

Biochemistry

Fall 2023

Course - CHEM 401.D5

Credit Hours - 3

Days - MW

Instructor - Dr. Engle

Phone - 814-886-6552

Office Hours - M 12:30-1, T 12-2, W 9-10, 12:30-1,
R 9-10, 12-2, F 9-10

Prerequisites - CHEM 301

Room - 212 Pierce Hall

Times - 2:00-3:15

Office - 211 Pierce Hall

Email - JEngle@mtaloy.edu

Web page - www.DrEngle.net

Text - J.L. Tymoczko, J.M. Berg, G.J. Gatto, and L. Stryer. 2019. Biochemistry: A Short Course 4th ed. W.H. Freeman and Co. New York. 851 pages. ISBN 978-1-319-11463-3

Course description - A one semester lecture course which provides an introduction to the structure, properties, reactions, and metabolism of biomolecules.

Grading:

Exams - Exams will be given in lecture following each major section see below. Exams will consist of multiple choice (like on grad. & professional program entrance exams) and essay questions. If you have to miss an exam, it is your responsibility to contact the instructor prior to the exam and explain your absence.

At the end of the first week, there will be a quiz on chapters 1 and 2 which will not be covered in lecture. Students are responsible for the content of chapters 1 and 2 on their own. Questions may be asked of the instructor at any time.

Research Paper - A student written paper describing a published research article is required.

The research article must be approved by the instructor by - **11 September**. Student presentation due date - **To Be Determined**. The presentation is worth 70 points. See below for the detailed requirements.

Grading Scale

A = 100-92% B+ = 91-88% B = 87-83% C+ = 82-79% C = 78-74% D = 73-65% F = 64-0%

Other grades (E, W, WP, WF) will be assigned as described in the College Catalog.

Additional Resources:

Alberts, B., et al. 2007. Molecular Biology of the Cell 5th ed. Garland Science NY. 1392pp.

Cooper, G.M. & Hausman, R.E. 2006. The Cell: A Molecular Approach 4th ed. Sinauer Associates, Inc. 745pp.

Garrett, R.H. & C. M. Grisham. 2010. Biochemistry 4th ed. Brooks/Cole Boston, MA. 1059pp.

Hames, B.D. 2005. Biochemistry Taylor & Francis 438pp. QP518.3 .H355 2005

Hancock, J.T. 2005. Cell Signaling 2nd ed. Oxford University Press, USA. 316pp.

Harding, J.J. & Crabbe, M.J.C. 1991. Post-translational Modifications of Proteins. CRC. 270pp.

Horton, R.H. et al. 2006. Principles of Biochemistry 4th ed. Pearson/Prentice Hall, Upper Saddle River, NJ 852pp.

Leskovic, V. 2003. Comprehensive enzyme kinetics. Kluwer Academic/Plenum Pub. 438pp. QP601.3 .L47 2003 EB

Lodish, H. et al. 2013. Molecular Cell Biology 7th ed. W.H. Freeman and Company, NY. 1154pp.

Martin, B.L. et al. 1994. Co-And Post-Translational Modification of Proteins: Chemical Principles and Biological Effects. Oxford University Press, USA.

Mayer, R.J. ed. 2006. Protein Degradation: The Ubiquitin-Proteasome System (Protein Degradation). Wiley-VCH. 300pp.

Nelson, D.L. & M.M. Cox. 2013. Lehninger: Principles of Biochemistry 6th ed. W.H. Freeman Co. 1198pp.

Taylor, K.B. 2002. Enzyme kinetics and mechanisms. Kluwer Academic Pub. 227pp. QP601.3 .T39 2002 EB

Voet, D. et al. 2008. Fundamentals of Biochemistry: Life at the molecular level. John Wiley & Sons, Inc. 1099pp.

Whitford, D. 2005. Proteins: structure and function. J. Wiley & Sons. 528pp. QP551 .W535 2005 EB.

In addition to the above policies and procedures, the instructor reserves the right to alter, augment, or delete from existing policies if in so doing the proper atmosphere for teaching and learning is maintained. All such policy changes will be announced.

Course Outline & Learning Objectives:

Buffers - Concept, Physiological buffers, Location and function, Quantitative expression
Define biochemistry; Explain the importance and uniqueness of water;
Explain how buffers stabilize pH

Amino acids - Side group structure and function, Nutritional aspects, & Titration
Describe amino acid structure and group classifications; Explain PKU;
Draw and annotate a titration curve; Define isoelectric point (pI)

Exam 1

Proteins - Biological function, Globular proteins
Describe all four levels of protein structure; List protein prosthetic groups

Enzymes - Physical properties
Detail the functioning of enzymes; Explain allosteric feedback
List the enzyme classes;

Enzyme Kinetics and Regulation
Explain the difference between first and zero order kinetics
Describe the enzyme substrate complex
Detail the Michaelis-Menten Equation
Draw and annotate the Lineweaver-Burk plot
Contrast the different types of inhibition

Exam 2

Bioenergetics - Redox and High energy compounds
Detail Gibbs free energy
Contrast enthalpy and entropy; Explain ΔG in light of pathways

Glycolysis - Glucose to pyruvate
Detail each step in glycolysis including the enzyme involved and the product;
State which reactions are irreversible in the pathway; List the energy input and outputs
Explain starch catalysis; Detail the entry of other monosaccharides into glycolysis
Describe fermentation and why it is necessary

Exam 3

Krebs cycle
Detail each step in the Krebs cycle including enzyme names and products
List each step energy is released and in what form

Electron Transport Chain
Explain proton motive force; Detail each of the four complexes of the pathway
Describe the structure and function of complex V
Trace the electron pathway through ATP synthase

Mitochondrial Shuttles
Detail the malate-aspartate shuttle and the glycerol 3-phosphate shuttle
Total the ATP generated per glucose from the respiratory pathways

Exam 4

Gluconeogenesis
Define gluconeogenesis along with its necessity, energy requirements, and controls
List the three crucial steps in gluconeogenesis
List precursors to gluconeogenesis

Lipids

Describe the structure of lipids; Explain how lipids are digested and transported
Contrast the differences between VLDL, LDL, and HDL; Detail fatty acid oxidation
Explain how unsaturated fatty acid oxidation differs from saturated fatty acid oxidation
Explain how odd numbered fatty acids are oxidized
Describe ketone bodies

Exam 5

If time permits we will cover additional topics like:

Prostaglandins, hormonal & allosteric regulation of Metabolism in liver, muscle, adipose, & brain tissue; or topics the class would like to cover.

Text book references are not provided on purpose. By this time students should be able to find topics in a text book on their own, that is what the table of contents and the index are for.

It is assumed that you are studying the text book as well the lecture material. As a result, you will be responsible for the material in the text book that corresponds to the topics listed in the course outline.

Biochemistry Presentation Rubric - *Dissection of a Scientific Paper*

Topic - Students will choose one recent (in the last ten years) peer reviewed journal article in the primary research (**not a review**) that focuses on a molecular or cellular system. The journal article should include 5 - 10 tables/figures. All articles must be pre-approved by the instructor.

General Requirements:

Student presentations should describe/summarize a research article in detail.

Content Outline:

Title - The first slide should include: your name, the chosen article title, the article authors, and its reference (where and when it was published).

Introduction - First start your presentation with an introduction. In the introduction, you need to educate the reader on what is known and what is not known. In other words, explain the background of the research.

Thesis - Your introduction should end with the thesis of the research article. In other words, with as few words as possible, state the question the research is attempting to answer.

Experimentation - Next you want to detail the research that was reported. The presentation should be experiment focused and not figure focused. For example, do not reference figures or tables in your presentation. Instead, state what question the researchers were answering. Then explain the experiment they conducted to answer the question. (Note - the methods should accompany the experiment and not be a separate section.) Next, explain the reported results / figure in detail. Finally relate how the data answers the question. You will have to repeat this procedure for each experiment. The bottom line is you want to tell a story. One experiment should lead to the next experiment.

Conclusion - Lastly the presentation should include a detailed section describing the significance of the paper. (Why was the work worth doing?) This last section should also include your evaluation of the results. This section should also contain (if applicable) why or why not the data is supported by other researchers. Finally end with if the results support or refute the hypothesis (thesis) and how strong the evidence is.

Note - Please be very careful to use your own words, not those of others. Do not quote any writings word-for-word from either your paper or any other work you cite. If you have any doubt about what would be appropriate vs. inappropriate paraphrasing, please see your instructor before turning in your paper. Also note: research never proves anything. Results only *suggest*.

Grading:

Point distribution: 10 points for the introduction
 5 points for your thesis
 30 points for the experimental portion of the paper.
 10 points for the conclusion
 15 points for grammar, spelling, and following directions.

Practice your presentation prior to presenting it to the class.

MAC Policies

Weather Delays and Compressed Schedule

In the event of a delayed opening, MAC will follow a compressed schedule. This will provide students with the opportunity to attend all scheduled classes on delay days with each class meeting for a shorter than usual session. For the Compressed Schedule for delay days, go to the following link: <http://www.mtaloy.edu/delays-cancelations>

Technology and Communication Assistance Statement

All students are expected to regularly log in to the Canvas course website. The site contains the syllabus and assignments, and supplementary materials will be placed there on a regular basis. Furthermore, important announcements will be posted on the site (especially if a class period is canceled due to weather, illness, etc.). For assistance in using Canvas, please contact the Canvas administrator at (Canvas@mtaloy.edu).

College offices and instructors often communicate important information through the MAC email system. Students should check their school email account regularly. For technical or log-in credential questions, please contact the help desk at (helpdesk@mtaloy.edu or 814-886-6502).

College Academic Integrity Statement

Mount Aloysius College is committed to the academic integrity of the entire community. All share responsibility for maintaining high standards of academic integrity, and no forms of academic dishonesty are tolerated. Forms of academic dishonesty include but are not restricted to: giving or receiving unauthorized assistance on an examination, project, or assignment; using unauthorized forms of assistance such as crib notes or cell phones on an examination; falsification of data or plagiarism (using another person's ideas or words as your own); and lying or falsifying reasons for missing examinations or class.

A student found guilty of lying, cheating, or plagiarism, depending on the nature of the offense and the history of the student, is usually subject to one or both of the following: a grade of zero on the assignment, project, or examination or a grade of F in the course. All cases of lying, cheating, or plagiarism where a punishment is incurred are reported to the Senior Vice President of Academic Affairs, who maintains a record of all offenses. Serial offenders may be subject to suspension or dismissal.

College Accommodations Statement

Mount Aloysius College is committed to providing reasonable accommodations to students with disabilities. Students with disabilities who wish to request an accommodation are required to contact Michele Leamer, Office Manager, Student Health and Wellness Center (MLeamer@mtaloy.edu or 814-886-6515) to formally request accommodations and provide supporting documentation. If you receive approval for accommodations, it is important that you stop in at the start of the semester so necessary arrangements can be made.

Attendance Policy

Attendance at all lecture and lab sessions is mandatory. It is your responsibility to notify the instructor **prior** to missing an exam or laboratory and you must have a valid reason. The instructor reserves the right to judge the validity of the excuse. If you miss an exam, you are responsible for taking the exam within one week of your return. There are no makeup labs unless you are able to come to another section during the same week and obtain instructor permission. *Failure of the student to follow the steps outlined above will result in a grade of "0" for the missed exam or lab!*

Conflict Resolution

Should a student encounter difficulty with course content or other aspects of the course, the first action should be to make an appointment to speak with the instructor. The instructor may suggest resources on campus or other tips to assist student learning. If a student has concerns with their instructor, then the best course of action is to seek out a meeting with the Science and Math Department Chair, Dr. John Whitlock, 814-886-6536, JWhitlock@mtaloy.edu. to discuss the difficulties. If an agreeable decision is not reached, the student should then request a meeting with the Dean, Dr. Chris Lovett, 814-886-6458, CLovett@mtaloy.edu. The Faculty, Department Chairs, and Deans are committed to treating all students with respect and fairness. Additional information is outlined in the academic grievance policy in the College catalog.

Title IX: Confidentiality and Responsible Employee Statement

Mount Aloysius College faculty are committed to creating a safe learning environment for all members of our community, free from gender and sex-based discrimination, including sexual harassment, domestic and dating violence, sexual assault, and stalking, in accordance with Title IX of the Education Amendments of 1972.

Please note that the Title IX and Sexual Misconduct Policy designates all faculty members, including teaching assistants, as "Responsible Employees." Under Mount Aloysius College's policy, all "Responsible Employees" must report all disclosures of sex or gender-based discrimination or violence to Mount Aloysius' Title IX Coordinator, Dr. Robin Gore, Vice President for Student Affairs, rgore@mtaloy.edu or 814-886-6426. The Title IX Coordinator will reach out to provide resources, support, and information after receiving a report, but community members are not required to respond to such outreach. Reported information will remain private.

If you have (or someone you know has) experienced any form of sex or gender-based discrimination or violence and wish to speak with someone *confidentially*, please contact one of our counselors at counseling@mtaloy.edu or call 814-886-6515. For more information regarding Mount Aloysius College's Title IX procedures, reporting, or support measures, please visit sites.google.com/mtaloy.edu/titleix/home.

Disclosures of gender and sex-based discrimination or violence made in relation to an assignment and/or educational prompt will not result in a referral to Mount Aloysius College's Title IX Coordinator unless requested otherwise.