date	Topic	Text Reference
08-26 Tue	**LECTURE:** Course Introduction, Basic Chemistry Review Placement Assessment **Before our class begins** please review the course objectives for Basic Chemistry. You may also want to work through this review worksheet and then go over the answers. It is very important that you memorize the names and formulas of the polyatomic ions.	online documents
08-28 Thu	**LECTURE:** Matter: Its Properties and Measurement (scientific method, classification of matter, density, percent composition, significant figures)	Chapter 1
	LAB: Check-In, Lab Safety, Mystery White Powder	Download pdf
09-02 Tue	**LECTURE:** Basic Chemistry Calculations and Concepts (nuclear atom, chemical elements, periodic table, mole/mass calculations)	Chapter 2
09-04 Thu	**LECTURE:** Maintaining a Laboratory Notebook, Writing Conclusions and Reflections	
	LAB: Simple Qualitative Analysis	Download pdf
09-09 Tue	**Quiz One: Basic Chemical Concepts** **LECTURE:** Molecules, Compounds and Chemical Equations (nomenclature, chemical composition, classifying and balancing chemical equations)	Chapters 1 & 2 Chapter 3
09-11 Thu	**LECTURE:** Chemical Reactions (predicting products, activity series, solubility properties)	Chapter 4
	LAB: Single and Double Displacement Reactions	Download pdf
09-16 Tue	**LECTURE:** Chemical Quantities (stoichiometry)	Chapter 4
09-18 Thu	**LECTURE:** Problem Solving (stoichiometry)	Chapter 4
	LAB: Qualitative Analysis	Download pdf
09-23 Tue	**Quiz Two: Chemical Reactions and Stoichiometry** **LECTURE:** Acid-Base and Redox Reactions	Chapter 3 & 4
09-25 Thu	**LAB:** Some Nonmetals and Their Compounds - Preparation and Properties	Download pdf
09-30 Tue	**LECTURE:** Reactions in Aqueous Solutions (solutions, precipitation, acid-base, redox, stoichiometry, titrations)	Chapter 4
10-02 Thu	**LECTURE:** Reactions in Aqueous Solutions (focus on redox)	Chapter 4
	LAB: The Alkaline Earths and the Halogens	Download pdf
10-07 Tue	**Quiz Three: Solutions** Review for Exam **Lab notebooks are due for first evaluation.** (Rubric)	
10-09 Thu	**Exam One: Chapters 1-4** **LECTURE:** Introduction to Gas Behavior (gas pressure, simple gas laws, ideal gas law)	Ch. 1 to 4 Chapter 5
10-14 Tue	**LECTURE:** Properties of Gases (gas stoichiometry, gas mixtures, Kinetic-Molecular Theory of Gases)	Chapter 5
10-16 Thu	**LAB:** Molar Mass of a Volatile Compound	Download pdf
10-21 Tue	**Quiz Four: Ideal Gas Law** **LECTURE:** Gas Effusion, Non-Ideal Gases, Partial Pressure	Chapter 5
10-23 Thu	**LECTURE:** Thermochemistry (Heat, Calorimetry)	Chapter 6
	LAB: Introduction to Thermodynamics in the Laboratory	Download pdf
10-28 Tue	**LECTURE:** Thermochemistry (Hess's Law, Standard Enthalpies of Formation, Fuels)	
10-30 Thu	**Quiz Five: Thermodynamics**	

	LECTURE: Thermodynamics	Chapter 6
11-04 Tue	**Quiz Six: Thermodynamics: Hess's Law** **Problem Solving Practice**	Chapters 5 & 6
11-06 Thu	**Exam Two: Chapters 5-6**	
11-11 Tue	**LECTURE:** Introduction to Quantum Chemistry **Lab notebooks are due for final evaluation.** (Rubric)	Chapter 7
	LAB ACTIVITY: Simulation of the Photoelectric Effect	Download pdf
11-13 Thu	**LECTURE:** Quantum Theory: Three Experiments, Quantum Numbers	Chapters 7 & 8
	LAB ACTIVITY: Atomic Spectra	Download pdf
11-18 Tue	**LECTURE:** Periodic Properties **LAB ACTIVITY:** Graphing Ionization Energies	Download pdf
11-20 Thu	**Quiz Seven: Atomic Theory and Periodic Properties** **LECTURE:** Chemical Bonding	Chapters 7 & 8 Chapters 9 & 10
	LAB ACTIVITY: Molecular Geometry and Shape	Download pdf
11-25 Tue	**Quiz Eight: Molecular Geometry** **LECTURE:** Bond Energies	
11-27 Thu	Thanksgiving	
12-02 Tue	**LECTURE:** Intermolecular Forces: Phase Diagrams	Chapter 11
	LAB ACTIVITY: Heating and Cooling Curves	Download pdf
12-04 Thu	**Exam Three: Chapter 7-12** **LECTURE:** Solutions and Their Physical Properties (solution concentrations)	Chapter 12
12-09 Tue	**REVIEW** **Comprehensive Final Examination** **All homework and extra assignments are due. This is the last day to turn in anything.**	Comprehensive
12-11 Thu	Final Class: Student Conferences, Discussion of Final Grade	

View Laboratory Assignments Only

Chemistry 201 Grading Policy

Your Grade will be based on:

(30%) laboratory work: which includes...
Lab notebook (10%) the laboratory notebook is collected twice for evauation. More information..
Lab activities (10%) Photoelectric Effect, Ionization Energies, Bohr Atom, Molecular Models, Heating and Cooling Curves
Determination of Unknowns (10%)

(20%) quizzes [best five of eight]
(20%) examinations [best two of three]
(5%) research paper
(5%) attendance, homework, class participation
(20%) comprehensive final exam

Extra Credit: One percent extra credit is available by doing the one book project.

Grading Scale

Letter Grade	Percentage
A	90%
B	80%
C	70%
D	60%
F	below 60%
I	*Incomplete
ADW	**Administrative Withdrawal
NSW	***No Show Withdrawal

***I (Incomplete)** is a non-grade received by students who have **actively pursued** the course and are doing passing work at the end of the course, but who have not completed the course's final examination and/or other specific course assignments.

****ADW (Administrative Withdrawal)** is given to any student who is not **actively pursuing** the course objectives will be administratively withdrawn from the course at mid-term. An ADW will be given if a student does not complete at least 70% of all assignments; homework, exams, laboratories, quizzes due prior to mid-term by the mid-term date. Since make up work is NOT permitted this means that attendance is extremely important and excessive absences will most likely result in an ADW.

*****NSW (No Show Withdrawal)** is given to any student who misses the first two classes and does not discuss with me the circumstances of these absenses will be given an NSW after the second class. A student who attends the first class and then fails to attend the next two classes and fails to discuss with me the circumstances of these absences will be given an NSW. Any student who misses more than half of the classes in the first two weeks of the term will also be given an NSW if we do not discuss the circumstances of these absences. In my discussion with you I will determine if it is feasible for you to sucessfully pursue the course objectives under whatever circumstances are causing you to miss class. Your success is very important to me and I know, from years of experience, that your success depends on your commitment and ability to attend the class and participate in all activities.

General Policies
Please read the general policies carefully. Failure to follow these policies will be reflected in the class participation portion of your grade.

Active Pursuit
Active Pursuit is defined as consistent attendance, communication with the instructor in person or by email about any absences, completion of assignments on time, commuincation with the instructor about any difficulties completing assignments on time, participating in class, taking quizzes and exams and performing laboratory experiments as assigned. Any student who misses two consecutive classes is at risk for being considered as not actively pursuing the class. The best strategy to handle any unforseen circumstances is to communicate as soon as possible with the instructor.

Make-Up Policy
Make-Up work is not permitted under any circumstances. This includes but is not limited to hospitalization, deaths in the family, illness, family emergencies. Life happens to everyone. This is why the lowest exam and some quizzes are dropped from your grade with no penalties. If circumstances arise that prevent you from actively participating in all aspects of this course please let me know. There is no substitute for attending classes regularly and on time. Please choose someone else in the class that will be able to exchange notes with you in the event either of you misses class. You are responsible for all missed announcements, assignments and class work. Please do not use the phrase "I didn't know" to excuse any missed work. Check the website often. Announcements and assignments are posted and updated

regularly.

Success in the Laboratory

Laboratory Work: You are expected to maintain a detailed laboratory notebook with observations, data, analysis and discussion of each demonstration and experiment. All data entries should be made in ink NOT pencil while you are in class.

Preparation: The moment lab begins is **not** an ideal time to begin to read a laboratory. You need to read the laboratory ahead of time and look up the meaning of any unfamiliar vocabulary. It is important to come to the laboratory prepared and properly dressed. No sandals and no shorts are allowed in the laboratory for safety reasons. Absolutely NO food or drinks are permitted in the laboratory.

Methods of Assessment

During the first week of class students are given a knowledge probe assessment to determine how well they are prepared to take the course and their current knowledge of major course concepts. Throughout the course students will participate in a variety of assessment activities, quick questions on index cards, problem recognition tasks, opinion polls, skill drills, and common misconceptions assessment.

Academic Integrity

There will be no tolerance for violations of academic integrity (e.g. plagiarism, cheating of any kind). Any violation will result in an "F" for the course.

Learning Outcomes and Course Objectives

Learning Outcomes for Chemistry 201

At the completion of this course, the successful student will be able to:

- Solve quantitative chemistry problems and demonstrate reasoning clearly and completely. Integrate multiple ideas in the problem solving process.
- Describe, explain and model chemical and physical processes at the molecular level in order to explain macroscopic properties.
- Classify matter by its state and bonding behavior using the Periodic Table as a reference.
- Apply important theories such as the Kinetic Molecular Theory of Gases or the Quantum Mechanical Theory of the Atom to the solution of general chemistry problems.
- Perform general chemistry laboratory experiments using standard chemistry glassware and equipment and demonstrate appropriate safety procedures.
- Record, graph, chart and interpret data obtained from experimentation and use that information to correctly identify/analyze assigned unknown substances.

Course Objectives for Chemistry 201

At the completion of this course, the successful student will be adequately prepared to take the subsequent course: General Chemistry II (Chemistry 203), and be able to do the following:

Topics marked with (R), review, should have been covered by the student in a Basic Chemistry course.

Scientific Method

- (R) Describe the scientific method.
- (R) Define and explain the terms: law, hypothesis, and theory.

Chemical Calculations

- (R) Use exponential notation.
- (R) Do mathematical calculations involving significant figures.
- (R) Differentiate between mass and weight.
- (R) Convert from the English system to the metric system (& vise versa) common units of length, mass, volume, and temperature.
- (R) Use the metric system in calculations.

Heat and Temperature

- (R) Differentiate between heat and temperature.
- (R) Do simple calculations of heat changes using specific heat.
- Define and use the terms standard state, standard enthalpy change, molar enthalpy of formation.

Density

- (R) Solve problems using density as the relationship between mass and volume.

Properties of Matter

- (R) Use and define (describe or explain) basic chemical concepts with respect to properties of matter: physical states of matter, physical and chemical properties of matter, physical and chemical changes, the law of conservation of mass, the law of conservation of energy, the law of definite composition, classification of elements.
- (R) Distinguish between pure substances (elements and compounds) and mixtures (homogeneous and heterogeneous).
- List the names and chemical symbols of at least 48 elements.

Atomic Theory and Structure, Molecular Theory and Structure

- (R) Distinguish between ionic and molecular compounds.
- (R) Determine the number and types of atoms represented in a chemical formula.
- Use basic chemical nomenclature for inorganic compounds.
- Write the formulas of binary ionic compounds, common binary molecular compounds, and at least 12 common acids, 4 common bases, inorganic ternary compounds using 15 common polyatomic ions.
- Use oxidation numbers to distinguish oxidation states of metals in compounds.
- (R) Balance chemical equations given the formulas of the reactants and products.

- Calculate the oxidation number of each element, given the formulas of the reactants and products.
- Balance redox equations using oxidation numbers.
- (R) List the basic principles of Dalton's atomic theory and indicate how the theory has been further developed in this century.
- (R) State the basic properties of the subatomic particles: protons, neutrons, and electrons.
- (R) Describe the Rutherford atom.
- (R) Define atomic number, mass number, and isotopes.
- (R) Define the atomic mass unit and Avogadro's number.
- (R) Use the conversion factor from grams to amu in simple calculations.
- Calculate the average atomic mass from isotopic masses and percent abundances.
- (R) Apply the terms: metals, nonmetals, alkali metals, alkaline earth metals, metalloids, transition metals, noble gases, halogens, and inner transition metals to the arrangement of elements in the periodic table.
- (R) Describe the arrangement of the elements in the periodic table.
- (R) Use the periodic table to predict formulas of compounds.
- (R) Define the terms anion, cation, and polyatomic ion.
- Describe how ionic and covalent bonds are formed.
- Calculate the oxidation number of each element in a chemical formula.

Mole-Mass Calculations

- (R) Calculate the percent composition of compounds, given the formulas.
- (R) Calculate the empirical formula, given the percent composition.
- (R)Calculate the empirical formula of compound given the mass of the sample, the mass of CO_2 and mass of H_2O produced in a combustion reaction.
- (R) Distinguish between empirical and molecular formulas.
- (R) Explain the concepts of the chemical quantity, the mole, and relate it to counting of atoms and molecules.
- (R) Convert mass in grams to moles, formula units, molecules (and/or atoms) using atomic weights, formula weights, and molecular weights.
- List the basic rules which predict whether a salt is soluble in water.

Stoichiometry

- Write the balanced equations describing several examples of combustion, acid-base, precipitation, and exchange reactions. Write the equations in the molecular, total ionic and net ionic format.
- (R) Explain the information given by the balanced chemical equations.
- Perform stoichiometric calculations from a given chemical equation.
- Use calculations determine the limiting reagent, how much excess reagent is left, and the theoretical and percentage yield of each product.

Solutions

- List the properties of solutions and distinguish true solutions from heterogeneous and colloidal mixtures.
- Define solubility, percent concentration, molarity, mole fraction, and molality.
- Explain factors affecting solubility and the rate of dissolving.
- Write molecular, total ionic and net ionic equations which show that the solution is the reaction medium.
- Use percent concentration, molarity, and molality in stoichiometric calculations.

Gases

- List the basic principles of the Kinetic Molecular Theory of gases.
- (R) Describe the measurement of pressure using a barometer.
- (R) Use four kinds of pressure units in calculations and convert from one to another.
- Calculate pressure, volumes, and temperatures of gases using Boyle's law, Charles' Law, the Combined Gas Law, and Dalton's Law of Partial Pressures.
- (R) Calculate Kelvin temperatures from Centigrade and vise versa.
- (R) Define standard conditions of temperature and pressure.
- Use the Ideal Gas Law to calculate density and molecular weight of a gas.
- Use the gas laws in chemical stoichiometric calculations.
- Define and distinguish between diffusion and effusion.

Energy and Light

- Define and explain the terms electromagnetic radiation, wavelength, frequency, wave amplitude, spectrum, and nodes.
- Describe the Bohr hydrogen atom; describe the hydrogen atom in terms of simple quantum mechanics.
- Perform calculations using the equation $\lambda v = c$.
- Explain the source of the atomic line spectra.
- Describe the properties of light.

Molecular Orbital Theory

- Write electronic configurations of the first 50 elements; show the diagrams of their electronic structure, and indicate the spin of each electron.
- Sketch the shape of the s, p and d orbitals.
- Identify the 4 quantum numbers for any electron in an atom.
- Predict which atoms or ions are paramagnetic and which are diamagnetic using the electronic configurations.
- State the Pauli Exclusion Principle, Hund's rule, and the Aufbau principle.
- (R) Define ionization energy and be able to rank using the periodic table.
- Use ionization energy trends to predict the stability of electronic configurations and the tendency for outer shell electrons to undergo changes in order to form compounds.
- (R) Define electronegativity: show how it varies with respect to the periodic table.
- (R) Use electronegativity to estimate the polarity of bonds.
- Show the trends of atomic and ionic sizes on the periodic table.
- State the octet rule, including exclusions.
- Write Lewis electron dot structures for simple covalent compounds and polyatomic ions.
- Use double and triple bonds to show structures of molecules and ions; use resonance to describe equivalent bonds.
- Use the Valence Shell Electron Pair Repulsion theory to describe electron pairs geometry, molecular geometry, hybridization, and bond angles.
- Predict the polarity of bonds and molecules.
- Define bond order and bond dissociation energy; use bond energies to estimate reaction enthalpies.
- Calculate the formal change of an atom in a molecule or ion, and use it to predict the most reasonable resonance structures.
- Explain the difference between oxidation number and formal change.
- Explain simple valence bond theory.
- Use the concepts of orbital overlap, sigma and pi bonds, hybrid orbitals to explain the strength and orientation of covalent bonds.

Properties of Solutions

- Use molarity in calculations concerning the dilution of solutions.
- Explain at least two examples of colligative properties.
- Calculate the freezing point depression and the boiling point elevation due to the addition of a nonvolatile molecular solute to a pure solvent.

Acids and Bases

- List at least four properties each for acids and bases.
- Explain the behavior of acids and bases in terms of the Arrhenius and Brønsted/Lowry theories.
- Write equations for acids and bases showing conjugated acid/base pairs.
- List at least five common strong acids and five common strong bases.
- Given an acid, write the formula of the conjugate base, and vise versa.
- Write complete equations for at least two examples of each of the following reactions: acid + base, acid + metal, acid + metal oxide, acid + carbonate.
- Given the formula of a salt, write the formulas of the acid and the base which would react to form the salt.
- Distinguish between electrolytes and non-electrolytes, strong and weak electrolytes. List at least three examples of each.
- Define pH. Given a pH value, state whether the solution is acidic, basic, or neutral.
- Given a pH value calculate the H^+ concentration, and vise versa.
- Estimate pH and pOH values without the use of a calculator given H^+ concentration and/or OH^- concentration.

- Given a pOH value calculate the OH^- concentration, and vise versa.
- Convert from H_3O^+ concentration to pH then to pOH then to OH^- concentration.

Laboratory and Evaluations

- Perform simple tasks in the laboratory. Perform ten laboratory experiments.
- Carry out laboratory measurements and calculations using the correct significant figures.
- Perform the necessary calculations, prepare any required graphs and answer the questions for each experiment.
- Achieve a grade of at least 50% for the final comprehensive examination.
- Record all data in ink directly onto the data sheet or in the laboratory notebook.
- Prepare a lab report including a summary.
- On any quizzes and exams answer short essay questions.

Teaching and Learning Goals Established by Truman College

Taking a course in Chemistry helps a student achieve all of the following general education goals. How this occurs is explained below.

- Communicate effectively in both written and oral forms

  Students will keep a laboratory notebook and learn to record careful observations, draw appropriate conclusions and reflect on what they have learned.
- Gather, interpret and analyze data

  Students will learn to collect data in the laboratory, create graphs, compare quantitative data and draw conclusions about the data obtained.
- Demonstrate the ability to think critically, abstractly and logically

  The Scientific Method is predicated upon deductive and inductive logical reasoning. Students will study applications of the scientific method to information gathered by the scientific community. Students will read articles about chemical discoveries. Abstract thinking is developed in many ways in chemistry from the use of symbols and models to the use of mathematics to solve a variety of problems.
- Work with a variety of technologies

  Students use computers, data acquisition equipment, microscopes, digital imaging devices, media, the Internet, podcasts, digital balances, all in the pursuit of scientific knowledge.
- Exhibit social and ethical responsibility

  This very serious goal is addressed on many levels in the chemistry course, from the discussion of the importance of careful and precise measurements that could affect the life of a patient to the discussion of what happened when the space ship Challenger exploded or a grain elevator explodes - we examine the role of responsible use of chemical knowledge.
- Perform productively in the workforce

  Because Chemistry education is comprehensive in utilizing the body (kinesiology), the mind (both spatial and analytical reasoning) and the heart (looking at the connection of chemistry to the world) it is an excellent course to prepare individuals for the workforce.
- Demonstrate the ability to learn independently

  Students are given independent projects to complete in the course. They are also given questions to research independently. Reporting these results to the class develops their ability to speak confidently to their peers.
- Gain awareness of their role in the global community

  By discussing the way that chemistry is connected to other occupations and careers we develop student awareness about their career choice and its dependencies on a basic understanding of chemistry.

General Education Goals Established by Truman College

- **GEG1:** The student exhibits social and ethical responsibility and is aware of her or his place in the global community.
- **GEG2:** The student performs effectively in the workplace and has the ability to work and make effective use of a wide variety of current technologies.
- **GEG3:** The student communicates effectively in both written and oral formats.
- **GEG4:** The student demonstrates the ability to think critically, abstractly, and logically.
- **GEG5:** The student gathers, interprets and analyzes data.

Physical Science and Engineering Departmental Learning Outcomes

Upon graduation with an Associate degree from Truman College a student should be able to:

- Organize, analyze and interpret information and use the scientific method to make inferences.
- Exhibit knowledge of scientific concepts through written and oral communication.
- Demonstrate excellent laboratory skills and techniques including the proper use of relevant instruments and related

technologies.

- Use the lexicon of science to explain abstract scientific concepts.
- Relate concepts learned in Physical Science and Engineering Department classes to real world situations.