

# MCB 100B Spring 2018: Biochemistry: Pathways, Mechanisms, and Regulation - Syllabus

**Instructors:** Prof. Roberto Zoncu (rzoncu@berkeley.edu)  
Prof. Michael Marletta (marletta@berkeley.edu)  
Prof. David Savage (savage@berkeley.edu)

## Part A. Specificity and Signaling – Prof. Roberto Zoncu

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: 5<sup>th</sup>, 6<sup>th</sup>, or 7<sup>th</sup> edition are acceptable. Chapter numbering below is based on 6<sup>th</sup> edition.

Lecture 1, Tue 1/16. Second messenger and G protein-coupled receptor signaling.

Lecture 2, Thur 1/18. Receptor tyrosine kinases and protein-protein interaction networks

Lecture 3, Tue 1/23. Binding affinity and specificity in molecular interactions. Analysis of binding with multiple targets.

Lecture 4, Thur 1/25. Protein-protein interactions, protein-nucleic acid interactions.

Lecture 5, Tue 1/30. Research papers on protein signaling networks

Lecture 6, Thur 2/1. Random walks, diffusion and Brownian motion. Chemotaxis.

Lecture 7, Tue 2/6. Molecular flux and transport. Fick's laws. Measurement of diffusion constants.

Lecture 8, Thur 2/8. Diffusion vs active transport. Diffusive processes in signal transduction.

Lecture 9, Tue 2/13. Research papers on diffusion in signaling.

## Part B. Central Metabolism and Enzyme Principles – Prof. Michael Marletta

Textbook resources: Lehninger's Biochemistry. Chapters 6, 13, 14, 15, 16, 19.

Lecture 10, Thur 2/15. Introduction to Metabolism: Logic and pathways

### **Midterm 1: Thur 2/15, 7 – 9 PM, Location TBA. (Zoncu material only)**

Lecture 11, Tue 2/20. Enzyme reaction mechanisms and cofactor function (I).

Lecture 12, Thur 2/22. Enzyme reaction mechanisms and cofactor function(II) and introduction to glycolysis.

Lecture 13, Tue 2/27. Glucose metabolism, gluconeogenesis and the pentose shunt.

Lecture 14, Thur 3/1. Regulation of carbohydrate metabolism and the Citric Acid Cycle: introduction.

Lecture 15, Tue 3/6. Citric acid cycle: reactions, logic and regulation.

Lecture 16, Thur 3/8. Oxidative phosphorylation and electron transport.

Lecture 17, Tue 3/13. ATP synthesis and regulation.

Lecture 18, Thur 3/15. Amino acid metabolism, Lipids and glycogen

### **Part C. Molecular Physiology Expanded – Prof. David Savage**

Textbook resources: Lehninger's Biochemistry. Chapters 14, 15, 17, 18, 19, 20, 21, 22.

Lecture 19, Tue 3/20. The regulation and storage of sugar in the cell.

Reading: 7.1, (review) 12.2 (review), 14.4, 15.3, 15.4, 15.5

### **Midterm 2: Thur 3/22, 7 – 9 PM, Location TBD. (Marletta material only)**

Lecture 20, Thur 3/22. 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.

### **Spring Break: 3/26 – 3/30**

Lecture 21, Tue 4/3. Fatty acid degradation.

Reading: 17.1, 17.2, 17.3

Lecture 22, Thur 4/5. Amino acid degradation and the urea cycle.

Reading: 18.1, 18.2, 18.3

Lecture 23, Tue 4/10. Photosynthesis and the Light Reactions.

Reading: 19.6, 19.7, 19.8, 19.9, 19.10

Lecture 24, Thur 4/12. Carbon assimilation and the Dark Reactions.

Reading: 20.1, 20.2, 20.3

Lecture 25, Tue 4/17. Lipid biosynthesis.

Reading: 21.1, 21.2, 21.3, 21.4 (briefly), 21.5 (briefly)

Lecture 26, Thur 4/19. Synthetic biology and engineering metabolism.

Reading: 21.5 (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 4/24. Amino acid and nucleotide biosynthesis.

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

Lecture 28, Thur 4/26. 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: 4/30 – 5/4**

### **Combined Midterm 3 and Final: Wed 5/9/18 11:30 – 2:30 PM. LOCATION TBA**