Course Description

Chemistry 327 is the second semester course in biochemistry. The major focus is to understand the chemistry behind the function of biological compounds involved in cellular processes. Specific topics include enzyme mechanisms and energetics, membrane dynamics, replication, transcription, protein translation, and signal transduction. Additionally, metabolism of lipids, amino acids, and nucleotides is studied in detail. (3 hrs lecture/3 hrs lab)

Prerequisite: CHEM326 (C- or higher)

Materials and Supplies

- D2L course access (Millersville University)
- Sapling access (available online)
- Laboratory Background & Protocols (available in D2L)
- Laboratory Notebook: permanently-bound composition notebook

Course objectives:

After completing this course, students actively engaging in the learning process should:

- Integrate chemical characteristics of a wide range of biochemical molecules with their biological relevance
- Connect protein structure, chemical mechanisms, and energetics to enzyme function
- Recognize biosynthetic pathways and metabolism for amino acids, proteins, nucleotides, nucleic acids, and lipids
- Describe chemistry relevant to nucleic acid structure, function, and processing
- Describe cellular transport and signal transduction processes and the relevance of dynamic membrane structures
- Read and evaluate published primary research in biochemistry
- Develop advanced laboratory skills and apply relevant biochemical principles for understanding and troubleshooting work in the biochemistry lab
- Record and analyze biochemical data accurately and effectively
Course Policies

Class Attendance: Students are responsible for material presented in class or distributed via D2L or MU e-mail. Only work missed for an absence excused based on Millersville’s approved guidelines may be made up. Any exam conducted outside the scheduled time may differ significantly in form and content from the in-class exam, including an oral portion.

Academic Honesty: Students are expected to conduct all course work in an honest and ethical manner, consistent with Millersville’s policy. Cheating on coursework bypasses the learning process and will NOT be tolerated. Anyone caught cheating will be assigned a score of zero on the work. Students should also avoid plagiarism of text or ideas in any coursework.

Cooperative Environment: Students are expected to be actively engaged in the classroom and lab, so questions and comments are encouraged. Please feel free to approach me with any special concerns you have. Additional resources are available in the Office of Learning Services and Tutoring Center. The safe and productive educational environment for this class includes compliance with Title IX as outlined in Millersville’s policy.

Homework: Mastery of chemical principles is developed through practice. In addition to the textbook, opportunities for students to interact with course content will be available online through Sapling. This will include required homework problems. Students are encouraged to use any Sapling resources that are helpful to their learning. Assignments will be due every couple weeks as announced.

Topic Articles: Students will identify and read primary research articles on topics related to material covered in class. Articles should be printed in hard copy and annotated with highlights of key information, comments interpreting the results and figures, questions, and ties to class material. One paper will be submitted before the beginning of the class following each exam.

Laboratory: Laboratory provides a place where learning is enhanced by application. Planned projects allow deeper exploration into functions of biological molecules. Students must complete every experiment. Please keep me informed of any special needs you have for completing lab requirements, and contact me immediately if you have an excused absence that conflicts with your scheduled work. Students are expected to respect and follow all safety instructions given in lab. Please notify me if you have any special circumstances (like allergies or pregnancy) that might require alternate experimental arrangements for you to safely work in lab.

Poster: Each lab pair will research, prepare, and present a poster about a pharmaceutical drug that regulates an enzymatic function related to a disease. Each poster should include general information, drug structure, diagram of the relevant biological pathway, and a protein model the students generate from a published crystal structure, highlighting the relevant protein-drug interactions. Detailed instructions, a template, and resources are available in D2L.

Grading

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Homework &amp; Learning Activities</th>
<th>6 %</th>
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<tbody>
<tr>
<td>Topic Articles</td>
<td>6 %</td>
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<tr>
<td>Poster</td>
<td>6 %</td>
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<tr>
<td>Exams</td>
<td>45 %</td>
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<td>Final</td>
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<tr>
<td>Lab</td>
<td>Notebook/Reports/Worksheets</td>
<td>22 %</td>
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NOTE: You must earn at least 60% in the lecture portion to pass Chem327. Your final grade will be assigned based on combined lecture and lab scores.

Letter Grade Correlation

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<th>Grade</th>
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<tbody>
<tr>
<td>A</td>
<td>93.0 -</td>
<td>100.0</td>
<td>A-</td>
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<tr>
<td>B+</td>
<td>87.0 -</td>
<td>89.9</td>
<td>B-</td>
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<tr>
<td>B</td>
<td>83.0 -</td>
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<td>C-</td>
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<td>C+</td>
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<td>C</td>
<td>73.0 -</td>
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Lecture Schedule (tentative)

**Chemistry of Amino Acids & Enzymes**
- Enzyme Mechanisms, Regulation & Movement, & Amino Acid Metabolism
  - Chapters: 6, 5, 22, 18
- Exam 1: Tues, Feb 19
- Topic 1: Thur, Feb 21

**Chemistry of Nucleotides & Nucleic Acids**
- Nucleotide & Nucleic Acid Metabolism, Replication, Transcription & Translation
  - Chapters: 25, 26, 27
- Exam 2: Thur, Mar 28
- Topic 2: Tues, Apr 2

**Chemistry of Lipids & Membranes**
- Membranes, Transport Mechanisms, Lipid Metabolism & Signal Transduction
  - Chapters: 17, 21, 11, 12
- Exam 3: Tues, Apr 30
- Topic 3: Thur, May 2

**FINAL**: Wed, May 8 at 2:45 pm
- Comprehensive final over the semester

Test Schedule (tentative)

**Chemistry of Amino Acids & Enzymes**
- Enzyme Mechanisms, Regulation & Movement, & Amino Acid Metabolism
  - Chapters: 6, 5, 22, 18

Laboratory Schedule (tentative)

<table>
<thead>
<tr>
<th>Jan 23 &amp; 30</th>
<th>Protein Isolation and Stability (Due: Feb 6)</th>
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<tr>
<td>Feb 6</td>
<td>Protein Modeling Activity &amp; Poster Topic Selection</td>
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<td>Feb 13 - Mar 6</td>
<td>Enzyme Purification, Activity &amp; Electrophoresis (Due: noon, Mar 8)</td>
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<td>Mar 13</td>
<td>No Lab: Spring Break</td>
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<td>Mar 20</td>
<td>Bioinformatics Activity &amp; Poster Work (draft submitted by end of lab)</td>
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<td>Mar 27</td>
<td>Combinatorial Chemistry &amp; Antibiotic Response (Due: Apr 3)</td>
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<td>Apr 3 &amp; 10</td>
<td>PCR &amp; DNA Electrophoresis (Due: Apr 17)</td>
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<td>Apr 16 (time TBA)</td>
<td>Made in Millersville: display in library (Poster Due: noon, Apr 12)</td>
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<td>Apr 17 &amp; 24</td>
<td>Lipid &amp; Cholesterol Analysis (Due: May 1)</td>
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<td>May 1</td>
<td>Poster Session 3rd floor hallway</td>
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Computer-based lab activities do not need to be included in the lab notebook. Specific assignments will be described within the material for the activity and are due by the end of the lab period.

Laboratory Policies

- Students are expected to access lab information via D2L. This will provide a mechanism for contact and distribution of information or representative data if necessary.
- Students are expected to respect and follow all safety instructions given in lab.
- Please notify me if you have any special circumstances (allergies, sensitivities or pregnancy) that might require alternate lab arrangements in Chem327.
- Occasionally, advanced laboratory work in biochemistry does not produce the expected results. Students are expected to engage in learning relevant troubleshooting as well as concepts behind the experiment.
Lab Evaluation:

Purpose/Pre-Lab Questions (5 pts):

Instructions are formatted to allow you to tape them directly into your notebook for use. For each experiment we undertake, students are expected to review the background information and write a short statement of the overall purpose in their notebook. This should include information regarding what biological property or system will be studied and the methods used for the investigation. You should also answer any pre-lab questions listed in the lab instructions.

Lab Notes/Data Record (15 pts):

Students will work in pairs to complete lab work and analyze data. However, each student should maintain an independent data notebook. Laboratory notebooks provide an official record of the rationale, procedures, observations, data collected and interpretations relating to scientific research. Every scientist should keep accurate and complete records as documentation of their research. You should record key experimental information and all primary data directly into your notebook so that you have everything needed for understanding your work and doing any required analysis. This information does not have to be neat but should be clearly labeled.

Data Analysis/Lab Summary (10 pts):

Graphs or printed tables produced from your data should be taped flat, fit on one page and have a descriptive title. When using linear regression analysis, both the equation of the line and the $R^2$ value should be displayed. Printed data tables are needed only if they show analyzed results beyond the primary data recorded by hand during the lab. You also need to clearly show an example of all calculations used for data analysis, including any data manipulations made in Excel worksheets.

Your notebook should also summarize your work, interpret the data collected in lab and communicate your understanding of the methods used. You may opt to include several smaller summaries related to different aspects of an overall project. However, you should ultimately include an overall summary that explains the connections among the experimental parts.

The summary is also where you should note any problems that may have been encountered during experimentation and explain the impact they may have had on your final results or interpretation.

Lab Submission

Most experiments will involve work over more than one week. Your lab notebook will generally be submitted in lab the week following the completion of the lab work for a given experiment.

There will be a daily 10% penalty for submission of late lab notebooks unless previously approved.