CHEM 210 Biochemistry

3 credits

Prerequisites: General biology and chemistry (recommended but not required)

Instructors: Rodney Austin, PhD
Heather Dorman, PhD
Kenneth Hartman, PhD
H. Elaine Frey, MHA
Kathy Austin, MEd
Jessica Schiren, MS, MEd

Contact Information: Faculty may be contacted through the Portage messaging system

Additional Information: www.portagelearning.com*

Course meeting times: CHEM 210 is offered continuously

Course Description: An introduction to the fundamentals of biochemistry covering biomolecules and metabolism. Chemical and cellular foundations are explored including cell organization, organic chemistry, and aqueous systems. The structure and function of biomolecules, including amino acids, proteins, carbohydrates, lipids, and nucleic acids, are examined. Finally, the metabolism and energy transformation of biomolecules is covered.

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

- Explain the elemental composition of biomolecules.
- Describe and articulate the biochemical role that carbon holds in biological organisms.
- Explain the importance of water, including its chemical and physical properties, for sustaining life.
- Classify and differentiate between the types of macromolecules found in nature.
- List the functions of proteins, carbohydrates, lipids, and nucleic acids in the cell.
- Recognize the essential properties and functions of the cellular membrane.
- Describe the biochemical processes surrounding energy flow, production, and storage in the cell.
- Discuss the significant metabolic pathways used for energy production.

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

* Portage Learning college courses are offered by Geneva College, which is regionally 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 platform.

Each of these CHEM 210 student learning outcomes is measured:

Directly by: (1) Module application problems (with instructor feedback)
(2) Module Exams
(3) 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 40 - 50 hours of reviewed module assignments with instructor feedback and 8 contact hours of secure online module exams.

Course Progression: It is the policy for all Portage Learning courses that only one module (lecture) 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 21 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.

Module Review Questions: 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 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 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 Canvas messaging system (see Inbox icon).

NOTE: Module review questions are not an option or a choice; *they are required*. This means that you must complete all the review questions within the modules. Not only are review questions class participation, they are the best way to prepare for the exams. **Instructors have the option to either not grade your exams**

until these are completed, or to deduct points from the related exam if blank modules are repeatedly submitted.

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. **Students may not reference or use outside materials from any source, including their own notes or drafts in a word processing document. Additionally, as we are required to evaluate the mastery of the material presented in this course, the use of content/processes/methods from a previous course will be considered as the use of an outside resource.** It is necessary to show all your work on exams.

A violation of the academic integrity policy will result in a *10 point deduction **per** question* for the first offense, a *"0" on the entire exam* for the second offense, and *possible expulsion from the course* following review by the instructor in consultation with an administrative-instructional committee for the third offense.

If students have questions about this policy, they should contact their instructor. Failure to understand this policy regarding violations of academic integrity will not excuse any student from its consequences. In the enforcement of the policy, **no notification is required between occurrences**. If three occurrences are found in your course prior to your instructor grading your work, each occurrence will be treated as an individual case, and the enforcement will apply as shown above.

For example: If you take two exams before your instructor has time to review your work and there are violations on both exams, you will receive a 10 point deduction per question involved in the first exam, and a zero for the second exam. If you have any question about the work you submitted, we recommend that you wait until your instructor has had time to grade your exam prior to taking another one.

Review the Student Handbook for more specifics. If you have any questions regarding the academic integrity policy, please consult your instructor **prior** to taking module exam 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. **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. It is recommended to also have

the latest version of Flash installed as a browser plugin as some sections of the course may require it. 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:

- System requirements: https://community.canvaslms.com/docs/DOC-10721-67952720328
- Browser requirements: https://community.canvaslms.com/docs/DOC-10720
- Respondus requirements: https://web.respondus.com/he/lockdownbrowser/resources/

Module & Lab Topics:

Module 1: In this module, the field of biochemistry and the fantastic molecules that permits life is introduced. Molecules, such as Vitamin C, hemoglobin, and insulin, are introduced and shown to give organisms specific characteristics. An overview of the organization (monomer, oligomer, and polymers) found in the molecules of life is presented. Furthermore, the point that all biomolecules are made up of the elements from the periodic table made. Elements, including C, H, O, N, S and some metals, combine in a variety of ways to make up the molecules that enables life. The element carbon is especially crucial for life due to its unique bonding patterns. The focus on carbon flows to an introduction of organic chemistry topics.

Module 2: In this module, the topic of water, its properties, and buffers are introduced. The fundamental properties of water, including its molecular shape and unique physical features, such as high H-bonding ability, high boiling point, and solubilizing ability are covered. These unique properties are related to common phenomena like water beading up on a waxed surface and a drink coaster "sticking" to a wet glass. Also, the ability of water to solubilize buffers systems such as phosphate and bicarbonate is covered. Buffered systems will be included in some detail bringing in pH, Ka, and pK_a calculations. As a connection to the health fields, blood buffering and the renal system is presented.

Module 3: This module covers amino acids, peptides, and proteins. The 20 standard amino acids, the peptide bond, levels of protein structure, and structure-function of proteins are all covered. Common proteins such as insulin, hemoglobin, and glucagon are covered to connect the course to common health issues. The secondary structure of proteins, alpha helices, beta sheets, and beta turns are discussed with some details of their arrangements. A protein's tertiary and quaternary levels of structure will be discussed; myoglobin and hemoglobin will serve as examples.

Module 4: The structures of carbohydrates, their structures, and functions are covered in this module. The module begins with the different functions of carbohydrates, such as energy and structure, in the natural world. Then, the mono-, oligo-, and polysaccharide molecules are introduced. Hexoses, including glucose, is covered with the numbering of carbons and the ring structure of hexoses. Finally, the descriptive, structural terms, such as anomers and epimers will be discussed are presented.

Module 5: This module covers lipids using the functional definition: a lipid is a carbon compound that dissolves in non-polar solvents. The five common classes of lipids: fatty acids, triacylglycerols, phospholipids, sphingolipids, and sterols are covered in detail. The basic structure and function of each type are presented. The relationship between composition and naming is introduced using the standard and omega systems. Additionally, the composition and structure of cellular membranes is discussed. The functionalities of phospholipids and cholesterol within the membrane are introduced. Proteins, solubilized by the lipids of the membrane and how they contribute a variety of functions such as transporters and receptors, is also reviewed. The general structure of membrane components, their functions and overall properties will be introduced (fluidity, mosaic, organization).

Module 6: The structure and function of nucleic acids, RNA, and DNA are presented in this module. The presentation of information starts with the structure of the standard bases, including structures of pentose and bases. The structures unique to DNA and RNA are explored, along with their particular functions. Finally, formation and properties of the RNA and DNA polymers are presented.

Module 7: The metabolic terminology such as flux, regulation, and control is introduced. An overview of the metabolic pathways of glycolysis and fatty acid are covered in detail. These pathways will be shown to lead to the electron transport chain, the primary energy production site whereby the biochemical processes are described in detail. A systematic evaluation of the citric acid cycle, fatty acid oxidation, breakdown byproducts and medium-chain fatty acid oxidation mutation pathways will be covered in detail.

Module 8: The goal of this module is to highlight the importance of the N handling by the body and the production of ATP by the mitochondrion. The reactions of the nitrogen-processing urea cycle are introduced along with the compartmentalization of the reactions. The connection of the carbon oxidation of amino acids will be covered but in no depth. The general scheme of funneling electrons and protons through the electron transport chain, which results in ATP

production by ATP synthase are presented. The importance of the chemiosmotic theory and ATP are included.

Grading Rubric:

Check for Understanding =	1 pt.
8 Module exams = 100 points each x 8 =	800 pts.
Final exam = 120 pts.	120 pts.
Total	921 pts.

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

Grading Scale:

89.5% - 100% (825 - 921 pts)	= A
79.5% - 89.49% (733 – 824 pts)	= B
69.5% - 79.49% (641 – 732 pts)	= C
59.5% - 69.49% (547 – 640 pts)	= D
< 59.49% (< 546 pts)	= 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.

Textbook (online):

Ahern, K.; Rajagopal, I. Book: Biochemistry Free & Easy (Ahern and Rajagopal) https://bio.libretexts.org/TextMaps/Biochemistry/Book:_Biochemistry_Free_and_Easy_(Ahern_and_Rajagopal) (accessed Oct 10, 2018).

Paper Models:

PDB101: Learn: Paper Models http://pdb101.rcsb.org/learn/paper-models (accessed Oct 10, 2018).

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. 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
Memorial Day
Labor Day
Christmas Break
Easter
Independence Day
Thanksgiving weekend

The schedule of holidays for the current calendar year may be found under the Student Services menu at 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; see the Student Handbook for further details.

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 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, contact the Academic Review Committee of Portage Learning

for further consideration. 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 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.