

Division of Biology, California Institute of Technology

## Bi-8: Introduction to Molecular Biology

by Prof. Angela Stathopoulos

January-March, 2009

Tuesdays and Thursdays, from 1-2 pm, Kerckhoff 119  
Recitation sections on Mondays (4-5 pm) or Tuesday (10-11 am)

### *Outline of the course and the dates of lectures:*

**Jan. 6. Lecture 1.** (Stathopoulos). DNA → RNA → protein within the cell. Introduction to the central dogma and to prokaryotic and eukaryotic cells.

*MBOC Chapter 6, p.329-331 and p. 400-408, and Chapter 1, p. 1-18, 26-33*

*Review: Chapter 2, p.45-55*

**Homework: Problem Set #1 Handed out**

**Jan. 8. Lecture 2.** (Stathopoulos). Biological macromolecules — introduction to the major classes of biopolymers: nucleic acids, lipids, and carbohydrates. Anabolic and catabolic pathways — the central role of ATP, catalysis, enzymatic catalysis.

*MBOC Chapter 2, p. 55-87; Chapter 8, p. 517-521*

**Recitation Topic Jan 12/13: Organic chemistry: chemistry of Life, atoms, forces, and amino acid/peptide chemistry**

**Jan. 13. Lecture 3.** (Stathopoulos). Proteins. Specification by amino acid sequence; functional domains; assembly of larger structures; experimental techniques used to analyze proteins.

*MBOC Chapter 2, p. 125-152; review p. 106-119 and Chapter 8, p. 510-531*

**Homework: PROBLEM SET #1 DUE, Problem Set #2 handed out**

**Jan. 15. Lecture 4.** (Stathopoulos). Protein Function. Protein chemistry; enzymes and kinetics; regulatory proteins.

*MBOC Chapter 3, p. 152-178, 187-190*

**Jan 19/20: No recitation sections this week due to Institute holiday Jan 21.**

**Jan. 20. Lecture 5.** (*Stathopoulos*). Structure and Function of DNA.

*MBOC Chapter 4, p. 195-207*

**Homework: PROBLEM SET #2 DUE.**

**Jan. 22. Lecture 6.** (*Stathopoulos*). DNA and chromosomes

*MBOC Chapter 4, p. 208-245.*

**Quiz handed out.**

**Recitation Topic Jan 26/27: Michaelis Menten enzyme kinetics**

**Jan. 27. Lecture 7.** (*Stathopoulos*). DNA replication

*MBOC Chapter 5, p. 263-295*

**QUIZ DUE at the beginning of lecture.**

**Jan. 29. Lecture 8.** (*Stathopoulos*). DNA repair and recombination; experimental techniques to analyze DNA.

*MBOC Chapter 5, p. 295-316, Chapter 8, p. 532-553*

**Homework: Problem Set #3 handed out.**

**Recitation Topic Feb 2/3: Eukaryotic vs. Prokaryotic DNA organization and transcription and Recombination exercises**

**Feb 3. Lecture 9.** (*Stathopoulos*). Protein Structure: discussion using DNA-binding proteins as an example.

*MBOC Chapter 7, 416-426*

**Feb. 5. Lecture 10.** (*Stathopoulos*). TBD

**Homework: PROBLEM SET #3 DUE**

**Midterm handed out**

**Recitation Topic Feb 9/10: No new recitation material this week. TAs will hold office hours to answer questions on the material during recitation time.**

**Feb. 10. MIDTERM EXAM DUE at 2:30pm**

**Feb. 12. Lecture 11.** (*Stathopoulos*) Introduction to regulation of gene expression.

*MBOC Chapter 6, p. 332-362 and Chapter 7, p. 411-421, 426-432.*

**Feb 16/17: No recitation sections this week due to Institute holiday on Feb 16.**

**Feb. 17. Lecture 12.** (*Elowitz*). From simple genetic circuits to cellular behaviors.  
*MBOC Chapter 3, p. 169-173; Chapter 7, p. 432-453*  
Problem Set #4 handed out

**Feb. 19. Lecture 13.** (*Davidson*). Evolution and Development.  
*MBOC Chapter 7, p. 454-466 and Chapter 8, p. 553-576*

**Recitation Topic Feb 23/24: Activator and Repressor Logic -- regulatory circuit exercises**

**Feb. 24. Lecture 14.** (*Stathopoulos*). (*Stathopoulos*). Studying gene expression and function; genomes // Translation and its regulation.  
*MBOC Chapter 1, p. 18-26 and Chapter 6: p. 366-381*  
Homework: PROBLEM SET #4 DUE, Problem Set #5 handed out

**Feb. 26. Lecture 15.** (*Stathopoulos*). Post-translational control.  
*MBOC Chapter 6: p. 382-399 and Chapter 7: p. 477-497*

**Recitation Topic March 2/3: Genome biology and preview of immunology**

**Mar 3. Lecture 16.** (*Rothenberg*). Immunology.  
*MBOC Chapter 24, p. 1531-1537, and Chapter 25, p. 1540-1545 and Chapter 8, p. 501-510*  
Homework: PROBLEM SET #5 DUE

**March 5. Lecture 17.** (*Baltimore*). Viruses.  
*MBOC Chapter 24, p. 1496-1498.*

**Recitation Topic March 9/10: No new recitation material this week. TAs will hold office hours to answer questions on the material during recitation time.**

**March 10. Lecture 18.** (*Stathopoulos, TAs*). Pre-Exam Review Session.

**March 12. Final Exam available by 1pm -- outside Prof. Stathopoulos' office, 261 Broad.**

**March 16. Monday. Final Exam due by 5pm -- 261 Broad.**

## **1. Recitation sections:**

Recitation sections DO NOT meet on Jan 19/20 and Feb. 16/17 due to Institute holidays that week.

Mon 4-5 pm - 101 Kerckhoff (last names A-K)

Mon 4-5 pm - 24 Kerckhoff (last names L-Z)

Tues 10-11 am - 03 Beckman Behavioral Biology (BBB)

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## **2. Textbooks for Bi8 course:**

### **Main reference:**

Alberts, Johnson, Lewis, Raff, Roberts, Watson (5th edition, 2007)

**Molecular Biology of the Cell (“MBOC”)**. Garland Publ. Co.

This book has been ordered for the course by the Caltech bookstore, and should be available by January 5. (Also on reserve at the Millikan Library).

### **Alternative references:**

Alberts, Bray, Hopkin, Johnson, Lewis, Raff, Roberts, Walter (2<sup>nd</sup> edition, 2004)

**Essential Cell Biology (“ECB”)**. Garland Publ. Co. (Available for purchase at the Caltech bookstore or on reserve at the Millikan Library)

Lodish, Baltimore, Berk, Zipursky, Matsudaira, Darnell (5th edition, 2003)

**Molecular Cell Biology**. Freeman and Co.

Karp (4<sup>th</sup> edition, 2005)

**Cell and Molecular Biology: Concepts and Experiments**. John Wiley & Sons, Inc.

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## **3. Course website:** [www.its.caltech.edu/~bi8](http://www.its.caltech.edu/~bi8)

Problem sets, quiz, exams, and answer keys will be available for download. When available, Powerpoint files for lectures will also be loaded – but you are responsible for all lecture content which may be missing from Powerpoint files.

#### **4. Schedule of Quiz and Exams**

The collaboration policy has been attached at the end of the syllabus. You may work collaboratively on the problem sets – but all answers must be written in your own words. You are not to use any internet sources on exams. Do not copy text from any source including textbooks or your peers. If you use sources outside the textbook or lecture notes to answer questions please cite your references. **DO NOT CONSULT PROBLEM SETS, EXAMS, OR ANSWER KEYS FROM THE BI8 COURSES OF PREVIOUS YEARS.** No late problem sets, quiz, or exams will be accepted: zero points will be assigned once keys are posted online.

The quiz and both exams are timed, take-home and individual effort, with no collaboration. The Quiz will be open-book and open-notes. The midterm and final will include both a closed-book section and an open-book section.

**Problem Sets (30%: 100 points total):** Study questions will be given out weekly (except for exam weeks). They will be graded, then returned and discussed during TA led recitation sections. Five problems sets – 20 points each.

**Jan. 29 (Tuesday): Quiz (10%: 50 points).** Due date: by 1:00 pm on Jan. 29 (Tuesday). The answers can be turned in by the beginning of lecture or can be placed in a box outside Prof. Stathopoulos' office on the second floor of the Broad building, 261 Broad, by 1:00 pm on Jan. 29.

**Feb. 7 (Thursday): Midterm Exam (25%: 150 points).** The midterm is due by 2:30 pm on Thursday, February 7. The answers can be turned in in person outside Kerckhoff 114 between 1:00 pm and 2:30 pm or can be placed in a box outside Prof. Stathopoulos' office on the second floor of the Broad building, 261 Broad, by 2:30 pm on Feb. 10.

**March 17 (Monday): Final Exam (35%: 200 points).** The final will be available in the box near Prof. Stathopoulos' office (261 Broad) by 1 pm on March 14. Due date: by 5 pm on March 17 (Monday). The answers should be placed inside the Bi8 dropbox outside Prof. Stathopoulos' office (261 Broad).

**500 points total. Bi-8 course is Pass/Fail.**

## **5. Regrade Policy:**

Requests for regrades should be discussed with your recitation TA before submitting a request. Requests must be submitted no later than 1pm on the Thursday of the week the problem set, quiz or exam was returned. Requests must include a detailed written description containing the problem number and why you think that your answer was misgraded which should be stapled to the front of the exam or problem set. Requests for regrades should be given to a TA or the instructor at the beginning of class on Thursday or arrangements should be made to turn it in. **DO NOT LEAVE REGRADES IN THE HOMEWORK BOX.** All requests are subject to a regrade of the entire exam or problem set.

## **6. Contact information:**

Teaching assistants and the lecturers will be available to address your questions and/or concerns.

**Head TA:** Yun Elisabeth Wang ([wangy2@caltech.edu](mailto:wangy2@caltech.edu));

**Teaching Assistants:** Adler Dillman ([adlerd@caltech.edu](mailto:adlerd@caltech.edu));

Na Hu ([nahu@caltech.edu](mailto:nahu@caltech.edu));

Amy McMahan ([ajm@caltech.edu](mailto:ajm@caltech.edu));

Nathanie Trisnadi ([ntrisnadi@caltech.edu](mailto:ntrisnadi@caltech.edu))

**Main Lecturer:** Angela Stathopoulos ([angelike@caltech.edu](mailto:angelike@caltech.edu))

**Guest lecturers:** David Baltimore

Eric Davidson

Michael Elowitz

Ellen Rothenberg

## Collaboration Policy

Course: Biology 8  
 Term: Winter 2009  
 Instructor: Angela Stathopoulos  
 Head TA: Elisabeth Wang

This sheet outlines the default course policies for problem sets, quizzes, and tests. These may be overridden by instructions to the contrary in particular instances. However, in the absence of other information, you are expected to follow these policies. If you have any questions, ASK! Ignorance and confusion are not excuses.

While working, you may consult:	PS	Quiz	Test
Required texts	X	X	See Comments
Recommended texts	X	X	See Comments
Textbook from prerequisite class (i.e. Apostol for a DiffEq class)	X	X	
Reference book (CRC, Merck Index, etc.)	X	X	
Any other book	X	X	

Comments:

The midterm and final exams will consist of an open book section as well as a closed book section. No materials can be used for the closed book section. Required and recommended texts can be used for the open book section.

You may use solution manuals for:	PS	Quiz	Test
Required texts	X	X	
Recommended texts			
Textbook from prerequisite class			
Any other book			

Comments:

While working, you may consult:	PS	Quiz	Test
You may use the Internet	X		

Comments:

You may not use the internet for any exam (i.e. quiz, midterm, and final). You may use the internet for problem sets, but it is discouraged (because the answers should more easily be found in the lecture notes and/or assigned reading) and there is a chance you will find an incorrect answer this way.

As for notes, you may use:

	PS	Quiz	Test
Your class notes (taken in lecture)	X	X	See Comments
Hand copies of the class notes of others	X	X	See Comments
The class notes of others (original or Xeroxed)			
Anything written in your own hand	X	X	See Comments
Class handouts	X	X	See Comments
TA/section handouts	X	X	See Comments
Homework/exams of past years			
Homework/exams of this year	X		See Comments
Solutions to homework/exams of past years			

Comments:

The midterm and final exams will consist of an open book section as well as a closed book section. No materials can be used for the closed book section. Class notes, anything written in your own hand (including notes of others), handouts and exams or homework from this year can be used for the open book section.

For computational aids you may use:

	PS	Quiz	Test
Four function/scientific calculators	X	X	X
Graphing calculators	X	X	X
Symbolic manipulators			
Mathematical reference tables (integrals, Laplace transforms, etc.)			

Comments:

The following types of collaboration are allowed:

	PS	Quiz	Test
Basic discussion of the problems	X		
Look at the communal materials while writing up solutions	X		
Look at other's non-communal work (i.e. write-ups)			
Turn in a set with more than one name on it			

Comments:

Answers to questions must be written in your own words.