# Syllabus for ESE/BI 168 – MICROBIAL METABOLIC DIVERSITY

Winter Term 2020/2021; MWF 9am-10am
Zoom Link: https://caltech.zoom.us/j/86870121749

## OFFICE HOURS

Professor: Dianne K. Newman; dkn@caltech.edu  
by appointment

TAs: John Ciemniecki; jciemnie@caltech.edu  
by appointment

Shaelyn Silverman; ssilverman@caltech.edu  
by appointment

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<th>Week</th>
<th>Monday</th>
<th>Wednesday</th>
<th>Friday</th>
<th>Topic</th>
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<td>Jan. 4 lecture</td>
<td>Jan. 6 paper 1A</td>
<td>Jan. 8 paper 1B</td>
<td>Foundations of Metabolism</td>
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<td>2*</td>
<td>Jan. 11 lecture</td>
<td>Jan. 13 lecture</td>
<td>Jan. 15 paper 2A</td>
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<td>3*</td>
<td>Jan. 18 MLK Day</td>
<td>Jan. 20 paper 3A</td>
<td>Jan. 22 paper 3B</td>
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<td>Jan. 25 lecture</td>
<td>Jan. 27 paper 4A</td>
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<td>Feb. 1 lecture</td>
<td>Feb. 3 paper 5A MIDTERM OUT</td>
<td>Feb. 5 paper 5B</td>
<td>Respiration</td>
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<td>6*</td>
<td>Feb. 8 lecture MIDTERM DUE</td>
<td>Feb. 10 paper 6A</td>
<td>Feb. 12 paper 6B</td>
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<td>Feb. 17 paper 7A</td>
<td>Feb. 19 paper 7A</td>
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<td>Feb. 24 papers 8A</td>
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<td>Mar. 3 paper 9A</td>
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<td>Mar. 8 paper 10A</td>
<td>Mar. 10 paper 10B, re-read paper 1A</td>
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<td>Growth in Context</td>
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<td>ORAL FINALS (TIMES TBD)</td>
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* recitations w/ TAs will be offered these weeks, time TBD

### Format
For two thirds of the class meetings, 1-2 original research papers will be assigned as required readings. During class, the papers 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. My goal is to ensure that
everyone participates equally and that students become comfortable engaging in constructively
critical discussions. 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.

**Zoom Format.** Due to Covid-19, this course will be conducted virtually through Zoom. Lectures
will require real-time note taking but will be recorded. The Zoom format for paper discussions
will depend on the class size.

**Grades.** One third of your grade will be based on the quality and quantity of your classroom
participation. Another third will come from a take-home midterm examination. The final third
will come from a 30 minutes oral final examination. The midterm exam will not come from the
assigned reading. Rather, it will test your overall understanding of the material we have covered
until that point. In the final, we’ll try to determine how much you have synthesized the key
concepts presented throughout the course.

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**Readings**

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*, 4th edition, or review
articles as background reading to complement the week’s theme.

**Week 1: Foundations of Metabolism**

Required background reading: From Harold F.M. *The Vital Force: A Study of Bioenergetics*,
Chapter 2, The Metabolic Web: “The Logic of Metabolism”, “ATP and Energy Coupling”,
“Functional Organization of Metabolism”.

1A: Kluyver, A.J. 1924. Unity and diversity in the metabolism of microorganisms. *Chemisch
Weekblad*, 21:266-.

1B: Chapman, A.G. *et al.* 1971 Adenylate energy charge in *Escherichia coli* during growth

**Week 2: ΔG**

Required background reading: D. Canfield, Ch. 3 – Thermodynamics and Microbial Metabolism;
Aquatic Chemistry Tables, Morel and Hering

2A: Jackson, B. and McInerney, M.J. 2002. Anaerobic microbial metabolism can proceed

**Week 3: Fermentation**
Textbook reading: White: Chapter 8, 15


Week 4: PMF/ATPase

Textbook reading: White: Chapter 4
Optional background reading: P. Mitchell Nobel Prize lecture


Week 5: Respiration

Textbook reading: White: Chapter 5


Week 6: Photosynthesis

Textbook reading: White: Chapter 6
Optional background reading: M. Calvin Nobel Prize lecture


**Week 7: Electron Bifurcation**


**Textbook reading:** White: Chapter 5 (section 5.2)


**Week 8: Syntrophy**


**Week 9: Redox Homeostasis**


**Week 10: Growth in Context**


1A: Kluyver, A.J. 1924. Unity and diversity in the metabolism of microorganisms. *Chemisch Weekblad*, 21:266-. NOTE: Re-read (this was assigned the 1st week of class).

**Appendix**

I. Aquatic Chemistry Tables from Morel and Hering
II. Four fun articles (these papers will give you some impressive and fun facts to share with your family and friends):