

Instructor: Prof. Duane Sears [duanesears@ucsb.edu](mailto:duanesears@ucsb.edu)TAs: Nerea Muniozguren [nereamuniozguren@ucsb.edu](mailto:nereamuniozguren@ucsb.edu)Amanda Maheras [a\\_maheras@ucsb.edu](mailto:a_maheras@ucsb.edu)

(Wk)	Day	Date	Lec. No.	Topics and Reading Assignments	Last updated on Tuesday, May 17, 2022
(1) M	June	20	Juneteenth Holiday	Course Introduction and Lecture L01	These two <i>Panopto</i> videos will help prepare you for this course.
			L01	Protein Structures and Functions	

## THEME I: Basic Properties of Amino Acids and Analysis of Reversible Ligand Binding Reactions

T	21	L02A	Basic Amino Acid Properties	L02B AA Stereochemistry	@@NC Ch 3 pp. 75-81; **WWBH-Ch 2 pp. 13-17; Prblms 2.1-7;10-11;14-18
W	22	L03A	Reversible Monovalent Ligand Binding Reactions.	L03B Buffers	NC Ch 2 pp. 45-74; Ch 5 pp. 157-166; &&RLBR pp. 1-16
R	23	L04A	Multivalent Reactions	L04B Equilibrium Perturbation by Microenvironment	NC Ch 3 pp. 81-5; RLBR pp. 21-30

## THEME II: Strategies for Isolating Proteins

F	24	L05	On the Trail of Recombinant Human Erythropoietin (rhuEPO) (Isolation and Characterization)		NC Ch 3 pp. 85-94
(2) M	27	L06	Distinguishing Recombinant from Native Human EPO		NC Ch 3 pp. 94-96
T	28	L07A	Sickle Cell Anemia	L07B Discovery of Sickle Cell Hb	##BF Ch 1 pp. 1-12; Ch 11 pp. 452-62; 472-92; Ch 12 pp. 502-12 NC Ch 5 pp 172-174; L. Pauling Science 110: 543 (1949)

## THEME III: Strategies for Characterizing Protein Sequences and Conformations

W	29	L08A	Primary (1 <sup>o</sup> ) AA Sequences of Hb A & HbS	L08B Polypeptide Sequencing	V. Ingram, Nature 180:326 (1957); NC Ch 3, pp. 92-106 WWBH Ch 3 pp. 30-36; BF Ch 1 pp 1-12; Ch 2 pp 13-35; WWBH Ch 3 Problems: 3.1-8, 11-12, 16-18
R	30	L10A	Stability and Folding of Proteins		NC Ch 4 pp. 143-152
F	July 1	L10B	Constraints on Protein Folding and Conformation		MIDTERM #1 EXAM REVIEW, ONLINE (TBA) BF Ch 2 Hb Structure pp. 13-35

(3) M	July 4	Independence Day			
		L09	3-D Structure Determination of Myoglobin and Hemoglobin		NC Ch 4 pp. 115-43; BF Ch 2 19-34

T 5 Online MIDTERM #1 EXAM, Tuesday, July 5<sup>th</sup>THEME IV: Analysis of the Regulation of O<sub>2</sub> Transport by Hemoglobin

W	6	L11	O <sub>2</sub> Binding and Transport by Hb (O <sub>2</sub> saturation plots)		NC Ch 5 pp 157-72; BF Ch 3 (all); RLBR pp. 30-40; \$\$\$Martin Ch 4-6
R	7	L12	Mechanism of Cooperative O <sub>2</sub> Binding by Hemoglobin (Hill plots.)		NC Ch 5 pp. 157-72; BF Ch 2 pp. 19-32; BF Ch 3 pp. 45-53
F	8	L13	Metabolic Regulation of Hb O <sub>2</sub> Transport		NC Ch 5 pp. 168-72 BF Ch 4 pp. 61-71; Ch 5 pp. 91-109; & Ch 7 pp. 169-77
(4) M	11	L14A	Fine-tuning Hb Function	L14B Hemoglobinopathies/Hb Variants	NC Ch 5 pp. 168-172; BF Chs 3, 5, & 17- BF Ch 14 pp. 91-109

## THEME V: Analysis of Enzyme Kinetics and Reversible Enzyme Inhibition

T	12	L15	General Properties of Enzymes (Focus on <u>double-reciprocal</u> & <u>direct-linear plots</u> )		NC Ch 6 pp. 186-206; WWBH Ch 8 pp. 144-151
W	13	L16A	Michaelis-Menten (MM) Kinetics	L16B Kinetic Constants and Plots	WWBH Ch 8 Problems: 8.1-9,11-12,15-22,24-26
R	MT2 14	L17	Mechanisms of Enzyme Inhibition (Focus on <u>competitive inhibition</u> .)		NC Ch 6 pp. 207-213; WWBH Ch 8 Problems: 8.16-17,20-22

## THEME VI: Specific Mechanisms of Enzyme Catalysis

F	15	L18	Structure and Catalytic Properties of Chymotrypsin		NC Ch 6 pp. 212-218; WWBH Ch 7
			MIDTERM #2 EXAM REVIEW, ONLINE (TBA)		

(5) M 18 Online MIDTERM #2 EXAM, Monday, July 18<sup>th</sup>

T	19	L19	Catalytic Mechanisms of Chymotrypsin and Serine Proteases		NC Ch 6 pp 212-218; WWBH Ch 7 Problems: 7.1-17, 21
W	20	L20	Catalytic Mechanism of Lysozyme, a Glycosidase		NC Ch 6 pp 220-223; Ch 7 pp. 257-258; WWBH Ch 7
R	21	L21A	Aspartyl Proteases Catalytic Mechanisms	L21B Cysteine Proteases Catalytic Mechanisms	NC Ch 6 p. 213,218-9

## THEME VII: Biological Strategies for Regulating Enzyme Activity

F	22	L22	Introduction to Enzyme Regulation		NC Ch 6 pp. 226-236; Ch 27, pp. 1147-1149; WWBH Ch 7
		L23	Allosteric Feedback Regulation of ATCase		NC Ch 5 pp. 168-170; Ch 6 pp 226-228; Ch 22 pp. 915-916; WWBH Ch 7
(6) M	25	L24	Differentially Regulated Reactions Catalyzed by Different Isozymes		NC Ch 14 pp. 563-565; Ch 15 p. 602
T	26	L25	Regulation of Different Pyruvate Kinase (PK) Isoforms in Mammalian Cells		NC Ch 14 pp. 555-58; Ch 15 p. 606-608
W	27	FINAL EXAM REVIEW, ONLINE (TBA)			
R	28	No scheduled lecture.			

F 29 Online FINAL EXAM, Friday, July 29<sup>th</sup>@@ Recommended TEXTBOOK: *Lehninger Principles of Biochemistry* (WH Freeman) D.L. Nelson & M.M. Cox (NC) 6<sup>th</sup> ed. (2012); *Optional*: 5<sup>th</sup> ed. (2008).As Posted on Gauchospace- (GS): <https://gauchospace.ucsb.edu/courses/>

&amp;&amp;(RLBR) – Reversible Ligand Binding Reactions, by D. Sears

\*\* (WWBH): W. B. Wood, J. H. Wilson, R. M. Benbow & L. E. Hood, *Biochemistry: A Problems Approach*, 2<sup>nd</sup> ed., 1981 – Chs 2-3 & 7-8##(BF) - KF Bunn & BJ Forget, *Hemoglobin: Molecular, Genetic & Clinical Aspects*, 1986 – Chs 1-5, 7, 11, 12\$\$\$ L. Martin *All you Really Need to Know to Interpret Arterial Blood Gases*, 2<sup>nd</sup> ed. Lippincott, Williams, & Wilkins, 1992 - Chs 1-6

### Course Drop Dates

- **June 24<sup>th</sup>** Drop deadline for a full refund. (No later than 5 pm.)
- **July 6<sup>th</sup>** Drop deadline for no withdrawal (W) recorded for your grade for this course. (No later than 5 pm.)

### Course Grades

- Letter grades for this course will be determined from the combined scores for 3 examinations and several short quizzes, each with a few questions and only worth a few points.
- The curve of the class distribution of these combined scores will be used to assign grades where the mean of the distribution will more or less define the “B-/C+” grade boundary.

### Online Graded Quizzes (120 points total) — Start and end times for these quizzes are posted on the *Gauchospace*.

Quiz 1 (Qz1) (5 pts), **Wednesday, June 22** — 20 min.

Quiz 2 (Qz2) (12 pts), **Friday, June 24** — 45 min.

Quiz 3A (Qz3A) (3 pts), **Sunday, June 26** — 30 min.

Quiz 3B (Qz3B) (3 pts), **Monday, June 27** — 30 min.

Quiz 3C (Qz3C) (8 pts), **Tuesday, June 28** — 30 min.

Quiz 3D (Qz3D) (2 pts), **Tuesday, June 28** — 30 min

Quiz 4 (Qz4) (22 pts), **Wednesday, June 29** — 60 min

Quiz 5 (Qz5) (14 pts), **Thursday, June 30 to July 4** — 45 min (*average of 2 attempts*)

Quiz 6 (Qz6) (9 pts), **Friday, July 8 to July 11** — 60 min.

Quiz 7 (Qz7) (14 pts), **Monday, July 11** — 60 min.

Quiz 8 (Qz8) (9 pts), **Wednesday, July 13** — 30 min.

Quiz 9 (Qz9) (13 pts), **Thursday, July 14** — 30 min.

Quiz 10 (Qz10) (6 pts), **July 20 to 22** — 45 min. (*1 attempt only*)

### Online Graded Examinations (Group study with others in the course might be worth considering..)

MIDTERM #1 EXAM (100 pts), **Tuesday, July 5** — 90 min.

MIDTERM #2 EXAM (100 pts), **Monday, July 18** — 90 min.

FINAL EXAM (200 pts), **Friday, July 29** — 150 min.

### Proctored Exams

- 3 exams will be administered by Gauchospace (with a password) and proctored on Zoom by one of the instructors.
- The exams quizzes, will focus on **problem-solving, data analysis, and application of fundamental course concepts**.
- All examinations and quizzes will be **open resource** that **allows access** to the following resources:
  - Your hand-written and/or digitally annotated notes can be used.
  - Any textbook (**not online**) and other printed materials (e.g. slide readers) can be used during the exams.
  - Any **digital resources** are allowed if already PRE-stored on the computer used during the exams. Thus, *ahead of the exam*, you should download the lecture PowerPoint slide PDFs and other PDFs to your computer.
  - If you want access to an online textbook or other online resource, download these materials to your computer before the exam.
  - As for **Internet access** during the exams, you are **only allowed access** to the **Gauchospace course website** and Prof. Sears' **Instructional Biochemistry website** — <https://biosci.mcdb.ucsb.edu/biochemistry/>.
- During an exam, you are **not allowed access** to other Internet websites or other digital devices that can be used to communicate with others.
- During an exam, you are **NOT to communicate with anyone** and after completing an exam, you are not permitted to communicate with someone who hasn't yet started the exam or who is still taking the exam.
- By checking the **academic honesty agreement checkbox** before opening an exam, you confirm that the answers submitted are yours and that you did not receive unauthorized help.

### Course Resources

- The schedule for weekly online **Instructor-led** or **TA-led review sessions** or **office hours** will be posted on Gauchospace.
- Log into **Gauchospace (GS)** for access to most of the digital materials you will likely need for this course including *PowerPoint lecture slides* (saved as *Acrobat* PDF files) and the *Panopto* lecture videos.
- The online **lecture slides** and **videos** will provide the primary sources of information for the examinations in this course.
- A complete set of **color** or **black-on-white** *PowerPoint* lecture slides can be obtained by contacting Professor Sears.
- The recommended **course textbook chapters** and other **reading materials** are listed on the syllabus and also posted on GS.
- A separate **instructional biochemistry website** — <https://biosci.mcdb.ucsb.edu/biochemistry/> — also hosts a variety of animations, interactive 3D structures, interactive graphs, tutorials, self-assessment quizzes, etc. which are primarily designed to help students master some of the more difficult concepts and problem-solving exercises covered in this course.
- **Online overviews** of various course topics and descriptions of the visualization tools for interactive molecular structure and graphical analysis can be found at <https://biosci.mcdb.ucsb.edu/biochemistry/MCDBW108A/MCDBW108AInfo.htm>.
- **Practice exam and quiz questions** will be activated with specific deadlines for completion throughout the course. These are designed to help you prepare for some of types of problem-solving questions you'll likely encounter on the exams. Most of the quizzes include a few 1- or 2-point graded questions to be answered during a short (15- to 30-min). time window. Your net score for each quiz will be counted in your total course score for all grade assignments, including the 3 full examinations.