Bi/Ch113: Biochemistry of the Cell, Spring 2017

Lectures: Tuesday and Thursday 11-11:55 am, Broad 100
Section 01: Wednesday 2-3:55 pm, Broad 200
Section 02: Thursday 7-8:55 pm, Kerckhoff 101

Date	Topic	Lodish 8th (2016)	Alberts 6th (2014)
4-Apr	Introduction	Chapters 4, 6	Chapters 8, 9
6-Apr	Protein translocation [1]	13.1-13.2	669-681
11-Apr	Secretion I [2, 3]	14.1-14.4	695-722
13-Apr	Secretion II	14.1-14.4	695-722
18-Apr	Endocytosis [4]	14.5	730-740
20-Apr	Membrane deformation and dynamics [5]	7.1-7.2	Chapter 10
25-Apr	Multivesicular body formation [6]	14.6	
27-Apr	Viral entry [7]		
2-May	ER morphology [8]		682-691
4-May	Autophagy [9, 10]	14.6	722-729
• *Midterm handed out after May 4 class, due beginning of May 9 class.*			
9-May	Apoptosis [11], Dr. Bruce Hay	21.5	Chapter 18
11-May	Mitochondrial protein import [12]	13.4	658-669
16-May	Mitochondrial dynamics [13]	12.2	
18-May	Trafficking and disease I [14]		
23-May	Trafficking and disease II		
25-May	Intracellular signaling pathways [15]	16.1-16.4	850-866
30-May	Oncogenesis I [16]	Chapter 24	Chapter 20
1-Jun	Oncogenesis II	Chapter 24	Chapter 20
• *Final exam, due Thursday June 8 (4 pm) for senior/grad students* • *due June Thursday June 15 (4 pm) for others*			

Review papers (required reading):

These papers are available on the course website.

1. Park, E. and T.A. Rapoport (2012). Mechanisms of Sec61/SecY-mediated protein translocation across membranes. Annu Rev Biophys 41, 21-40.
2. Bonifacino, J.S. and B.S. Glick (2004). The mechanisms of vesicle budding and fusion. Cell 116, 153-66.
3. Mellman, I. and G. Warren (2000). The road taken: past and future foundations of membrane traffic. Cell 100, 99-112.

4. Jung, N. and V. Haucke (2007). Clathrin-mediated endocytosis at synapses. Traffic 8, 1129-36.
5. Martens, S. and H.T. McMahon (2008). Mechanisms of membrane fusion: disparate players and common principles. Nat Rev Mol Cell Biol 9, 543-56.
6. Christ, L., C. Raiborg, E.M. Wenzel, C. Campsteijn, and H. Stenmark (2017). Cellular Functions and Molecular Mechanisms of the ESCRT Membrane-Scission Machinery. Trends Biochem Sci 42, 42-56.
7. Harrison, S.C. (2008). Viral membrane fusion. Nat Struct Mol Biol 15, 690-8.
8. Westrate, L.M., J.E. Lee, W.A. Prinz, and G.K. Voeltz (2015). Form follows function: the importance of endoplasmic reticulum shape. Annu Rev Biochem 84, 791-811.
9. Mizushima, N., B. Levine, A.M. Cuervo, and D.J. Klionsky (2008). Autophagy fights disease through cellular self-digestion. Nature 451, 1069-75.
10. Yang, Z. and D.J. Klionsky (2010). Eaten alive: a history of macroautophagy. Nat Cell Biol 12, 814-22. PMC3616322
11. Tait, S.W. and D.R. Green (2010). Mitochondria and cell death: outer membrane permeabilization and beyond. Nat Rev Mol Cell Biol 11, 621-32.
12. Neupert, W. and J.M. Herrmann (2007). Translocation of proteins into mitochondria. Annu Rev Biochem 76, 723-49.
13. Mishra, P. and D.C. Chan (2014). Mitochondrial dynamics and inheritance during cell division, development and disease. Nat Rev Mol Cell Biol 15, 634-46. PMC4250044
14. Youle, R.J. and D.P. Narendra (2011). Mechanisms of mitophagy. Nat Rev Mol Cell Biol 12, 9-14.
15. Dhillon, A.S., S. Hagan, O. Rath, and W. Kolch (2007). MAP kinase signalling pathways in cancer. Oncogene 26, 3279-90.
16. Hanahan, D. and R.A. Weinberg (2011). Hallmarks of cancer: the next generation. Cell 144, 646-74.

Course information:

Bi/Ch 113 (4-0-8) is an advanced undergraduate course on selected topics in modern cell biology. Students are expected to have taken introductory biology and Bi 9 (Introductory Cell Biology). Course website: http://www.its.caltech.edu/~bich113/

There are three major goals of the course: (1) To present our current understanding of these topics, with an emphasis on the underlying molecular mechanisms. (2) To illustrate the experimental strategies biologists use to analyze cell biological processes. (3) To read research papers in detail and to discuss them critically.

Required reading
Background reading: Either Lodish et al, *Molecular Cell Biology* (7th edition, 2013) or Alberts et al, *Molecular Biology of the Cell* (6th edition, 2014) is sufficient to cover background material for the required papers.

Primary reading: Each lecture/topic will have an associated review article, and research papers will be assigned for section homework and discussion.

Office hours
Please contact by email to make an appointment: dchan@caltech.edu.

Teaching assistants
Amanda Mock, jmock@caltech.edu
Greg Varuzhanyan, gvaruzhanyan@caltech.edu
Ruohan Wang, rwwang@caltech.edu

Sections
Students are assigned to either section 01 or 02. One research paper will be presented and discussed in detail each week in section. See the handout for details on these sections.

Exams
The dates of the midterm and final are listed on the syllabus.

Section performance:
Sections are an essential part of this class, because one of the major goals of this course is to critique and present original papers. Therefore, *section attendance is mandatory*, will be recorded, and will be incorporated into the section grade.

Grading:
Course grade is determined as follows: section performance 1/3; midterm 1/3; final exam 1/3.

Policy on deadlines:
Students are required to hand in paper evaluations and exams on time, in addition to attending classes and sections. Make sure that you are able to make the deadlines listed, because *no extensions are allowed for paper summaries, the midterm, or the final*.

Additional policies:
In homework and exams, copying of materials from papers or the internet is considered plagiarism and is strictly prohibited. Such actions will result in no credit and will be reported to the Board of Control.

Students are encouraged to collaborate with each other in learning the material. However, exams must be completed individually without consultation with others.

Guidelines for reading and discussing research papers:

In scientific work, it is essential to be able to read papers critically. Papers should be read with a critical frame of mind (to what degree do the experiments support the authors' claims?). In addition to reading critically, the ability to communicate with clarity is an important skill. In this course, you will read and discuss several research papers. Many of these papers are true classics that have greatly advanced the field; others, while important, have raised controversy and have flaws. You should approach these exercises as an opportunity to both think and communicate clearly.

Structure of a scientific paper

Most scientific papers follow a general format. The **abstract** summarizes the work and should be understandable to a relatively broad audience. Most scientists peruse the title and abstract of the paper to decide whether the paper is worth detailed reading. The **materials and methods** section documents the technical aspects of the paper. Ideally, it should provide enough details so that other investigators can reproduce the experiments. The **results** section forms the core of the paper. It describes the experiments performed and the observations made. This section contains the **figures** and **tables,** which contain the data of the paper. These data should be scrutinized carefully. Finally, the **discussion** section interprets the results and places the conclusions in the context of our current understanding. In this section, authors have more liberty to (cautiously) speculate about the significance of their findings.

Discussing papers

In your reading and discussion, the following questions should be keep in mind:

1. What is the overall question the authors are addressing? Is it an important question?
2. What experimental strategy do the authors use to answer this question?
3. Are the experiments appropriate for the question, and are they well-done? Are the data convincing?
4. Are the experiments properly controlled?
5. How strongly do the data support the conclusions? That is, do you believe their conclusions?
6. Are the findings interesting and important?
7. Where does one go from here?
    - -What additional studies can be done to test the conclusions?
    - -Is a new line of research suggested by these findings?

Section homework: Paper evaluations

You will receive a copy of the paper one week before section. Prepare a written evaluation (maximum 3 pages) that addresses each of these 7 issues and hand it to the teaching assistants at the beginning of the section. Late evaluations are not accepted.

Research paper presentations:

In science, it is important to be able to communicate clearly. To get practice, students will form groups of 2-3 students to present the assigned paper each section. The TAs will work with students to help their presentation. The presentations should typically include the following, which would be split among the members of a group as appropriate:

1) Provide **introduction** giving background material and describing the state of knowledge at the time the experiment was done. How does this work fit into the overall state of the field?

2) Analyze the **individual figures/tables** in the paper. What is the figure purporting to demonstrate, and what method is used? Are the data convincing?

3) **Overall evaluation/conclusions**: does the paper accomplish what it claims to do? Are the results important? What are the directions for future work?

The papers for section are available on the BiCh113 website.