

Small 111; TR 9:30-10:50 am

Instructor:	<u>Office</u>	<u>Phone</u>	<u>Office Hours*</u>	<u>email</u>
Doug Young	ISC 2037	221-2539	T (1:00–2:30); W (10:00–11:30)	dyoung01@wm.edu

* Please note that office visitations are not necessarily restricted to these times. Additional times arranged by appointment.

Text: T. McKee & J.R. McKee, *Biochemistry: The Molecular Basis of Life*, 6th Edition, Oxford University Press. Text web address: www.oup.com/us/mckee. Supplemental Text: Berg, J.M. et al. *Biochemistry* 7th Edition. W.H. Freeman & Co. will be posted on Blackboard and a copy will be on reserve in Swem. Additional readings from the primary literature will be provided on Blackboard.

Course Goals: This course is intended for chemistry and biology majors and pre-medical students. It aims to provide a more in depth exploration of topics covered in the introductory biochemistry course. The course will act to provide a fundamental background on a variety of topics including key biomacromolecules (e.g. proteins, DNA, RNA, etc.), protein structure/function relationships, enzymatic kinetics/mechanisms, the biochemical underpinnings associated with various diseases, and bioorganic chemistry and its applications. In addition to the academic content, the course aims to strengthen written and oral communication skills, in addition to critical thinking skill and utilization of the primary literature.

Grading:

	<u>Date</u>
15% Mid-term Exam	Week of Oct 8 th
20% Final Exam	Dec 18 th 9am-11am
20% Protein Project	--
20% Disease Paper	Final Paper due Nov 20 th
15% Literature Presentation	--
10% Participation	--

Final grades will be based on the typical 10 pt scale (e.g. 100-90 = A/A-, 89-80 = B+/B/B-, etc.). If you obtain a score on this scale you will be guaranteed at least that letter grade; however, based on overall student performance, a curve MAY be instituted adjusting grades UP in an equivalent manner. **No grades will be adjusted down.**

Examinations: The exams will have (i) problems requiring numerical answers, (ii) short-answer questions, and (iii) multiple-choice questions. Both exams will be open book/readings and open note (**NOT open internet**). The mid-term exam will be the week of October 8th, and will be self-scheduled from one of several 2 hour exam blocks during that week. If you need to reschedule an exam, please contact me BEFORE the exam date. The exam will be written to be 1 hour in length; however, all students will receive 2 hours to complete the exam.

Final Exam: The final exam will be **Tuesday, Dec 18th 9:00 am – 12:00 in Small 111**. The final will **NOT** be cumulative, and will focus on the content presented after the mid-term exam.

Protein Project: Students will select a protein of choice, review its overall relevance and conduct a primary literature search to evaluate current investigations on the protein. The project will culminate in a 1 page infographic as well as a brief 2-3 min presentation. More details will be provided later in the semester.

Disease Paper: Students will select a disease of choice (preferably one with a genetic component) and conduct a primary literature search to understand the biochemical mechanisms associated with the disease or condition. The investigation will result in a 2-3* page paper summarizing the big picture context of the disease, as well as 2-3 recent publications involving the disease. In addition to the paper itself, students will participate in a peer review process of other student's papers. More details will be provided later in the semester; however the final paper should be emailed by **11:59pm Nov 20th**.

*Students enrolled in either 415W or 515 will produce a 4-6 page paper by expanding the scope of the research and the number of peer reviewed publications summarized.

Literature Presentation*: Students will be assigned in groups of 3-4 for 30-40 min presentations on a primary literature paper. Assignments will be made based on 1) topic interest, 2) presentation dates, and 3) partner preferences. The 10 primary literature papers will be provided at the beginning of the semester and topic selection will occur around the week of October 1st. More details will be provided later in the semester.

*Students enrolled in CHEM 515 will also be responsible for selecting an additional biochemically relevant article in their field of interest and submitting a 2-3 page synopsis and critical evaluation of that manuscript.

Participation: Attendance is required for full participation credit. Excused absences for university-sanctioned events must be arranged prior to the class period. One "freebie" absence will also be allowed over the course of the semester (unless additional absences are arranged through consultation with the professor and potentially the Dean of Students office due to pre-existing conditions or illness). Activities such as 1) taking notes, 2) answering questions, 3) commenting on reading assignments will contribute to the participation component. Disruptive behaviors and absences will result in lower participation grades.

Schedule:

The following is a tentative schedule for the semester and is subject to change. Bold readings indicate primary literature that will be provided prior to class.

Lecture	Topic	Reading	Due
8/30	Introduction and Water	McKee: Ch. 1 & 3	
9/4	Water/ Noncovalent Interactions DNA Structure Introduction to PyMol/ChemDraw	McKee: Ch. 3 & 17	
9/6	Protein Structure pKa values and protein function	<ul style="list-style-type: none"> • McKee: Ch. 5 • Pace, C.N. "Protein Ionizable Groups" <i>J. Biol. Chem</i>, 2009. 	Protein Project Presentation Date Selection Completed
9/11	Protein Structure Protein Folding	<ul style="list-style-type: none"> • McKee: Ch. 5 • Dobson, C. "Protein Folding and Misfolding" <i>Nature</i>, 2003. 	Disease Paper Selection Completed
9/13	Biochemical Techniques	Berg: Ch. 3	Protein Projects Begin
9/18	Biochemical Techniques	Berg: Ch. 3	
9/20	Enzyme Kinetics	McKee: Ch. 6.3	
9/25	Enzyme Catalysis	<ul style="list-style-type: none"> • McKee: Ch 6.4 • Knowles, J. "Enzyme Catalysis" <i>Nature</i>, 1991. 	Literature Presentation Selection Due
9/27	Enzyme Catalysis	McKee: Ch. 6.3	
10/2	Enzyme Inhibition Drug Development	Berg: Ch. 36	
10/4	Drug Development	Berg: Ch. 36	
10/9	Cell Signaling	Berg: Ch. 14	MID-TERM EXAM
10/11	Cancer	<ul style="list-style-type: none"> • Hanahan, D. "The Hallmarks of Cancer" <i>Cell</i>, 2000. • Collins, I. "New Approaches to Molecular Cancer Therapeutics" <i>Nat. Chem. Biol.</i> 2006. 	MID-TERM EXAM
10/16	Fall Break		
10/18	HIV and anti-virals	<ul style="list-style-type: none"> • Russell, R. "The Structure of HFN1 Avian Influenza" <i>Nature</i>, 2006. • Barre-Sinoussi, F. "Past, Present and Future: 30 Years of HIV Research" <i>Nat. Rev. Microbiol.</i> 2013. 	

10/23	Diet/Obesity/Heart Disease Introduction to Cas9/CRISPR	Kopelman, P. “Obesity as a Medical Problem” <i>Nature</i>, 2000.	Disease Paper Rough Draft Due
10/25	No Class		
10/30	Cas9/CRISPR Presentation Introduction to miRNA	Jinek, M. “RNA-programmed genome editing” <i>eLife</i>, 2013.	Literature Presentations Begin
11/1	miRNA Presentation Introduction to Aptamers	Gumireddy, K. “Small-molecule Inhibitors of miRNA” <i>Angew. Chem.</i> 2008.	
11/6	RNA Aptamer Presentation Introduction to DNA synthesis and Combinatorial Chemistry	Rusconi, C. “RNA Aptamers as Reversible Antagonists” <i>Nature</i>, 2002.	Disease Paper Peer Reviews Due
11/8	DNA Synthesis Presentation Introduction to Expanded DNA Code	Gartner, Z. “DNA-Templated Organic Synthesis” <i>Science</i>, 2004.	
11/13	Expanded DNA Code Presentation Introduction to Unnatural Amino Acids	Malyshev, D. “A Semi-Synthetic Organism” <i>Nature</i>, 2014.	
11/15	Unnatural Amino Acid Presentation Sensory Systems	Ge, Y. “A Genetically Encoded Multifunctional UAA” <i>Chem. Sci.</i> 2016.	
11/20	Sensory Systems Thanksgiving Party	Berg: Ch. 33	Disease Paper Final Draft Due
11/22	Thanksgiving		
11/27	Zika Antiviral Presentation Introduction to Stem Cells	Gizzi, A. “A Naturally Occurring Antiviral” <i>Nature</i>, 2018.	
11/29	Stem Cell Differentiation Presentation Introduction to Metabolic Engineering	Ding, S. “Synthetic Small Molecules that Control Stem Cell Fate” <i>PNAS</i>, 2003.	
12/4	Artemisin Presentation Introduction to Metalloenzymes	Ro, D. “Production of the Antimalarial Drug” <i>Nature</i>, 2006.	
12/6	Metalloenzyme Presentation Review/Wrap-up	Dydio, P. “An Artificial Metalloenzyme” <i>Science</i>, 2016.	