

**Prerequisites:** High school chemistry

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**Contact Information:** Faculty may be contacted through the Canvas messaging system

**Additional Information:** [www.portagelearning.com](http://www.portagelearning.com)\*

**Course meeting times:** CHEM 103 is offered continuously

**Course Description:** A systematic investigation of the fundamental principles of chemistry and the scientific method. The laws, theories and mathematical concepts surrounding chemical reactions are examined. Discussions on the metric system, stoichiometry, thermochemistry, and atomic structure are included. Intra and intermolecular interactions, bonding and the physical properties associated with the solid, liquid and gas phases are also covered in detail. The laboratory component of this course is delivered using virtual labs and interactive simulations with detailed instruction and demonstrations from an experienced chemist.

**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
- Explain solid and liquid properties and phase diagrams

\*Please see the *Module & Lab Topics* section below for expanded course outcomes.

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\* Portage Learning college courses are offered by Geneva College, which is accredited by the Middle States Commission on Higher Education. Portage Learning is included in the College's Department of Professional and Online Graduate Studies; courses are delivered through the [PortageLearning.com](http://PortageLearning.com) platform.

**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
- Perform gas manipulations and calculations
- Carry out temperature and thermochemical measurements
- Carry out filtration and distillation procedures
- Analyze and apply solubility data

The CHEM 103 student learning outcomes are measured:

Directly by: (1) Module application problems (with instructor feedback)  
(2) Module exams  
(3) Lab notebooks and lab applications  
(4) Cumulative final exam

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 applications.

**Course Progression:** It is the policy for all Portage Learning courses that only one (module lecture/final) exam is to be completed within a 48-hour period. Research on the best practices in learning indicates that time is needed to process material for optimal learning. This means that once an exam has been completed, the next exam may not be opened or taken until 48 hours after the submission of the previous module exam. This allows for instructor feedback/class expectations as the student moves through the material. Instructors, like the College, are not available during the weekend; grading, therefore, is M-F and may take up to 72 hours during these days. Also, it is the policy of Portage Learning to support a minimum of 28 days to complete a course; this is not a negotiable time period. Please plan your time accordingly.

**Note:** Professors reserve the right to reset any exam taken in violation of these guidelines.

**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. Please note the exam questions are based upon the readings. Video lectures which support each lesson module subject should be viewed as many times as is necessary to fully understand the material.



We do not support the use of outside resources to study, except for the ones listed in the syllabus under “Suggested External References”. If you have questions about the material or would like further explanation of the concepts, please contact your instructor.

**Module Problem Sets:** The module problem sets within the modules are required and a part of your final grade. They will be reviewed for completeness (not correctness) by the instructor. You must show your work in order to receive full credit. **Be sure to answer all of the problems, being careful to answer the questions in your own words at all times since this is an important part of adequate preparation for the exams.**

After you submit the problem set, compare your answers to the solutions provided. 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 Canvas messaging system (see Inbox icon).

**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. 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 or put their work into question, as this would compromise the student's preparation for future work. It is the student's responsibility to review the **Student Handbook** and all policies related to academic integrity. If clarification is necessary, the student should reach out to their instructor for further explanation **before** initiating module one.

**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 potentially compatible with the course, but not all features are available for all tablet computers. The latest full version of Google Chrome, Firefox, Edge, or Safari browser is required for the optimal operation of the Canvas Learning Management System. In addition, this course will use the Respondus Lockdown Browser for exams; a strong internet connection is needed. You are also **required to use LockDown Browser with a webcam**, which will record you during an online, nonproctored exam. (The webcam feature is sometimes referred to as “Respondus Monitor.”) **Your computer must have a functioning webcam and microphone. Additionally, a photo ID that includes your picture and full name is required. Please note, Chromebooks and tablets (other than iPad) are not compatible on exams using the Lockdown Browser.** Instructions on downloading and installing this browser will be given at the start of the course. 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.



For more information on basic system and browser requirements, please reference the following:

Canvas browser and system requirements: <https://community.canvaslms.com/t5/Canvas-Basics-Guide/What-are-the-browser-and-computer-requirements-for-Canvas/ta-p/66>

Respondus Requirements: <https://web.respondus.com/he/lockdownbrowser/resources/>

Respondus Monitor Requirements: <https://web.respondus.com/he/monitor/resources/>

## 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 thermochemistry, including temperature-change and phase-change calorimetry, thermochemical equations, heats of reaction and Hess's Law. This module also contains a detail treatment 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.
- Module 4: This module contains a detail 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 5: 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 6: The properties and detailed structure of the liquid and solid phases of matter are studied in this module and used to illustrate and explain phase changes and phase change diagrams of water. Homogeneous and heterogeneous mixtures are illustrated and discussed. Solubility is discussed and applied to explain the solution concentration terms mass percent, molarity, and molality. Various colligative properties of solutions are discussed, and calculations are done to illustrate these, including the determination of molar mass. Ionization in electrolyte solutions is discussed and used to illustrate the conductivity and special colligative properties of these solutions.
- Lab 1: Safety Equipment. 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: Chemical Reactions. 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 3: Quantitative Analysis. This lab examines quantitative chemical analysis by examining two analyses that of a metal carbonate and of a hydrate. The analysis of the metal carbonate is carried out to determine percent  $\text{CO}_2$  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: Thermochemistry. The heat exchange associated with chemical reactions is examined in this experiment using an instrument called a calorimeter. First, a calorimeter is calibrated and then used to measure the heat exchange of an acid-base reaction. Then a second type of calorimeter is used to measure the heat change for the combustion of a hydrocarbon fuel.
- Lab 5: Gas Law Experiment. This lab covers Boyle's Law, Charles Law, and the Ideal Gas Law. Experiments will explore the pressure-volume relationship and the volume-temperature relationship of gases. Also, the ideal gas law will be used to predict the molar mass of a gas.



- Lab 6: Bonding and Properties. In this lab, a variety of organic compounds are compared in regard to 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, no-polar, hydrogen-bonding.
- Lab 7: Molality/Colligative Property Experiment. In this experiment, the properties of solutes dissolved in a solvent will be covered. First, the calculation of molality,  $m$ , is covered using two salts to demonstrate. Next, the two salts are investigated for their ability to lower the temperature of ice. Preparation of ice cream is used to show the differing impact of the two salts on lowering the melting point of ice.
- Lab 8: Molar mass. In this experiment, colligative properties are used to determine the molar mass of a compound. Solute tends to lower the freezing point of a solvent with more solute lowering the freezing point to a greater degree. The freezing point of a pure solvent is determined and then compared to that of the solvent with a solute. The molar mass of the solute is estimated from the freezing point difference.

#### Required Labs and Assignments:

For the laboratory portion of the course, students will observe an experienced lab instructor. **It is the responsibility of the student to view each lab video in its entirety** and only mark the lab as "done" when it is completed. Do not open all the labs at once; otherwise, they may be reset at the discretion of the instructor. Students are required to keep a lab notebook while watching the videos and submit their signed and dated notebook prior to the related lab exam. The lab notebook is a graded component of the course. A lab notebook template and explanation and expectations are provided under "Lab Overview". The lab notebook and explanation and expectations can be used as a resource to the student while completing their lab application assignment(s). Please note that the use of outside material (i.e. the internet, textbooks, articles, etc.) is not permitted while completing their lab application assignment(s). A recommended lab schedule can be found under "Lab Overview"; the student should follow this schedule to meet course objectives.

**Additional Tools:** There are two different calculators that will be provided within the exam. One of the calculators can be found here: <https://www.desmos.com/scientific>. If you plan on using this calculator for the exams it would be wise to practice using it for both the practice problems and module problem sets. There is also a calculator that is built into LockDown Browser. It can be found in the top left hand corner as a small calculator symbol and only appears during exams. If you have any questions regarding how to input numbers or perform certain calculations, please contact your instructor for assistance before moving forward in the course. You are also welcome to use a personal calculator (non-cell phone) if you would like. 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.



### 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. Students may feel free to complete the course on a schedule determined by them within the parameters outlined under "Course Progression."

<b><u>Time Period</u></b>	<b><u>Assignments</u></b>	<b><u>Subject Matter</u></b>
Days 1-15	Module 1, Exam 1	Matter, metric measurements, atomic theory, periodic table, naming and writing of formulas
	Labs 1, Lab Exams 1	Safety/Mass/Volume
Days 16-30	Module 2, Exam 2	Balancing/writing molecular and ionic reactions, redox balancing, molarity, stoichiometric calculations, percent composition, empirical formula
	Lab 2, Lab Exams 2	Reaction Chemistry
	Lab 3, Lab Exam 3	Quantitative Analysis
Days 31-46	Module 3, Exam 3	Thermochemistry, Gas laws
	Lab 4, Lab Exam 4	Thermochemistry
	Lab 5, Lab Exam 5	Gas laws
Days 47-62	Module 4, Exam 4	Quantum theory of atoms, electron configuration, periodic table, periodic properties
Days 63-78	Module 5, Exam 5	Ionic and molecular bonding, octet rule, Lewis structures, molecular geometry
	Lab 6, Lab Exam 6	Bonding by Spectroscopy and Physical Properties
Days 79-93	Module 6, Exam 6	States of matter, solutions, colligative properties
	Lab 7, Lab Exam 7	Molality / Colligative Properties
	Lab 8, Lab Exam 8	Molar mass
Days 94-108	Final Exam	Comprehensive - including all course material

### Grading Rubric:



Check for Understanding =	1 pt.
6 Module Problem Sets = 5 pts. each x 6 =	30 pts.
6 Module Exams = 100 pts. each x 6 =	600 pts.
8 Lab Reports = 5 pts. each x 8 =	40 pts.
8 Lab Exams = 30 pts each x 8 =	240 pts.
<u>Final Exam = 120 pts.</u>	<u>120 pts.</u>
Total	1031 pts.

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

### Grading Scale:

96.5% - 100% = A+
92.5% - 96.4% = A
89.5% - 92.4% = A-
86.5% - 89.4% = B+
82.5% - 86.4% = B
79.5% - 82.4% = B-
76.5% - 79.4% = C+
72.5% - 76.4% = C
69.5% - 72.4% = C-
66.5% - 69.4% = D+
62.5% - 66.4% = D
59.5% - 62.4% = D-
0% - 59.4% = F

### 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

**NOTE:** We do not support the use of outside resources to study, except the ones listed above.

### Learning Support Services:

Each student should be sure to take advantage of and use the following learning support services provided to increase student academic performance:

**Video lectures:** Supports diverse learning styles in conjunction with the text material of each module

**Messaging system:** Provides individual instructor/student interaction



**Tech support:** Available by submitting a help ticket through the student dashboard

### 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. To receive the accommodations, the student should furnish documentation of the learning disability at the time of registration, if possible. Scan and e-mail the documentation to [studentservices@portagelearning.com](mailto:studentservices@portagelearning.com). Upon receipt of the learning disability documentation, Portage staff will provide the student with 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.

### One-on-one Instruction:

Each student is assigned to his/her own instructor. Personalized questions are addressed via the student dashboard messaging system.

Online learning presents an opportunity for flexibility; however, a discipline to maintain connection to the course is required; therefore, communication is essential to successful learning. **Check your messages daily.** Instructors are checking messages daily Monday-Friday to be sure to answer any questions that may arise from you. It is important that you do the same so you do not miss any pertinent information from us.

### 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

The schedule of holidays for the current calendar year may be found under the Student Services menu at [www.portagelearning.com](http://www.portagelearning.com)

**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.



This is a classroom; therefore, instructors have the academic freedom to set forth policy for their respective class. Instructors send a welcome e-mail detailing the policy of their class, which students are required to read prior to beginning the course.

**Grievances:** If a student has a complaint about the course, the student is advised to first consult the instructor of the course. After communicating with the instructor, if the matter is still unresolved, students may file a formal grievance for consideration by the Academic Review Committee. The process must be initiated via written communication to [academics@portagelearning.com](mailto:academics@portagelearning.com), with "Academic Grievance" listed in the subject line of the email.

**Remediation:** At Portage Learning we allow a "one-time" only opportunity to re-take an alternate version of **one** module exam AND **one** lab 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 regarding the material by reviewing both the old exam and the lesson module material. 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.

**Note:** Exams on which a student has been penalized for a violation of the academic integrity policy may not be re-taken.

Syllabi are subject to change as part of ongoing educational review practices. Students are responsible for accessing and using the most recent version of the course syllabus.

