

**Biology for Bioengineers**  
(ORTO 6004)  
**Fall, 2009**

**Course Coordinators**

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**Reading and Study Materials**

Required reading

- 1) GM Cooper and RE Hausman, The Cell: A Molecular Approach, Fifth Edition, Sinauer Associates, Sunderland, MA, 2009.

Recommended supplemental reading (copies for borrowing are available in our office)

- 1) A Tözeren and SW Byers, New Biology for Engineers and Computer Scientists, Pearson Education, Inc., Upper Saddle River, NJ, 2004.
- 2) BO Palsson and SN Bhatia, Tissue Engineering, Pearson Education, Inc., Upper Saddle River, NJ, 2004.

# **Biology for Bioengineers**

(ORTO 6004)

## **Goals and Objectives**

### Course goals/objectives

- 1) To review the basic principles of molecular and cellular biology so that BME students will become familiar with the vocabulary and processes associated with the Central Dogma of Modern Biology.
- 2) To review the basic structure of cells and the processes that occur inside cells (including bioenergetics, metabolism, the cytoskeleton, cell movement, cell signaling, the cell cycle and cell death) and in the extracellular matrix so that BME students will gain a fundamental understanding of cellular functions.
- 3) To discover the contribution of biology to a comprehensive understanding of problem solving in biomedical engineering.

### Expected course outcome

Students will come to appreciate that a good understanding of the principles of biology and engineering are required for success in solving problems in biomedical engineering.

### Specific course content

Overview of cells and cell research; tools of cell biology

The composition of cells; cell metabolism

Fundamentals of molecular biology: heredity, genes, DNA, RNA, recombinant DNA, gene function in eukaryotes

Fundamentals of molecular biology: the genome, replication, DNA repair

Fundamentals of molecular biology: RNA (transcription) and protein synthesis (translation)

The nucleus

The nucleus (part 2) and protein sorting/transport

Bioenergetics and metabolism

The cytoskeleton and cell movement

The plasma membrane

Cell walls, the extracellular matrix, and cell interactions

Cell signaling: signaling molecules, cell surface receptors, intracellular signal transduction, signaling networks

Cell signaling (part 2): the cell cycle, and cell death and cell renewal

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**Course Outline-Fall, 2009**

**Required Text**

GM Cooper and RE Hausman, The Cell: A Molecular Approach, Fifth Edition, Sinauer Associates, Sunderland, MA, 2009.

**Lecture/Reading Schedule**

August 25– August 27`:

Introduction to ORTO 6004; overview of cells and cell research; tools of cell biology  
Cooper/Hausman: Chapter 1 (pp 3-42)

September 1 – September 3:

The composition of cells; cell metabolism  
Cooper/Hausman: Chapters 2-3 (pp 43-102)

September 8 – September 10:

Fundamentals of molecular biology-Part 1 (heredity, genes, DNA, RNA, recombinant DNA, gene function in eukaryotes)  
Cooper/Hausman Chapter 4 (pp 103-152)

September 15– September 17:

Fundamentals of molecular biology- Part 2 (the genome, replication, DNA repair)  
Cooper/Hausman Chapters 5-6 (pp 155-250)

September 22– September 24:

Fundamentals of molecular biology- Part 3 (RNA and protein synthesis)  
Cooper/Hausman Chapters 7-8 (pp 251-352)

September 29: EXAM #1 (to cover Chapters 1-8)

October 1 -October 6:

The nucleus and protein sorting/transport  
Cooper/Hausman Chapters 9-10 (pp 355-432)

October 8 – October 13:

Bioenergetics and metabolism  
Cooper/Hausman Chapter 11 (pp 433-472)

October 15– October 20:

The cytoskeleton and cell movement  
Cooper/Hausman Chapter 12 (pp 473-528)

October 22-October 27 :

The plasma membrane  
Cooper/Hausman Chapter 13 (pp 529-570)

October 29:

Cell walls, the extracellular matrix, and cell interactions  
Cooper/Hausman Chapter 14 (pp 571-600)

November 3: EXAM #2 (to cover Chapters 9-14)

November 5- November 10:

Cell signaling (signaling molecules, cell surface receptors, intracellular signal transduction, signaling networks)

Cooper/Hausman Chapter 15 (pp 603-652)

November 12-November 17:

Cell signaling (part 2), the cell cycle, and cell death and cell renewal  
Cooper/Hausman Chapters 15-17 (pp 603-724)

November 19: Student presentations/guest lecturers

November 24: Student presentations/guest lecturers

November 26: University holiday (Thanksgiving)

December 1: Student presentations/guest lecturers

December 3: Dr. Xiao-Dong Chen (Guest lecturer)  
“Stem cells”

December 8: Student presentations/guest lecturers

December 10: Student presentations/guest lecturers

December 15: Dr. Merry Lindsey (Guest lecturer)  
“Proteomics”

December 17: Final Exam (comprehensive)

### **Assessment of Student Progress**

	Percent of final grade
Exams (2) during semester:	50%
Final exam (comprehensive)	25%
Presentation	25%

**Oral Presentation**  
ORTO 6004: Biology for Bioengineers  
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The overall goal of this assignment is to reinforce the material we are covering in this course by reviewing publications where biology and engineering principles have been used to address a contemporary issue in biomedical engineering. As a secondary goal, students will gain experience in collaboration and working in teams.

To stimulate discussion and provide students an opportunity to refine their presentation skills, each topic will be introduced by a team of three students using PowerPoint, followed by a discussion led by the team. Presentations will be approximately 20 minutes in length, followed by 20 minutes of discussion.

In selecting a topic, each team will select 3 papers from the recent engineering literature (papers should have been published in 2007 to the present) and then schedule an appointment to meet with Drs. Dean and Sylvia. At this meeting, the team will present a rationale for selecting the papers, including how each is relevant to the focus of the exercise (i.e.: how biology and engineering are necessary to problem-solving in BME). A final selection will be agreed upon by the team and course leaders. The team will then begin preparing the presentation and developing discussion questions. After the presentation is complete, the team will meet again with Drs. Dean and Sylvia to review the PowerPoint and discussion questions. Suggestions for changes to the presentation will be made; after completing the agreed upon changes, the team will be ready to present to the class. The relevant publication(s) will be e-mailed to all classmates for review prior to the presentation by the group.

Important dates:

September 21	Meet with Drs. Dean and Sylvia to review three potential papers for presentation; at this meeting, approval will be given for the selected paper(s)
November 2	Meet with Drs. Dean and Sylvia to review PowerPoint and proposed discussion questions
November 19	All teams must be prepared to make their presentation

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Grading of presentations

Organization of work, team cohesion	5 points
Quality of final PowerPoint presentation (graphics, text, etc)	7 points
Quality of oral presentation to class	6 points
Discussion	7 points

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Total: 25 points  
(25% of final course grade)