Course Syllabus
CHEM 108 - General Lab Chemistry for Health Professions
4 credits

Prerequisites: High school chemistry (recommended, but not required)
Instructor: Kenneth Hartman, PhD
Facilitator: H. Elaine Frey, MHA
Contact Info: Faculty may be contacted through the Portage messaging system
Course web site address: www.portagelearning.com
Course meeting times: CHEM 108 is offered continuously

Course Description: A systematic exploration of the fundamental laws, theories and mathematical concepts of inorganic, organic and biological chemistry designed to contain comprehensive information needed for health professions study. The laboratory component of this course is delivered using virtual labs and interactive simulations.

Course Outcomes: As a result of this course experience a student should be able to:

- Apply the principles of the scientific method and measurement
- Describe the electron structure and chemical periodicity of atoms
- Name and write formulas for common inorganic compounds
- Perform stoichiometric, thermochemical and molarity calculations
- Determine the bonding, geometry and polarity of molecules and use these to explain the physical properties of these molecules
- Balance simple and redox chemical equations
- Understand gases and perform gas law calculations
- Predict the effect of various stresses on chemical equilibria
- Explain acid/base properties and perform pH and titration calculations
- Describe the structures and properties of simple organic compounds and name or write formulas for these compounds
- Predict and describe the typical reactions of simple organic compounds
- Recognize the structures of carbohydrates, lipids, proteins and nucleic acids and their building-block molecules

Lab Outcomes: As a result of this laboratory experience a student should be able to:

- Practice safe procedures in the chemical laboratory
- Perform accurate volume and mass measurement
- Carry out and describe chemical reactions
- Carry out extraction and distillation procedures
- Perform pH measurements
- Carry out acid-base titrations

- Carry out organic and inorganic synthesis
- Perform qualitative and quantitative analyses

The CHEM 108 student learning outcomes are measured:

Directly by: (1) module application problems (with instructor feedback)
(2) exams
(3) lab reports and lab exams
(4) comparison of pre-course / post-course exam results

Indirectly by an end of course student-completed evaluation survey

Course Delivery: This course is asynchronously delivered online and is composed of 10-15 hours of module assignments, 20-25 hours of video lectures, 10-15 hours of secure online exams, 10-15 hours of demonstration labs, 5-10 hours of lab notebook maintenance, 10-15 hours of written lab reports/exams.

It is the policy for all Portage Learning courses that only one exam be completed each day. Research on best practices in learning psychology indicates that time is needed to process material for optimal learning. This means that once an exam has been completed, the next exam will not unlock until the following day. Please plan your time accordingly. If you have a legitimate need for an exception to this policy, please contact your instructor.

Required Computer Accessories: It is recommended that students use a desktop or laptop computer, PC or Mac, when taking the course. Some tablet computers are compatible with the course, but not all features are available for all tablet computers. The latest full version of Firefox is required for the optimal operation of the Portage Learning Management System. In addition, you must have the latest full version of Adobe Flash Player installed as a plug-in in order to view any of the videos on the site. We highly recommend using a high speed Internet connection to view the video lectures and labs. You may experience significant difficulties viewing the videos using a dial-up connection.

Required readings, lectures and assignments: Portage courses do not use paper textbooks. Students are required to read the online lesson modules written by the course author which contain the standard information covered in a typical course. Video lectures which supplement each lesson module subject should be viewed as many times as is necessary to fully understand the material.

The practice problems within the modules are not quantitatively part of your final grade, but the module work is a pass/fail component of the course and will be reviewed for completeness by the instructor. Be sure to answer all of the problems since this is an important part of adequate preparation for the exams. After you answer the practice problems, compare your answers to the solutions at the end of the module. If your answers do not match those at the end, attempt to figure out why there is a difference. If you have any questions please contact the instructor via the My Messages tab or call the help line at 1-888-724-3590 x2 especially for questions that require long answers or discussion.

Grading Rubric:

8 Module exams = 100 pts. each x 8 =	800 pts.
10 Lab Exam/Reports = 30 pts each x 10 =	300 pts.
Final exam = 160 pts.	160 pts.
Total	1260 pts.

The current course grade and progress is continuously displayed on the student desktop.

Grading Scale:

89.5% - 100% (1128 - 1260 pts)	= A
79.5% - 89.4% (1002 - 1127 pts)	= B
69.5% - 79.4% (876 - 1001 pts)	= C
59.5% - 69.4% (750 - 875 pts)	= D
<59.4% (<750 pts)	= F

Modules and Labs

Module 1: This module introduces the science of chemistry by examining its fundamental terminology and measurement system. The metric system is explained, compared to the English customary system and applied. Matter is classified and atomic theory is introduced. The Periodic Table is presented as a foundation for discussion of the elements and their application to the naming of chemical compounds and writing of their formulas.

Module 2: Chemical reactions are considered in this module including balancing and listing of common types and redox equations. Percent composition and determination of empirical and molecular formulas are presented. The mole concept is explained and applied to stoichiometric equation calculations. Molarity solution concentration is also discussed as an application of the mole concept.

Module 3: The module begins with a discussion of the kinetic-molecular theory of gases as an introduction to the presentation of and application of the combined and ideal gas laws and use of these in determination of gas volume stoichiometry. The topic of gases is extended further to include an examination of the law of partial pressures and diffusion and effusion. This module also contains a detailed treatment of atomic structure including determination of electron configuration and orbital diagrams. The wave theory of the electron is presented along with the quantum theory of the atom leading to the determination of quantum numbers and use of this material to predict periodic trends in the atomic properties of ionization energy, electronegativity and atomic size.

Module 4: This module includes a detailed treatment of ionic and covalent intra-molecular bonding and various types of inter-molecular bonding. Lewis structures are discussed and used to determine

electron geometry, hybridization and molecular shape. This information is then applied to predict molecular polarity and used to predict physical properties and solubility.

Module 5: This module contains a detailed examination of kinetics including calculation of reaction rate and its use to determine rate constants and reaction order. Radioactive decay is examined as an example of first order reactions. Collision theory is introduced leading to examination of energy of activation, transition state, reaction spontaneity, heat of reaction, catalysis and enzymes. Reversible reactions are examined so as to discuss equilibrium reactions and determination and use of the equilibrium constant and LeChatelier's principle.

Module 6: This module contains an extensive treatment of acid-base chemistry beginning with terminology definitions and a discussion and application of the three most common acid-base theories. Relative acid and base strengths are predicted and types of reactions of acids and bases are considered. pH is defined and determined. Acid-base titration calculations are carried out and expanded to include titration curves and their use to determine endpoints and indicator choice. Weak acid/weak base equilibria are examined and applied to determine pH and percent ionization and extended to explain the effect of acid-base buffers.

Module 7: This module presents the chemistry of organic compounds beginning with a review of the structure and nomenclature of the four types of hydrocarbons and continuing with structure and nomenclature of nine other common functional group types. The five most common types of organic reactions are listed and discussed. Organic structure determination by spectroscopic analysis is examined including SEM/EDS qualitative elemental analysis, Mass Spectrum analysis for molecular weight, Infrared (IR) analysis for the presence of certain functional groups and Nuclear Magnetic Resonance (^{1}H-NMR) analysis for H arrangement.

Module 8: This module includes an examination of biochemistry and nuclear chemistry. The structures and functions of each of the four main classes of biochemical materials (carbohydrates, lipids, proteins and nucleic acids) are presented. The nuclear chemistry section begins with an examination of nuclear particles and their involvement in the balancing of the five types of radioactive decay reaction equations or transmutation reaction equations. This section concludes with a treatment of nuclear half-life processes and mass-energy conversion and binding energy calculations.

Lab 1: This lab includes a presentation of safety and equipment aspects of the chemistry laboratory as well as an examination of mass and volume measurement. Each of the common items of lab equipment are presented and discussed. Mass measurement is carried out using the various types of balances commonly used in the lab. Volume is measured using cylinders, pipettes and burettes and the accuracy of these devices is compared.

Lab 2: In this lab, mass and volume measurement are carried out and used to determine the density of many solid and liquids and some materials of biological interest. The determined densities are compared to known values to introduce the concepts of percent error and average deviation.

Lab 3: This lab examines quantitative and qualitative chemical analysis. The quantitative analysis of a metal carbonate is carried out to determine percent CO_2 and used to determine the identity of the metal carbonate. The quantitative analysis of a hydrate is carried out to determine the percent water and used to determine the identity of the metal hydrate. Paper chromatography is performed on an amino acid mixture and used to determine the amino acid components of the artificial sweetener Aspartame. Scanning Electron Microscopy is performed on various materials to determine their qualitative elemental composition and used to determine the identity of two unknown substances.

Lab 4: In this lab, several examples of the six types of chemical reactions are carried out and five types of results are observed during the reactions. The oxidation-reduction of methylene blue indicator is carried out to demonstrate the reversibility of a reaction.

Lab 5: In this lab, a variety of organic compounds are compared as to their water solubility, boiling points determined by distillation and Infrared spectra to determine what types of inter-molecular and intra-molecular bonding might be present in those materials. The types of materials studied are ionic, polar, non-polar, hydrogen-bonding.

Lab 6: In this lab, equilibrium reactions are studied quantitatively by first determining the equilibrium constant for the acid-catalyzed esterification of acetic acid with 1-propanol. Then seven reversible reactions are studied to demonstrate the shifting of these equilibrium reactions according to LeChatelier's principle.

Lab 7: In this lab, six acid-base titrations are carried out for various purposes. (1) The first titration is a weak acid- strong base titration between potassium biphthalate and sodium hydroxide solution for the purpose of standardizing the NaOH. (2) The standard NaOH is then used in another weak acid- strong base titration between vinegar and the NaOH to determine the percent acetic acid in the vinegar. (3) The standard NaOH is then used in a strong acid- strong base titration between a HCl solution and the NaOH to standardize the HCl solution. (4) The standard HCl is then used in a strong acid- weak base titration between household ammonia and the HCl to determine the percent ammonia in the cleaning solution. (5) The standard HCl and standard NaOH are also used in a back-titration procedure between antacid tablets and the HCl to determine the percent $CaCO_3$ in the antacid tablet. Lastly, the standard NaOH is used in a titration of acetic acid by pH meter to construct a titration curve to determine the K_a of acetic acid and demonstrate the suitability of phenolphthalein as an indicator for the titration.

Lab 8: In this lab organic synthesis is demonstrated as three syntheses are carried out from available precursors. Aspirin is synthesized from salicylic acid and the product's structure is confirmed by chemical test, melting point and Infrared spectroscopy. Urea is synthesized from ammonium cyanate and the product's structure is confirmed by melting point and Infrared spectroscopy. Salicylic acid is synthesized from oil of Wintergreen and the product's structure is confirmed by chemical test, melting point and Infrared spectroscopy. In all syntheses, percent yields are determined.

Lab 9: In this lab inorganic synthesis is demonstrated as three syntheses are carried out from available precursors. Alum is synthesized from scrap aluminum foil and the product's structure is confirmed by melting point and Infrared spectroscopy. Calcium carbonate is synthesized by mixing solutions of sodium carbonate and calcium chloride and the product's structure is confirmed by Infrared spectroscopy. Zinc iodide is synthesized by a combination reaction between zinc and iodine and the product's structure is confirmed by Infrared spectroscopy. In all syntheses, percent yields are determined.

Lab 10: In this lab, six qualitative chemical tests are performed on a simulated urine sample to demonstrate urinalysis. The tests performed are for calcium, chloride, ammonium, protein, sugar and ketones.

Holidays:

During the following holidays, all administrative and instructional functions are suspended, including the grading of exams and issuance of transcripts.

New Year's Day	Easter
Memorial Day	Independence Day
Labor Day	Thanksgiving weekend

Christmas Break (one week before Christmas through New Year's Day)

The schedule of holidays for the current calendar year may be found under the Student Services menu at www.portagelearning.com

Additional Tools

A built-in **scientific calculator** for the course has been incorporated into the website and can be found in the tool bar above each module and exam page. If you choose to purchase a calculator, keep in mind that you do not need to purchase an expensive calculator as the features you will need are available on basic scientific calculators with a cost of less than $20. Many mobile phones also include a scientific calculator and you may use a calculator during any exam.

Suggested Timed Course Schedule (to complete the course within a typical college semester)

All Portage courses are offered asynchronously with no required schedule to better fit the normal routine of adult students, but the schedule below is suggested to allow a student to complete the course within a typical college semester. Despite this suggestion, the students may feel free to complete the course at their desired pace and on a schedule determined by them.

Time Period	Assignments	Subject Matter
Days 1-12	Module 1, Exam 1	Matter, metric measurements, atomic theory, periodic table, naming and writing of formulas
	Labs 1-2, Lab Exams 1-2	Safety/Mass/Volume, Density
Days 13-24	Module 2, Exam 2	Balancing/writing molecular and ionic reactions, redox balancing, molarity, stoichiometric calculations, percent composition, empirical formula
	Labs 3/4/9, Lab Exams 3/4/9	Quant/Qual Analysis, Reaction Chem, Inorg Synthesis
Days 25-36	Module 3, Exam 3	Kinetic-molecular theory, gas laws, quantum theory of atoms, electron configuration, periodic table, periodic properties
Days 37-48	Module 4, Exam 4	Ionic and molecular bonding, octet rule, Lewis structures, molecular geometry
	Lab 5, Lab Exam 5	Bonding by Spectroscopy and Physical Properties
Days 49-60	Module 5, Exam 5	Rate laws, reaction mechanisms, activation energy, catalysis, chemical equilibria
	Lab 6, Lab Exam 6	Chemical Equilibrium/LeChatelier's Principle
Days 61-72	Module 6, Exam 6	Acids and bases, pH calculations, titration calculations, acid-base equilibria, buffers
	Lab 7, Lab Exam 7	Acid-Base Titrations
Days 73-84	Module 7, Exam 7	Organic chemistry, spectroscopy
	Lab 8, Lab Exam 8	Organic Synthesis
Days 85-96	Module 8, Exam 8	Biochemistry, nuclear reactions, radiation, half-life
	Lab 10, Lab Exam 10	Urinalysis
Days 97-108	Final Exam	Comprehensive - including all course material

Suggested External References:

If the student desires to consult a reference for additional information, the following textbooks are recommended as providing complete treatment of the course subject matter.
Jean Umland, **General Chemistry**, West Publishing
Darrell Ebbing, **General Chemistry**, Houghton Mifflin Publishing

Learning Support Services:

Each student should be sure to take advantage of and use the following learning support services which are provided to increase student academic performance:
Video lectures which supplement the text material of each course module
Messaging system which provides individual instructor/student interaction
Toll-free phone tutoring help line which is available daily at appointed times (see below)
Tech support which is available by submitting a help ticket

Accommodations for Students with Learning Disabilities:

Students with documented learning disabilities may receive accommodations in the form of an extended time limit on exams, when applicable. In order to receive the accommodations, the student should furnish documentation of the learning disability prior to registration, if possible. Upon receipt of the documentation of a learning disability, Portage staff will provide the student with registration instructions for a variation of the course containing exams with extended time limits. This accommodation does not alter the content of any assignments/exams, change what the exam is intended to measure or otherwise impact the outcomes of objectives of the course.

Student Help Line:

Portage students have access to our help-line phone service. The phone service is staffed by instructors who will answer questions regarding material in those courses. Please call 1-888-724-3590 and choose option #2 if you would like assistance with your course work. Due to high call volume, we cannot guarantee that your call can be answered immediately so you may be required to leave a voicemail. The help-line instructors will return the voicemails as soon as possible and within one business day. If the hours above do not fit your personal schedule, please leave a message on the help line voicemail requesting an appointment. In the voicemail, please leave several dates and times convenient for a return call. If a help line representative cannot call you at one of your preferred times, you will be contacted to set up a mutually suitable time. Appointment slots are limited and will be granted as instructor time becomes available and at the discretion of the help line instructor. No appointments will be scheduled for Sunday.

Help Line Hours

Mon - Fri: Noon - 9 PM ET

Sat: 9 AM - 11 AM ET

Sun: Closed

Code of Conduct: Students are expected to conduct themselves in a way that supports learning and teaching and promotes an atmosphere of civility and respect in their interactions with others. Verbal and written aggression, abuse, or misconduct is prohibited and may be grounds for immediate dismissal from the program.

Academic Integrity is a serious matter. In the educational context any dishonesty violates freedom and trust, which are essential for effective learning. Dishonesty limits a student's ability to reach his or her potential. Portage places a high value on honest independent work. In a distance learning situation, we depend on the student's desire to succeed in the program he or she is entering. It is in a student's own best interests not to cheat on an exam, as this would compromise the student's preparation for future work. It is required of each student to take exams without consulting course materials or study aids including another person, the lesson pages, printed materials, or the Internet. To this end, your instructor will be alert to any indications that a student may be violating this principle. It will be necessary to show all your work on exams. When the nature of the course does not require numerical or symbolic determination (perhaps instead just requires recitation of learned descriptions), our experienced staff is able to detect the unauthorized consultation of study aids when answering exam questions. A violation of the academic integrity policy may result in a score of zero on the exam and possible expulsion from the course, at the discretion of the instructor with consultation with an administrative-instructional committee.

Grievances: If for any reason a student has a complaint about the course work or the instructor, the student is advised to first consult the instructor, who will be willing to listen and consider your concern. However, if you don't feel you have received a satisfactory reply, you are encouraged to contact the Executive Director of Portage Learning for further consideration of your complaint. The formal grievances process must be initiated via written communication. If desired, please file a written grievance to academics@portagelearning.com to initiate the process.

Remediation:

At Portage Learning we allow a "one-time" only opportunity to re-take an alternate version of one module exam on which a student has earned a grade lower than 70%. This option must be exercised before the final exam is started. If an exam is retaken, the original exam grade will be erased and the new exam grade will become a permanent part of the course grade. However, before scheduling and attempting this retest, the student must resolve the questions they have in regard to the material by reviewing both the old exam and the lesson module material. The student is also encouraged to contact the phone help line for assistance. Once ready to attempt the retest of the exam they must contact their instructor to request that the exam be reset for the retest. Remember, any module retest must be requested and completed before the final exam is opened.