



BMED 601
CELL & MOLECULAR PHYSIOLOGY
FALL 2019 SEMESTER
11:00 AM-1:15 PM TUESDAY AND THURSDAY
ROOM 134, KATHERINE JOHNSON HALL

An email from a recent BMED grad:

Hi Professor! My name is Jessica and I was a student of GeorgeSquared from 2017-2018. I am currently a first year medical student at Howard University. Although we are early in our semester, I have found the foundation of biochemistry I learned while in your class has truly helped me understand and digest the large amount of information being thrown at me thus far. I was just reaching out to say thank you! I thoroughly enjoyed your class and have found much of what you taught has stuck with me.

Best,

Jessica Andre

Instructor: Dr. Robin Couch; rcouch@gmu.edu; 703-993-4770; room 2023 in the Institute for Advanced Biomedical Research building, located on the GMU Prince William Science and Technology campus.

Instructor Bio: Proteins and small molecule metabolites are typically the primary focus of the drug discovery pipeline, and as such Dr. Couch spent the early stages of his research career aimed at mastering the skills necessary for their purification and characterization. In 2000, Dr. Couch received a Ph.D. in Biochemistry from the University of Calgary, Canada, where his graduate research focused on using chemical and genetic means to rationally eliminate the production of unwanted metabolites from the fungal fermentation of lovastatin, an anticholesterol drug. After receiving his doctorate, Dr. Couch joined the laboratory of Dr. Ronald Parry at Rice University, located in Houston Texas. As a postdoc in the Parry lab from 2000-2003, Dr. Couch employed column chromatography to purify several phytopathogenic bacterial proteins and carried out subsequent detailed enzymological investigations to determine their substrate specificity. Dr. Couch then joined the laboratory of Dr. Amy Anderson as a postdoc in 2003, and spent the next three years at Dartmouth College using a combination of immunofluorescent microscopy with cultured human lymphoma cells, affinity column chromatography, proteomics (LC-MS/MS), and protein binding studies to conclusively illustrate that the mechanism of action of a semi-synthetic cancer chemotherapeutic known as CDDO involves binding to tubulin, thereby disrupting its ability to polymerize and causing cells to undergo apoptosis. Dr. Couch joined George Mason University in 2006, and is now an Associate Professor in the Chemistry and Biochemistry Department and Adjunct Associate Professor at Georgetown University. Ongoing areas of research include gastrointestinal disease, Alzheimer's disease, and infectious disease. Dr. Couch currently serves as an Editorial Board member for the Journal of Chromatography and Separation Techniques and the journal Advances in Alzheimer's Disease.

Office Hours: Monday 9-10 am; other times by appointment



Class Webpage: Available on Blackboard via myMason (<https://mymasonportal.gmu.edu>), under the Courses tab.

Required Course Materials:

Required Textbook: *Lehninger Principles of Biochemistry, Nelson & Cox, 5th edition* (or later)



Lecture notes will be provided as pdf files via Blackboard (alternative file formats are not available).

Methods of Evaluation:

Student progress will be evaluated by **four examinations**. The exams are entirely multiple choice and focus on the material presented in the lecture notes, handouts, and assigned textbook chapters. The **midterm exams** will be administered **during the normal class period**, whereas the **final exam** is scheduled by the registrar and is held **outside of the normally scheduled class period** (see schedule below for exam dates). Course components are weighted as follows to calculate the final course grade:

- 1) **Three midterm exams (5 %, 30 %, and 30 %, respectively).**
- 2) **The final exam (35 %).**

Missed Exams:

a) Midterm Exams – Per Mason policy, it is the obligation of students to provide faculty, **within the first two weeks of the semester**, with the dates of major religious holidays on which they will be absent, and/or the dates for which they are requesting an excused absence for participation in any **university-sponsored activity** scheduled prior to the start of the semester. Students requesting an excused absence for participation in a university-sponsored activity must provide their instructor with a letter from a university official stating the dates and times that participation in the activity would result in the student missing class.

Examinations missed due to illness require a signed, third party, and verifiable documentation of illness from a licensed physician, on official letterhead from the physician's office.

There is no opportunity to write a missed midterm exam. An unexcused absence will result in a score of zero (0) for the missed examination. With an excused absence, the weight of the missed midterm exam will be added to the next exam. Hence, **with an excused absence**, the second midterm exam will be weighted as 35% of the total grade if the first midterm was missed; the third midterm exam will be weighted as 60% of the total grade if the second midterm is missed; the final exam will be weighted as 65% of the total grade if the third midterm is missed. If more than one midterm exam is missed, the student will receive a grade of F in the course.



b) Final Exam - Per Mason policy, **absences from final exams will not be excused by the instructor except for sickness on the day of the exam.** Signed, third party, verifiable documentation of illness from a licensed physician, on official letterhead from the physician's office, is absolutely required. You must be deemed by a physician to be physically unable to write the exam. **Per the policy, failure to provide satisfactory, verifiable documentation of illness will result in a grade of F for the entire course.**

The final exam date is scheduled by the registrar. All BMED 601 students are expected to attend the scheduled exam. **Accommodations will not be made for requests for an alternative date or time to write the midterm or final exams.**

Tentative Grading Scale:

95-100	A+
90-94	A
85-89	A-
77-84	B+
70-76	B
62-69	B-
50-61	C
<50	F

It remains possible that the scale for this semester may be altered slightly due to changes in exam difficulty, etc; you will be informed of any changes.

Course Description:

This is a four-credit biochemistry course that examines the molecular mechanisms that underlie cell and organ function. The course is divided into four sections. **The first section** provides an introduction to understanding protein function and lays the conceptual foundation for our studies of intermediary metabolism. Much of this section involves an examination of protein structure and enzymology and how protein structures contribute to protein function. Particular attention is given to understanding the kinetics and function of enzymes and other physiologically dynamic proteins, such as hemoglobin and myoglobin. **The second section** addresses the dogma central to cellular and molecular biology, namely the flow of genetic information from DNA to RNA to protein. **The third section** examines cell membranes and their components, and looks at signal transduction across these membranes. **The fourth and final section** of the course is all intermediary metabolism. This section begins with catabolic processes, those biochemical pathways that involve the breakdown of foods and the extraction of energy from proteins, carbohydrates and fats. This part also examines the thermodynamics of energy transfer from foods to chemical forms of energy used for maintaining normal physiology. The section continues with anabolic processes, those biochemical pathways that involve the biosynthesis of macromolecules from simple molecules and food derived precursors, including storage forms of carbohydrate and fat, membrane lipids, and proteins.

Academic Integrity

GMU is an Honor Code University; please see the University Catalog for a full description of the code and the honor committee process. University Catalog: <http://catalog.gmu.edu>

It is expected that students adhere to the George Mason University Honor Code as it relates to integrity regarding coursework and grades. The Honor Code reads as follows: "To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University community and with the desire for greater academic and personal achievement, we, the student members of the University



Community have set forth this: Student members of the George Mason University community pledge not to cheat, plagiarize, steal and/or lie in matters related to academic work.” Cheating includes, but is not limited to, the use of unauthorized reference materials during examinations (i.e. cheat sheets, in hardcopy or electronic format), looking at other’s exam booklets or answer sheet (scantrons) during exams, or changing answer selection on scantron sheets after examinations have been graded. More information about the Honor Code, including definitions of cheating, lying, and plagiarism, can be found at the Office of Academic Integrity website at <https://oai.gmu.edu>

The principle of academic integrity is taken very seriously and violations are treated gravely. When in doubt (of any kind) please ask for guidance and clarification. **We have had Honor Code violations that have resulted in expulsion.**

GMU Email Accounts

Mason uses electronic mail to provide official information to students. Examples include notices from the library, notices about academic standing, financial aid information, class materials, assignments, questions, and instructor feedback. Students are responsible for the content of university communication sent to their Mason e-mail account and are required to activate that account and check it regularly. Students are also expected to maintain an active and accurate mailing address in order to receive communications sent through the United States Postal Service. **Communication with students will only occur from a GMU email address to a GMU email address (not to/from Gmail or other email provider).**

Office of Disability Services

If you are a student with a disability and you need academic accommodations, please see me and contact the Office of Disability Services (ODS) at 993-2474. All academic accommodations must be arranged through the ODS. Accommodations for examinations must be requested at least 2 weeks prior to the examination date.

<http://ods.gmu.edu>

Counseling and Psychological Services (CAPS): (703) 993-2380; <http://caps.gmu.edu>

University Policies

The University Catalog, <http://catalog.gmu.edu>, is the central resource for university policies affecting student, faculty, and staff conduct in university academic affairs. Other policies are available at

<http://universitypolicy.gmu.edu/>. All members of the university community are responsible for knowing and following established policies.

Notice of Mandatory Reporting of Sexual Assault, Interpersonal Violence, and Stalking. As a faculty member, I am designated as a “Responsible Employee” and must report all disclosures of sexual assault, interpersonal violence, and stalking to Mason’s Title IX Coordinator per University Policy 1412. If you wish to speak with someone confidentially, please contact one of Mason’s confidential resources, such as the Student Support and Advocacy Center (703-380-1434; <https://ssac.gmu.edu>) or Counseling and Psychological Services (703-993-2380; <http://caps.gmu.edu>). You may also seek assistance from Mason’s Title IX Coordinator by calling 703-993-8730 or emailing cde@gmu.edu.



Suggested Textbook Problems (5th edition textbook)

As not all of the textbook questions are suitable for the objectives of this class, the following questions are those that I recommend you take a look at. **Note that these are not mandatory and will not be graded.** The course TAs are an excellent resource for discussing these questions.

<p><u>Chapter 1</u> Questions 5, 6, 7, 8, 11, 12, 14a, 14b, 14g</p> <p><u>Chapter 2</u> Questions 1, 2, 3, 4, 5, 10, 12, 13, 14, 20, 29, 30</p> <p><u>Chapter 3</u> Questions 1, 4, 6</p> <p><u>Chapter 4</u> Questions 1, 2, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14</p> <p><u>Chapter 5</u> Questions 1, 2, 3, 4, 5, 6, 7, 8</p> <p><u>Chapter 6</u> Questions 1, 3, 4, 5, 6, 7, 11, 12, 15, 18, 21, 23</p> <p><u>Chapter 7</u> Questions 1, 2, 10</p> <p><u>Chapter 8</u> Question 1</p> <p><u>Chapter 10</u> Questions 1, 2, 3, 4, 8, 9, 10, 11, 12, 14, 15, 17</p> <p><u>Chapter 11</u> Questions 4, 9, 13, 14, 15, 19</p> <p><u>Chapter 13</u> Questions 7, 12, 17, 19a, 21</p>	<p><u>Chapter 14</u> Questions 5, 8, 10, 11, 12, 13, 16, 17, 19, 21, 22, 25, 26, 27, 30</p> <p><u>Chapter 15</u> Questions 5, 6, 8, 11, 14a,c,d, 15, 16</p> <p><u>Chapter 16</u> Questions 4, 7, 12, 13, 14, 19, 22a, 28, 29, 30, 31, 34</p> <p><u>Chapter 18</u> Questions 1, 2</p> <p><u>Chapter 19</u> Questions 2, 5, 7, 9, 13, 15, 23</p> <p><u>Chapter 24</u> Questions 2, 4, 9</p> <p><u>Chapter 25</u> Questions 1, 5, 7, 11</p> <p><u>Chapter 26</u> Questions 2, 3, 4, 10</p> <p><u>Chapter 27</u> Questions 1, 2, 3, 4, 5, 8, 10, 11</p> <p><u>Chapter 28</u> Question 2</p>
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Presentation/Lecture List

SECTION 1: PROTEIN STRUCTURE AND FUNCTION

Lecture 1	Aug 27	Introduction & Overview: The Foundations of Biochemistry, Water, Molecular Interactions <i>Lehninger Chapters 1 and 2,</i>
Lecture 2	Aug 29	Protein Structure <i>Lehninger Chapter 3-3.2, Chapter 4</i>
Lecture 3	Sept 3	Structure/Function Relationships of Proteins: Myoglobin & Hemoglobin <i>Lehninger Chapter 5-5.1</i>
Lecture 4	Sept 5	Enzymes <i>Lehninger Chapter 6</i>
EXAM #1	Sept 10	<u>EXAM #1</u> (held during class; covers material from lecture 1 up to and including lecture 4)

SECTION 2: INTRODUCTION TO CELL & MOLECULAR BIOLOGY

Lecture 5	Sept 12	Nucleic acids, DNA, & Gene Structure <i>Lehninger Chapter 8-8.2; Chapter 24</i>
Lecture 6	Sept 17	DNA Replication & Repair <i>Lehninger Chapter 25.1, 25.2</i>
Lecture 7	Sept 19	Transcription & RNA Processing <i>Lehninger Chapter 26-26.2</i>
EXAM #2	Sept 24	<u>EXAM #2</u> (held during class; covers material from lecture 1 up to and including lecture 7)
Lecture 8	Sept 26	Regulation of Gene Expression <i>Lehninger Chapter 28-28.3</i>
Lecture 9	Oct 1, Oct 3	Protein Translation, Precursor Processing, Targeting, and Degradation <i>Lehninger Chapter 27</i>

SECTION 3: INTRODUCTION TO TRANSPORT AND SIGNAL TRANSDUCTION

Lecture 10	Oct 8	Lipids <i>Lehninger Chapter 10-10.2</i>
Lecture 11	Oct 10	Biological Membranes, Membrane Proteins, and Membrane Transport <i>Lehninger Chapter 11-11.3</i>
NO CLASS	Oct 15	Columbus Day Recess, no class
Lecture 12	Oct 17	Signal Transduction Part I: General features, G Protein coupled receptors, Receptor Tyrosine Kinases, and Receptor Guanylyl Cyclases. <i>Lehninger Chapter 12-12.4,</i>



Lecture 13 Oct 22 Signal Transduction Part II: Structure & Function of Ion Channels, Steroid Hormone Receptors, and Lipids as signals
Lehninger Chapter 12.6, 12.8, 10.3

SECTION 4: INTERMEDIARY METABOLISM

Lecture 14 Oct 24 Introduction to Metabolism: bioenergetics & coenzymes
Lehninger Chapter 13

EXAM #3 Oct 29 **EXAM #3 (held during class; covers lecture 8 up to and including lecture 13)**

Lecture 15 Oct 31 Carbohydrates: mono-, di- & polysaccharides
Lehninger Chapter 7-7.4

Lecture 16 Nov 5 Glycolysis and Gluconeogenesis
Lehninger Chapter 14-14.4

Lecture 17 Nov 7 Pentose Phosphate Pathway
Lehninger Chapter 14.5

The Coordinated Regulation of Glycolysis and Gluconeogenesis
Lehninger Chapter 15.3

Lecture 18 Nov 12 Citric Acid Cycle
Lehninger Chapter 16-16.3

Lecture 19 Nov 14 Part 1: Oxidative Phosphorylation: reduction potentials, electron transport, ATP formation
Lehninger Chapter 19-19.4

Lecture 19 Nov 19 Part 2: Oxidative Phosphorylation: reduction potentials, electron transport, ATP formation
Lehninger Chapter 19-19.4

Lecture 20 Nov 21 Glycogen Metabolism: hormonal control & regulation
Lehninger Chapter 15.4-15.5

Amino Acid Oxidation and the Production of Urea
Lehninger Chapter 18.1-18.2

Lecture 21 Nov 26 Lipid & Fatty Acid Metabolism: fatty acid catabolism
Lehninger Chapter 17

NO CLASS Nov 28 **Thanksgiving Recess, no class**

Lecture 22 Dec 3 Lipid & Fatty Acid Metabolism: fatty acid biosynthesis
Lehninger Chapter 21

Lecture 23 Dec 5 Integration of Metabolism: starvation & diabetes
Lehninger Chapter 23.3

FINAL Dec 11-18* **FINAL EXAM (cumulative exam covering all course material, but with emphasis on lecture 12 up to and including lecture 23)**

* Note the final exam will occur on one of the days during this exam period. The actual date and time is officially set by the registrar. You will be informed of the actual date and time once the exam schedule is made available by the registrar.