MCB 100B Spring Syllabus: Biochemistry: Pathways, Mechanisms, and Regulation

Time & Location: Tuesday / Thursday 3:30 – 5:00 PM, 101 Barker Hall

Part A. Specificity and Signaling
Textbook resources:

1. The Molecules of Life by Kuriyan, Konforti & Wemmer. Chapters 12, 13 and 17. (The course will build on material covered in MCB 100A).
2. Lehninger's Biochemistry, Chapter 12. Note: 5th, 6th, or 7th edition are acceptable. Chapter numbering below is based on 6th edition.

Lecture 1, Tue 1/18 (ZOOM). Second messenger and G protein-coupled receptor signaling. Lehninger Chap 12, 437-456

Lecture 2, Thur 1/20 (ZOOM). Receptor tyrosine kinases and protein-protein interaction networks. Lehninger Chap 12, 461-474

Lecture 3, Tue 1/25 (ZOOM) Binding affinity and specificity in molecular interactions. Analysis of binding with multiple targets. TMOL Chap 12, 531-548, Chap 13, 581-589

Lecture 4, Thur 1/27 (ZOOM) Protein-protein interactions, protein-nucleic acid interactions. TMOL Chap 13, 590-623

Lecture 5, Tue 2/1. Random walks, diffusion and Brownian motion. Chemotaxis, diffusion through ion channels. TMOL Chap 17, 787-801; TMOL Chap 11, 484-492

Lecture 6, Thur 2/3. Molecular flux and transport. Fick's laws. Measurement of diffusion constants. TMOL Chap 17, 802-817

Lecture 7, Tue 2/8. Diffusion vs active transport. Diffusive processes in signal transduction. TMOL Chap 17, 818-825

Lecture 8, Thur 2/10. Ion pumps and transporters. TMOL Chap 11, 482-496 & 517-523

Lecture 9, Tue 2/14 The transmission of action potentials in neurons. TMOL Chap 11, 474-475 & 497-517

Part B. Central Metabolism and Enzyme Principles
Textbook resources: Lehninger's Biochemistry. Chapters 3, 6, 7, 10, 13, 14, 15, 16, 18, 19

Lecture 10, Thur 2/17. Introduction to Metabolism: Logic and pathways. Lehninger Chap 3 (review); Chap 6, 187-198

Midterm 1: Wed 2/16, 7-9pm 145 Dwinelle (Part A material only)

Lecture 11, Tue 2/22. Enzyme reaction mechanisms and cofactor function (I). Lehninger Chap 6, 213-225 & Chap 13, 501-526

Lecture 12, Thur 2/24. Enzyme reaction mechanisms and cofactor function(II) and introduction to glycolysis. Lehninger Chap 14, 533-545

Lecture 13, Tue 3/1. Glucose metabolism, gluconeogenesis and the pentose shunt. Lehninger Chap 14, 546-567 & Chap 7, 241-261

Lecture 14, Thur 3/3. Regulation of carbohydrate metabolism and the Citric Acid Cycle: introduction. Lehninger Chap 14, 568-570 & Chap 15, 575-594 & Chap 16, 619-630

Lecture 15, Tue 3/8. Citric acid cycle: reactions, logic and regulation. Lehninger Chap 16, 631-643 & Chap 19, 711-718

Lecture 16, Thur 3/10. Oxidative phosphorylation and electron transport. Lehninger Chap 19, 718-730

Lecture 17, Tue 3/15. ATP synthesis and regulation. Lehninger Chap 731-744

Lecture 18, Thur 3/17. Amino acid metabolism, Lipids and glycogen Lehninger Chap 19, 744-750, Chap 18, 675-690 & Chap 10, 361-381

Spring Break: 3/22 – 3/26

Part C. Molecular Physiology Expanded
Textbook resources: Lehninger's Biochemistry. Chapters 14, 15, 17, 18, 19, 20, 21, 22.

Midterm 2: Tues 3/29, 7-9 pm 10 Evans (Part B material only)

Lecture 19, Tue 3/29. The regulation and storage of sugar in the cell.
Reading: 7.1, (review) 12.2 (review), 14.4, 15.3, 15.4, 15.5

Lecture 20, Thur 3/31. Techniques for quantitating metabolism.
Reading: 3.3 (chromatography), 3.4 (mass spectrometry) 15.1, 15.2
Optional: For those interested, Section 15.1 is based upon Bennett BD, Kimball EH, Gao M, Osterhout R, van Dien SJ, Rabinowitz JD. 2009. Absolute metabolite concentrations and implied enzyme active site occupancy in Escherichia coli. *Nature Chemical Biology* **5**: 593–599.

Lecture 21, Tue 4/5. Fatty acid degradation.
Reading: 17.1, 17.2, 17.3

Lecture 22, Thur 4/7. Amino acid degradation and the urea cycle.
Reading: 18.1, 18.2, 18.3

Lecture 23, Tue 4/12. Photosynthesis and the Light Reactions.
Reading: 19.6, 19.7, 19.8, 19.9, 19.10

Lecture 24, Thur 4/14. Carbon assimilation and the Dark Reactions.
Reading: 20.1, 20.2, 20.3

Lecture 25, Tue 4/19. Lipid biosynthesis.
Reading: 21.1, 21.2, 21.3, 21.4 (briefly)

Lecture 26, Thur 4/21. Synthetic biology and engineering metabolism.
Reading: 21.4 (isoprenoid section)
Additional information available in: Keasling JD. 2008. Synthetic Biology for Synthetic Chemistry. *ACS Chem Biol* **3**: 64–76 and Martin VJJ, Pitera DJ, Withers ST, Newman JD, Keasling JD. 2003. Engineering a mevalonate pathway in Escherichia coli for production of terpenoids. *Nat Biotechnol* **21**: 796–802.

Lecture 27, Tue 4/26. Amino acid and nucleotide biosynthesis.

Reading: 22.1, 22.2, 22.3 (briefly), 22.4 (biosynthesis section)

Lecture 28, Thur 4/28. Cancer and metabolism. (**PROBLEM SET 3 DUE**)

Reading: 23 (skim).

Additional information available in: Ward, P S, and C B Thompson. 2012. “Signaling in Control of Cell Growth and Metabolism.” Cold Spring Harbor Perspectives in Biology 4 (7) (July 2): a006783–a006783. doi:10.1101/cshperspect.a006783.

RRR Week: 5/4 – 5/8

Combined Midterm 3 and Final: Friday 5/13, 7-10 pm location TBD