

ISC 1280; 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 (2:00–3:30); 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. 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, as well as, critical thinking skills and utilization of the primary literature.

Grading:

	<u>Date</u>
15% Mid-term Exam	Week of Oct 10 th
20% Final Exam	Dec 12 th 9 am - noon
15% Protein Project	--
15% Disease Paper	Final Paper due Dec 8 th
15% Literature Presentation	--
10% Group Project	Video due Nov 3 rd
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 exam will have (i) problems requiring numerical answers, (ii) short-answer questions, and (iii) multiple-choice questions. The exam will be open book/readings and open note (**NOT open internet other than Blackboard**). The mid-term exam will be the week of October 10th and will be self-scheduled over a 2-hour exam block 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. **Examinations are meant to be taken individually and without external assistance.** Posting exams on any website will result in an automatic failure of the course and submission of a conduct violation to the honor council. Viewing current or previous exams online will result in a zero on that exam (and potential submission to the honor council).

Final Exam: The final exam will be **MONDAY, DECEMBER 12th 9:00 am – 12:00 in ISC 1280**. 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 Dec 8th**.

*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 September 15th. 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.

Group Project: In the same group as the literature presentation, groups will be responsible for making a brief (~2 min) video focusing on a metabolic pathway. This could be a presentation of the pathway itself, the relevance of the pathway on a disease, or some other creative interpretation of a pathway. It is important to be able to present complex scientific concepts to a general audience and this video is meant to be for a general audience and in a "Tik Tok" style. This is a chance to tap into some creativity while still intellectually engaging biochemical material.

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. Everyone starts with a participation grade of 90/100, activities that contribute to the course will increase the grade, while previously mentioned activities will result in a lowering of the grade.

COVID Considerations: Due to the uncertainty associated with the semester the schedule on the syllabus is open to modifications as well as the due dates. Communication is vital this semester, so it is expected that you are regularly checking Blackboard/email, and you alert me of any issues. Finally, we find ourselves under extraordinary circumstances, so I ask for your patience and understanding and will do my best to reciprocate.

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 (completed for that date)	Due
9/1	Introduction and Water/Noncovalent Interactions	McKee: Ch. 1, 3, & 17	
9/6	DNA Structure and Phosphates Introduction to PyMol/ChemDraw	Westheimer, F. "Why Nature Chose Phosphates" <i>Science</i> 1987.	Information Slide Due
9/8	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
9/13	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
9/15	Biochemical Techniques	Berg: Ch. 3	Literature Presentation/ Group Project Selection Due
9/20	Biochemical Techniques	Berg: Ch. 3	Protein Projects Begin
9/22	Enzyme Kinetics	McKee: Ch. 6.3	
9/27	Enzyme Catalysis	<ul style="list-style-type: none"> • McKee: Ch 6.4 • Knowles, J. "Enzyme Catalysis" <i>Nature</i>, 1991. 	
9/29	Enzyme Inhibition Drug Development	Berg: Ch. 36	
10/4	Drug Development	Berg: Ch. 36	
10/6	Cell Signaling	Berg: Ch. 14	
10/11	Cancer	Hanahan, D. "The Hallmarks of Cancer" <i>Cell</i>, 2000.	MID-TERM EXAM
10/13	FALL BREAK		
10/18	Cancer	Collins, I. "New Approaches to Molecular Cancer Therapeutics" <i>Nat. Chem. Biol.</i> 2006.	
10/20	HIV, COVID, and Antivirals	Russell, R. "The Structure of HFN1 Avian Influenza" <i>Nature</i>, 2006.	

10/25	HIV, COVID, and Antivirals	Barre-Sinoussi, F. “Past, Present and Future: 30 Years of HIV Research” <i>Nat. Rev. Microbiol.</i> 2013	Disease Paper Rough Draft Due
10/27	RNA Aptamer Presentation Introduction to miRNA	Rusconi, C. “RNA Aptamers as Reversible Antagonists” <i>Nature</i>, 2002.	Literature Presentations Begin
11/1	miRNA Presentation Introduction to CRISPR/Cas9	Gumireddy, K. “Small-molecule Inhibitors of miRNA” <i>Angew. Chem.</i> 2008.	Disease Paper Peer Reviews Due
11/3	Cas9/CRISPR Presentation Introduction to DNA synthesis and Combinatorial Chemistry	Broughton, J. “CRISPR-Cas12-based detection of SARS-CoV-2” <i>Nat. Biotech.</i> 2020	Group Project Due
11/8	NO CLASS (ELECTION DAY)		
11/10	DNA Synthesis Presentation Introduction to Expanded DNA Code	Gartner, Z. “DNA-Templated Organic Synthesis” <i>Science</i>, 2004.	
11/15	Expanded DNA Code Presentation Introduction to Unnatural Amino Acids	Malyshev, D. “A Semi-Synthetic Organism” <i>Nature</i>, 2014.	
11/17	Unnatural Amino Acid Presentation Introduction to Antivirals Sensory Systems	Ge, Y. “A Genetically Encoded Multifunctional UAA” <i>Chem. Sci.</i> 2016.	
11/22	Sensory Systems Thanksgiving Party (ZOOM OPTION)	Berg Ch. 33	
11/24	THANKSGIVING		
11/29	Zika Antiviral Presentation Introduction to Stem Cells	Gizzi, A. “A Naturally Occurring Antiviral” <i>Nature</i>, 2018.	
12/1	Stem Cell Differentiation Presentation Introduction to Engineering	Ding, S. “Synthetic Small Molecules that Control Stem Cell Fate” <i>PNAS</i>, 2003	
12/6	Artemisin Presentation Introduction to Metalloenzymes	Ro, D. “Production of the Antimalarial Drug” <i>Nature</i>, 2006.	
12/8	Metalloenzyme Presentation Review/Wrap-up	Dydio, P. “An Artificial Metalloenzyme” <i>Science</i>, 2016.	Disease Paper Final Draft Due

IMPORTANT DATES: Add/Drop: Monday 9/12/22
Withdraw: Wednesday 10/31/22