Micro625: Physiology of Microorganisms

Fall Semester, 2008

Time: Monday, Wednesday, Friday 8:50-9:40am, Rm. 1420 MSB

Professor:
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Assistant:
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Grading:

Your grade will be based on a total of 530 points

3 Exams	= 300 points
4 Problem sets	= 80 points
1 Comprehensive Final	= 150 points
Total:	530 points

Potential bonus points:
14 Confusing Topics (1 point each) See Below

Exams: Three exams will be worth 100 points each and will cover the class material up to the lecture before the exam day. For example, if the exam is on Wednesday night, the information covered will include material up to Monday's lecture.

The final will be worth 150 points and will have 100 points from the new material and 50 points of questions focused on the prior exams and problem sets.

Exams will be in short answer/essay/problem-solving format.

Make up exams will NOT be given.

Exam Schedule:
Monday September 29, 5:30-7:00 pm
Wednesday October 22, 5:30-7:00pm
Wednesday November 19, 5:30-7:00pm
Final: Wednesday December 17, 2:45-4:45pm

Problem Sets: Four Problems Sets will be handed out throughout the semester. Each Problem Set is worth 20 points. The Problem Sets will be handed out approximately half way through a particular section and will provide examples of the types of questions that will appear on the associated exam. The Problem Sets will be handed out in class one week before they are due. Answers to the Problem Sets will be handed out at the end of class the day the Problems Sets are due.

Problem Set Schedule:

Problem Set 1:	Out Sept. 17 – Due Sept. 24
Problem Set 2:	Out Oct. 13 – Due Oct. 20
Problem Set 3:	Out Nov. 7 – Due Nov. 14
Problem Set 4:	Out Dec. 5 – Due Dec. 12

Confusing Topics: Each Friday send me an email commenting on one topic presented during that week that was confusing and could be discussed in detail again. At the beginning of class on the following Monday, the topic with the most questions will be discussed. You will receive one bonus point for each week you send a question. The question must be received by Friday at midnight.

Textbook: There are **NO** required textbooks for this course. All material discussed in class and asked about on the exams will be provided by the instructor as part of the class handouts. The handouts will be copies of the slides presented in class.

You will be charged $10 for the handouts. Pay this fee as soon as possible in the Department of Bacteriology office (Rm. 1322 Microbial Sciences Building). **IF YOU FAIL TO PAY THIS FEE BY THE END OF THE SEMESTER – YOU WILL RECEIVE AN "F" FOR THE CLASS!**

Materials on Reserve at Steenbock Libraries:

"The Physiology and Biochemistry of Prokaryotes" 2nd Edition. David White. This is an excellent textbook on microbial physiology with a strong emphasis on metabolism. If you are looking to purchase the best and most current textbook on microbial physiology – this is it.

"Bacterial Metabolism" 2nd Edition. Gehard Gottschalk. An excellent textbook on the metabolism of bacteria. It has a strong emphasis on core metabolic pathways found in many organisms with a focus on *E. coli*.

"Biology of the Prokaryotes" Ed. J. Lengeler, G. Drews, H. Schlegel. Very thorough textbook on all aspects of microbial physiology without the usual "*E. coli*-centric" view of the world.

COURSE SCHEDULE

September 3:	Bioenergetics: Chemiosmotic theory, calculating electrochemical energy, and the thermodynamics of ATP generation.
September 5:	Simple mechanisms for generating an electrochemical gradient:Substrate/product exchange, sodium-pumping decarboxylations, bacteriorhodpsin.
September 8:	Introduction to electron transport chains: reduction potentials, electron/proton carriers, aerobic respiration by *E. coli* (Q loop mechanism).
September 10:	Flexibility of *E. coli* electron transport chain, anaerobic respiration, *Paracoccus denitrificans* electron transport chain, mitochondrial electron transport chain (Q-cycle).
September 12:	Mechanism of coupling electron transport chain-derived proton motive force to ATP synthesis, mechanism of ATP synthase, calculations concerning the scale and mechanism of the proton motive force.
September 14:	Research paper analysis of the electron transport chain of *Mycobacterium tuberculosis*.
September 15:	Introduction into phototrophic mechanisms for generating a proton motive force. Anoxygenic phototrophy by Green sulfur and non-sulfur bacteria.
September 17:	Anaoxygenic phototrophy by Purple sulfur and non-sulfur bacteria.
September 19:	Oxygenic phototrophy: comparison to plants and evolutionary relationship to anoxygenic phototrophy, mechanisms of light harvesting at multiple wavelengths.
September 22:	Introduction into fermentation: calculating oxidation states of molecules, analysis of the chemical energy of the cytosol for substrate-level phosphorylation.
September 24:	Analysis of fermentation pathways: homo- and heterofermentative lactic acid fermentation by pathogens, biofuel-producing fermentation, fermentation by *Clostridium* species.
September 26:	Introduction into central metabolism: discussion into chemical structures of essential metabolites and basic chemistry of metabolism.
September 29:	Review for Exam #1 (morning); **Exam #1** (evening)
October 1:	Glycolysis: chemical logic of pathway, steps involved in ATP and reducing equivalent generation.
October 3:	Regulation of metabolic flux of glycolysis by feedback regulation and precursor activation, thermodynamics of glycolytic pathway.
October 6:	Modified glycolytic pathway in archaea, analysis of the Entner-Doudoroff pathway.

October 8:	Pentose Phosphate Pathway: Chemical logic and mechanistic details of decarboxylation and rearrangements.
October 10:	Mechanistic details concerning pyruvate to acetyl-CoA conversion, introduction into the TCA cycle.
October 13:	Tricarboxylic acid pathway: chemical logic and mechanistic details of pathway when functioning as oxidative cycle.
October 15:	Glycoxylate shunt and anaplurotic pathways.
October 17:	Research paper discussion on a modified TCA cycle in *M. tuberculosis*. Depolymerization of larger carbon sources
October 20:	Nitrogen and sulfur assimilation.
October 22:	Review for Exam #2 (morning); **Exam #2** (evening)
October 24:	Introduction into the nitrogen cycle. Nitrate reductases and their role in respiration, dissimilation, and assimilation.
October 27:	Denitrification during anaerobic respiration.
October 29:	Nitrogen fixation: mechanism of well-known nitrogenase and the difference with the newly identified oxygen-resistant nitrogenase.
October 31:	Regulation of nitrogenase at transcriptional and posttranslational level.
November 3:	Anaerobic ammonia oxidation (ANAMMOX)
November 5:	Ammonia oxidizating bacteria, nitrate oxidizing bacteria
November 7:	Sulfur cycle introduction: use of sulfate as an electron accepator and thiosulfate as electron donor in anaerobic respiratory systems.
November 10:	Iron oxidizing and reducing bacteria. Acetogenesis: mechanism of the methyl and carboxyl branches of acetogenesis, energy generation by the generation of sodium and proton motive forces.
November 12:	Continuation of acetogenesis, introduction into methanogenesis.
November 14:	Methanogenic mechanisms using alternative electron donors/acceptors.
November 17:	Synotrophic organisms: symbiosis through metabolism.
November 19:	Review for Exam #3 (morning); **Exam #3** (evening)
November 24:	C1 metabolism by methylotrophs
November 26:	CO_2 fixation using the Calvin Cycle. Phospholipid biosynthesis.
December 1:	Continuation of phospholipid biosynthesis and modification, peptidoglycan and LPS biosynthesis.

December 3:	Protein secretion: SecB-, SRP-, and independent protein secretion pathways.
December 5:	Protein secretion: Type I-IV secretion systems used by pathogens.
December 8:	Flagella assembly and chemotaxis.
December 10:	Cell-cell communication by bacteria. Autoinducers and disruption of these autoinducers.
December 12:	Continuation of cell-cell communication and its use in coordinating multicellular behavior by bacteria.
December 17:	**Final Exam**