

Chem*4520

METABOLIC PROCESSES

Fall 2003

Instructor: M. Brauer
334 MacNaughton Bld.

Lectures: Mon. 9:30 - 10:20, Wed. 9:30 - 10:20, Fri. 9:30 - 10:20
MacNaughton 118

Office Hours: Mon. 11:30 - 12:00, Wed. 11:30 - 12:00, Fri. 11:30 - 12:00

Suggested Texts: **Voet and Voet, *Biochemistry* - 3d Edition (Vol. 1), 2003. **
Very Highly recommended. A detailed and comprehensive text,
especially for metabolism and chemical mechanisms.
Matthews, Van Holde, Ahern, *Biochemistry* - 3d Edition, 2000.
Highly recommended. Reasonably detailed for metabolic reaction
mechanisms, up-to-date and useful for a variety of advanced
biochemistry/molecular biology courses.
Stryer, *Biochemistry* - 5th Edition, 2001 or 4th Edition, 1995, or Voet
and Voet 2nd Edition, 1995. Acceptable. Everyone who took
Chem*3560 already has this book. It is a good general book, but
not in the detail of the first two. (Voet, Voet and Pratt,
Fundamentals of Biochemistry, 1999; or Lehninger's *Biochemistry*,
Nelson & Cox, 2001. Also acceptable). You need not buy a new
book, if you already have one of these. These books are on
reserve at the library.

Objectives: This course presents an in-depth study of metabolic pathways. The governing role of free energy in determining the extent and direction of reactions will be used as a guiding principle to demonstrate the patterns and associations that contribute to the ordered functioning of a complete biochemical system. Principles of organic reaction mechanisms will be introduced and used to demonstrate the chemical logic governing synthesis and breakdown of the major groups of biochemical substances. Regulatory mechanisms will be examined and their role in determining the integration of complete biochemical systems will be demonstrated.

Presentation: There will be three lectures a week. Problem sets will be given out weekly to reinforce the lecture material. Solutions to these problems can be found at the reserve desk in the library.

Policy on Missed Examinations:

Only valid excuses (medical or compassionate reason) will prevent a grade of zero for any missed test. It is the student's responsibility to arrange for the necessary verification from the Medical or Psychological Services or the Director of Student Affairs. *Make-up tests will not be given.*

Detailed Course Outline and Reading Sources - Approximate

V = Voet and Voet, 2003; **S** = Stryer, 1995; **M** = Mathews, 2000.

1. Intro. to Thermodynamics - forms of energy, life and the second law of thermodynamics
V 51 - 60, 574-579; S 185-86; M 58-67
- 2,3. Free Energy - free energy of formation, coupled reactions
V 566-71; S 443-47, 186-87; M 68-73
4. Free Energy Calculations - free energy of hydrolysis, bioenergetic status (EC, PP)
V 566-71; S 443-47, 186-87; M 74-79
5. Redox Reactions and Free Energy - standard potentials, Nernst equation, redox balance
V 571 - 578; S 531-33; M 525-29
6. Metabolic Flux V 608 - 611, 470-71; M 433-34
7. Intro. to Reaction Mechanisms V 552-559
- 8,9. Glycolysis-Reaction Mechanisms V 581-607; S 490-91, 493-96; M 448-459
- 10,11. Glycolysis-Bioenergetics and Regulation V581-607; S 483-89, 498-504; M 459-466
12. Starting and Ending Points for Glycolysis-glycogen, glucose, fructose, galactose, lactate, ethanol, biochemistry of tumours
V 618 - 622, 476-79; S 491-93, 496-98; M 466-478
13. Pyruvate Dehydrogenase - Mechanism of Action V 768-781; S 514-18; M 488-96
- 14,15. TCA Cycle - Mechanisms, Bioenergetics and Control
V 781-796, 548-61; S 509-514; M 497-505
16. TCA Cycle - Anaplerotic Reactions V 792-794; S 522-24; M 505-8
17. Electron Transport-components, leakage of electrons, free radical scavengers
V 797-827; S 534-44, 553-55; M 522-36
- 18,19. Electron Transport/ Oxidative Phosphorylation-states of mitochondria, respiratory control
V 827-839; S 544-53; M 537-57

20. Compartmentation and Transport in the Mitochondria
V 726-750; S 529-31; M 549-51
21. Ethanol Metabolism V 604-5; M 461
22. Triglycerides and Fatty Acids - lipoproteins, transport and β oxidation
V 909-919, 688-90; S 603-12, 697-702; M 627-645
23. Oxidation of Unsaturated and "Odd-ball" Fatty Acids
V 919-928; S 622-24; M 645-648
24. Ketone Bodies V 928-930; S 612-13; M 649-50
25. Mevalonate Metabolism and Steroid Biosynthesis V 942-959; S 691-97; M 686-692
26. Steroid Biosynthesis and Function V 659, 666-668; S 702-709; M 692-700
27. Nitrogen Scavenging and the Urea Cycle
V 985-995, 731-35; S 629-31, 634-37; M 727-30
28. Mechanism of Action of Pyridoxal Phosphate V 996-1000, S 631-34; M 731-33
- 29,30. Protein and Amino Acid Catabolism V 1000-1013, S 637-51; M 746-76
31. Amino Acid and Neurotransmitter Biosynthesis V 1024-44760-762; S 717-30; M 782-791
32. Amino Acids and Porphyrin Biosynthesis V 1013-1024; M 776-82
- 33-34. Pyrimidine Biosynthesis and Purine Catabolism - xanthine oxidase and hypoxia
V 1076-1081, 1094-1098; S 755-58, 739-55; M 806-15
35. Review of Coenzymes and Cofactors
36. Review of Metabolic Regulation and Integration of Pathways