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**Office Hours:** Tuesdays and Thursdays 3-5 pm and by appointment

**Required Text:** *Lehninger Principles of Biochemistry* by David L. Nelson and Michael M. Cox, 4<sup>th</sup> edition, Worth Publishers, 2005.

<http://bcs.whfreeman.com/lehninger/default.asp?s=&n=&i=&v=&o=&ns=0&uid=0&rau=0>

**Recommended Text:** *Biochemistry* by Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, 6<sup>th</sup> edition, W. H. Freeman and Co., 2006.

<http://bcs.whfreeman.com/biochem5/default.asp?s=&n=&i=&v=&o=&ns=0&uid=43225&rau=43225>

The electronic version of handouts and study questions for every class are available to download to your PC by FTP or HTML from the Environmental Biotechnology Institute server: <http://image.fs.uidaho.edu/Lecture-Indexes/>. Only PCs connected to the UI hard-wired network have access to the FTP site. Please download Power Point (\*.ppt) files and Word files (\*.doc). There are also in the folder animations files which are very useful to understand more complicated processes. Please do not remove any document from the folder. If you need help with the FTP procedure, please visit my office and I will show you how to FTP, give you copy of the handouts on the disk or print hard copy of handouts. Using handouts during classes and reading relevant material from the text books before the class is strongly recommended. Study questions are similar to the questions given during the examinations.

MMBB 442/542 will focus on nitrogen metabolism in living systems. Students will learn how cells synthesize and degrade small amino acids and large protein biomolecules, and how energy is generated and consumed on the molecular level during these biochemical processes. All of the reactive oxygen species (ROS) and reactive nitrogen species (RNS) will be introduced. We will explore their damaging reactivity towards different biomolecules and how these reactive species are used in different ways to benefit the cells that are generating them. Students will learn the metabolism of small organic molecules in the cell and how they form larger structures. The course will emphasize anabolism and catabolism of amino acids, nucleotides, proteins, and nucleic acids. The trophophasic and idiophasic growth of cells and their biochemical basis and biotechnological application will be introduced. The catalytic strategy employed by enzymes and their structure-function relations will be reviewed. For example, the catalytic mechanism and molecular structures of peroxidases (ligninase), proteases (chymotrypsin), carbonic anhydrase and pyruvate dehydrogenase will be discussed and analyzed. The application of modern analytical techniques such as; mass spectrometry,

nuclear magnetic resonance, X-ray diffraction spectrometry to biochemical and biological sciences will be discussed with given groups of biomolecules.

### **Examinations:**

Second Thursday of February	Exam I	100 points
Second Thursday of March	Exam II	100 points
Second Thursday of April	Exam III	100 points
Thursday (final week)	Final*	100 points

\* Score greater than 90% from exams I, II and III will make the student eligible for exemption from final exam.

Exams will cover material in the assigned text reading and material presented during the lectures. The exam format may consist of multiple choices, true/false, matching or short answer and essays questions.

In addition, graduate students will be required to write a detailed review paper or give a presentation about the selected subject, and generate a computer model of the biomolecules covered in their paper (using data deposited in the Protein Data Bank (<http://www.rcsb.org/pdb/>)). The review paper is worth 100 points and is due by the end of March.

The course grade will be calculated from the sum of the all exams and the paper (graduate students only), using the following scale: A 90-100%, B 80-89%, C 70-79%, D 50-69%, F below 49%

Unexcused, missed exams will count as 0 points. Excused absences will be granted based on individual cases. Refer to the University of Idaho General Catalog, Requirements and Academic Procedures, Section M. Acts of cheating or/and plagiarism in MMBB 442/542 will result in an automatic 0 for that exam or paper and could result in an automatic F as a final grade for the course. Refer to the Student Code of Conduct (2300) in the Faculty Staff Handbook for more information.

The University of Idaho course evaluation site is located at this URL: <http://www.its.uidaho.edu/studentevals>. Student evaluations are confidential. As soon as the student submits an evaluation, the data is entered into a table that cannot be linked to the student. I strongly encourage all students to take a time to take time to evaluate this class. The students' inputs help to make this better.

### **Tentative subjects:**

1. The foundations of biochemistry: cellular, chemical, physical, genetic, and evolutionary. Biochemical and cellular basis of vision process. Evolution of

- vision pigments and recombination leading to color blindness. Hydrolytic cleavage of peptide by chymotrypsin, the enzyme structure and reaction mechanism. (*Lehninger*, chapters: 1; 6.4; 12.7 including Box 12.3; *Stryer Biochemistry*, chapter: 32.3)
2. Oxygen and water: the sculptors of life on the Earth. Carbon dioxide, carbonic acid and bicarbonate equilibria and buffer system. Structure and mechanism of carbonic anhydrase reaction (*Lehninger*, chap. 2; *Stryer Biochemistry*, chap 9.2; *Methods in Enzymology* vol. 105 1984).
  3. Amino acids, peptides, and proteins. Mass spectrometry as a principle analytical tool of proteomic and metabolomic research. (*Lehninger*, chap. 3; *Stryer Biochemistry*, chap. 4.1 and 4.2).
  4. Reactive oxygen species (ROS) in biological systems (*Methods in Enzymology* vol. 105, 1984). Definition of free radicals, cation radicals, anion radicals, radical propagation, radical polymerization, and radical recombination. (*Handbook of Organic Chemistry*, H. Beyer and W. Walter, T.J. Press Ltd. 1996). Reactive nitrogen species (RNS). Implication of ROS and RNS in aging process: “free radical theory of aging.” (*Mass Spectrometry Reviews*, 2005, 24, 701– 718)
  5. Iron homeostasis. Iron acquisition, iron storage, iron and redox stress, iron insertion into proteins, life without iron. (*FEMS Microb. Rev.* 27: 215-237, 2003 *Molec. Microbiol.* 54:14-22, 2004.)
  6. The three-dimensional structure of proteins (*Lehninger*, chap. 4).
  7. The citric acid cycle, the structure and function of pyruvate dehydrogenase complex (*Lehninger*, chap. 16; *Stryer* chap. 17).
  8. Proteins and amino acids degradation, nitrogen metabolism, urea cycle, ubiquitin-proteasome pathway (*Lehninger*, chap. 18 and 27; and *Stryer Biochemistry*, chap. 23, A. Goldberg et al., The cellular chamber of doom. 2001. *Scientific American*, Jan 2001 pp. 68-73).
  9. Biosynthesis of amino acids, nucleotides, and related molecules (*Lehninger*, chap. 22; and *Stryer Biochemistry*, chap. 24).
  10. Protein synthesis and processing, genetic code (primary and secondary), translation, posttranslational modifications. (*Lehninger*, chap. 27; and *Stryer Biochemistry*, chap 29).
  11. Gene regulation and recombinant DNA technology (*Lehninger*, chap. 9, 28).

12. The biochemical evolution of iron and copper proteins. Copper and iron metalloproteins are primary oxidases, oxygenases, and oxygen carriers in all cells. Their evolution will be covered from the early stages of the Earth's history (no oxygen) to the present multimetal containing oxidases (e.g., cytochrome oxides, superoxide dismutases). (from review papers of E. Frieden, including *Metal Ions in Biological Systems*, vol. 13:1-14, 1981).
13. Contemporary topics in biochemistry.
14. Nobel Price winners in biology and medicine in recent years, their research and the importance of their discoveries.