Syllabus for ESE/BI 168 – MICROBIAL METABOLIC DIVERSITY

Winter Term 2011; MWF 11-12pm, 215 North Mudd

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OFFICE HOURS
by appointment

Week	Monday	Wednesday	Friday	Topic
1	Jan. 3 *lecture*	Jan. 5 *paper 1A*	Jan. 7 *paper 1B*	ΔG
2	Jan. 10 *lecture*	Jan. 12 *paper 2B*	Jan. 14 *paper 2C*	Δp/ Fermentation
3	Jan. 17 *holiday/no class*	Jan. 19 *paper 3A*	Jan. 21 *paper 3B*	Respiration
4	Jan. 24 *lecture*	Jan. 26 *paper 4A*	Jan. 28 *paper 4B*	Photosyn.
5	Jan. 31? *lecture*	Feb. 2? *paper 5A* MIDTERM out	Feb. 4 *paper 5B*	Syntrophy
6	Feb. 7 *lecture* MIDTERM due	Feb. 9 *paper 6A*	Feb. 11 *paper 6B*	C-fixation/ Biomineral.
7	Feb. 14 *lecture*	Feb. 16 *paper 7A*	Feb. 18 *paper 7B&C*	Metal(loid)s
8	Feb. 21 *holiday/no class*	Feb. 23 *paper 8A*	Feb. 25 *paper 8B*	Redox Homeostasis
9	Feb. 28 *lecture*	Mar. 2 *paper 9A*	Mar. 4 *paper 9B*	Persistence
10	Mar. 7 *paper 10A*	Mar. 9 *papers 10B&C*	Mar. 11 *Optional Discussion*	Signaling

FINAL EXAM WEEK: March 14-16

Reading

The course reader contains the papers we will discuss in class. In addition, I will assign specific sections from D. White's The Physiology and Biochemistry of Prokaryotes, 3rd edition as background reading to complement the week's theme. Handouts for topics not covered in this book will be provided as appropriate.

Week

1 *handout*-Aquatic Chemistry Tables

2 Chapter 3 and Chapter 14

3 Chapter 4

4 Chapter 5

5 *handout*

6 Chapter 13 + Calvin Nobel Lecture

7 *handout*

8 *handout*

9 *handout*

10 *handout*

Format. For two thirds of the class meetings, one original research paper will be assigned as required reading. During class, this paper will be discussed critically and in detail. The emphasis here is on discussion—apart from the lectures I give to introduce the topics, this will not be a lecture course. I expect each student to participate actively and often. To insure this participation, I will call on students at random either to summarize the major points in a paper, or to comment specifically on a particular experiment or conclusion. Accordingly, it is essential that you read and think about the assigned papers. If you have not done so, then don't come to class.

Grades. One third of your grade will be based on the quality and quantity of your classroom participation. Another third will come from a midterm examination. The final third will come from a 30 minute oral final examination. The midterm exam will not come from the assigned reading. Rather, it will test your overall understanding. In the final, we'll try to determine how much you have really learned.

Readings

Introduction (will not be discussed in class, but you are responsible for reading):
Kluyver, A.J. 1924. Unity and diversity in the metabolism of microorganisms. *Chemisch Weekblad*, 21:266-.

1A. Jackson, B. and McInerney, M.J. 2002. Anaerobic microbial metabolism can proceed close to thermodynamic limits. *Nature*, 415:454-456.
1B. Lin, B., Westerhoff, H.V. and Röling, F.M. 2009. How *Geobacteraceae* may dominate subsurface biodegradation: physiology of *Geobacter metallireducens* in slow-growth habitat-simulating retentostats. *Environ. Microbiol.*, 11:2425-2433.

2A Mitchell, P. 1961. Coupling of phosphorylation to electron and hydrogen transfer by a chemiosmotic type of mechanism. *Nature*, 191:144-148.
2B. Maloney, P.C. Obligatory coupling between proton entry and the synthesis of adenosine 5'-triphosphate in *Streptococcus lactis*. 1977. *J. Bacteriol.*, 132:564-575.
2C. Michel, T.A. and Macy, J.M. 1990. Generation of a membrane potential by sodium-dependent succinate efflux in *Selenomonas ruminantium*. *J. Bacteriol.*, 172: 1430-1435.

3A. Calhoun, M.W. *et al.* 1993. Energetic efficiency of *Escherichia coli*: effects of mutations in components of the aerobic respiratory chain. *J. Bacteriol.*, 175:3020-3025.
3B. Tran, Q.H. and Unden, G. 1998. Changes in the proton potential and the cellular energetics of *Escherichia coli* during growth by aerobic and anaerobic respiration or by fermentation.

4A. Cohen, Y., Padan, E., and Shilo, M. 1975. Facultative anoxygenic photosynthesis in the cyanobacterium *Oscillatoria limnetica*. *J. Bacteriol.*, 123:855-861.
4B. Ehrenreich, A. and Widdel, F. 1994. Anaerobic oxidation of ferrous iron by purple bacteria, a new type of phototrophic metabolism. *App. Environ. Microbiol.*, 60:4517-4526.

5A. Bryant, M.P., Wolin, E.A., Wolin, M.J., and Wolfe, R.S. 1967. *Methanobacillus omelianskii*, a symbiotic association of two species of bacteria. *Archiv. Microbiol.*, 59:20-31.
5B. Fröstl, J.M., and Overmann, J. 1998. Physiology and tactic response of the phototrophic consortium *"Chlorochromatium aggregatum"*. *Arch. Microbiol.*, 169:129-135.

6A. Calvin, M. and Benson, A.A. 1948. The path of carbon in photosynthesis. *Science*, 107:476-480.
6B. Milligan, A.J. and Morel, F.M.M. 2002. A proton buffering role for silica in diatoms. *Science*, 297:1848-1850.

7A. Lane, T.W. and Morel, F.M.M. 2000. A biological function for cadmium in marine diatoms. *PNAS*, 97:4627-4631.
7B. Lane, T.W., Saito, M.A., George, G.N., Pickering, I.J., Prince, R.C., and Morel, F.M.M. 2005. A cadmium enzyme from a marine diatom. *Nature*, 435:42.

7C. Wolfe-Simon, F. *et al.*. 2010. A bacterium that can grow by using arsenic instead of phosphorus. *Science*, Will appear in Science Express on Friday!

8A. Richardson, D.J. *et al.* 1988. The role of auxiliary oxidants in maintaining redox balance during phototrophic growth of *Rhodobacter capsulatus* on propionate or butyrate. *Arch. Microbiol.* 150:131-137.
8B. Dhamdhere, G. and Zgurskaya, H.I. 2010. Metabolic shutdown in *Escherichia coli* cells lacking the outer membrane channel TolC. 77:743-754.

9A. Rao, P.S., Alonso, S., Rand, L., Dick, T. and Pethe, K. 2008. The protonmotive force is required for maintaining ATP homeostasis and viability of hypoxic, nonreplicating *Mycobacterium tuberculosis*. *PNAS*, 105:11945-11950.
9B. Pamp, S.J., Gjermansen, M., Johansen, H.K. and Tolker-Nielsen, T. 2008. Tolerance to the antimicrobial peptide colistin in *Pseudomonas aeruginosa* biofilms is linked to metabolically active cells, and depends on the *pmr* and *mexAB-oprM* genes.

10A. Schauder, S., Shokat, K., Surette, M.G., and Bassler, B.L. 2001. The LuxS family of bacterial autoinducers: biosynthesis of a novel quorum-sensing signal molecule. *Mol. Microbiol.*, 42:463-476.
10B. Kolter, R. 2007. Deadly Priming. *Science*, 318:578-579.
10C. Kolodkin-Gal, I. *et al.* 2007. A linear pentapeptide is a quorum-sensing factor required for *mazEF*-mediated cell death in *Escherichia coli*. *Science*, 318:652-655.