BME 411: Science and Technology Approaches to Problems in Human Health

Course Directors:

Prof. Chris B. Schaffer
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Office hours and location:
Tuesday, 2:45 to 3:45 pm in 128 Olin Hall
Thursday, 2:45 to 3:45 pm in 218 Olin Hall

Prof. Mike Kaplitt
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Office hours and location:
Periodically through semester, see Blackboard

Teaching Assistant:

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By appointment

Course description:

BME 411 will provide an in-depth look at diseases that impact human health along with current scientific research and engineering that is aimed at addressing these problems. Faculty from Weill Cornell Medical College will come to the Cornell campus to discuss the health problems they are currently unable to treat as well as they would like. For each disease discussed, faculty from Cornell University and Weill will talk about current research aimed at better understanding disease process, developing new treatment strategies, and ultimately improving patient outcomes. Six to eight topics will be explored in depth over the course of the term. This course is particularly appropriate for students considering medical school or careers in biomedical science and engineering.

In addition to the lectures, opportunities for informal interactions with the faculty teaching the course (those from both Weill Cornell Medical College and Cornell University) will be available, including small question and answer sessions, additional seminars, as well as lunches with the faculty.

Course topics:

Possible human health topics include: cardiovascular disease, cancer, neurological disease, infectious disease, stroke, musculoskeletal diseases, trauma and shock, diabetes, reproductive disorders, congenital disease, autoimmune disease and allergies, psychiatric disorders, and environmental toxins. The research discussed will embrace a wide range of disciplines and approaches ranging from basic science-oriented work like genetics and immunology to technology-driven approaches like nanotechnology and biomedical engineering. By providing in-depth "snapshots" of current problems in human health and the research aimed at overcoming these problems students will gain an understanding of both the incredible progress that has been made in biomedical research as well as the considerable challenges that lie ahead.

Course website:

Please check the BME 411 website on Blackboard DAILY. Office hour schedules, course announcements, reading assignments, reading and lecture quizzes, information about the term project, and extra materials will all be distributed via the website. Please enroll in the BME 411 site at http://blackboard.cornell.edu/ as soon as possible. **The access code to enroll is: 987654.** Detailed instructions for enrolling are given below.

Textbook:

Medical Physiology, by Walter F. Boron, MD, PhD and Emile L. Boulpaep, MD (Elsevier, 2005)
The majority of the reading materials for the course will be posted on the course website.

Schedule:

Lecture: Tuesday and Thursday, 1:25 to 2:40 pm, in 155 Olin Hall. An after-class question and answer session with the day's lecturer and Prof. Schaffer will be held for interested students in 128 Olin on Tuesdays and 218 Olin on Thursdays.

Informal interactions with faculty and special lectures: Scheduled throughout the term, with times and locations announced in class and posted online. Some events require signing up and have limited capacity.

Reading and lecture quizzes:

Online quizzes on the reading assignments and lectures will be due **weekly**. These quizzes will typically be posted after lecture each Thursday and will be due by 5:00 pm on Sunday, three days after posting. There will be 12 quizzes over the course of the term. The assigned reading will be posted at least a week before the quiz is due and will be relevant for the upcoming two or three lectures. The quiz will focus on this reading and on issues discussed in the previous two or three lectures. It will not be possible to complete these assignments after 5:00 pm on the due date, nor will there be any means of making up this work. Written notification of approved school activities is required for exceptions. The quizzes will consist of about ten multiple choice questions followed by four essay questions. The first two essay questions as well as the multiple choice questions will be related to the material in the assigned reading and the previous two lectures. The third and fourth essay questions ask that you describe concepts in the reading material and lectures, respectively, that you found confusing (or interesting, if nothing was confusing). The multiple choice and first two essay questions will be graded for accuracy. For the final two essay questions it must be clear from your response that you have read the assigned reading and have thought carefully about the material covered in the reading and lectures in order to receive full credit. A summary of common points of confusion or interest from the readings will be provided to the lecturers and will be used to guide their choice of topics. Answers to common questions will also be posted on the course website. It should not take more than an hour of your time to complete the quiz, assuming you have already done the reading and you paid attention to the lectures. Additional information about the web quizzes is posted on the course website.

Term project:

One of the main goals of this course is to help you develop some of the knowledge and concepts necessary to begin to develop original research ideas of your own. As part of the course, you will work on a three-part term project in teams of three. Each team will have at least one student from an engineering or quantitative science background and one from a biology or medicine background. The goal of the project will be to put together a short proposal for original research on a basic or applied topic that is relevant to human health (either directly or through advances in biomedical research). Properly completing this project will require you to learn about what is currently known through careful reading of papers (that you must find!) from the medical and scientific literature. Our standard for this project is very high – we hope you will develop and convincingly describe novel research ideas – and we will be here to help you achieve this high standard.

For your project, your team will first prepare a one-page summary that outlines the area of research, its relevance to human health, the methods that will be used, and, very importantly, the specific goals (or "specific aims" as the National Institutes of Health calls them) of your proposed research. Each specific aim should describe a focused scientific question that can be addressed with existing techniques or with methods that you propose to develop in another specific aim. Next, your team will give a very short talk (five minutes) to the course instructors describing your proposed research using a maximum of three **printed** slides. This talk should be clear, focused, and given at a level appropriate for a professional scientist, but not an expert in your proposed field of study. This meeting will also provide a formal opportunity for you to get some help refining your ideas. At the end of the term, a proposal of, at most, five pages (including figures, but excluding references) is due. The proposal should consist of four parts: Specific Aims, Background and Motivation, Preliminary Data, and Research Design. The first section will be a revised version of the one-page introduction and summary of the goals of your proposed research. The second section should provide a brief review of the medical and scientific literature relevant to your research topic and the medical problem you seek to address. This section should end by identifying the 'hole" in current knowledge that your proposed work would fill. While you will not likely have preliminary data of your own, we expect you to demonstrate the feasibility of the work you propose to do by finding examples of relevant techniques, demonstrations of the basic principles, etc. from the scientific literature. You may use properly referenced figures from published papers to illustrate your ideas in this preliminary data section. The final section (approximately half of your proposal) should provide a detailed description of the experiments you propose to do and how these experiments would accomplish

the specific aims you laid out and fill the "hole" in current knowledge you identified. List potential problems and how you might overcome them. Describe how the successful completion of your project would affect human health, either directly or by furthering biomedical research. Throughout the proposal, it is helpful to use illustrations and figures to highlight key ideas. To keep things consistent, we ask that you use 11 pt. Arial or Helvetica font and 0.75 inch margins (all the way around) for your outline and final report. Example proposals are posted on the course website. Note that these example proposals do not necessarily adhere to your length limitations.

In addition to the formal opportunity for feedback during your presentation, you are encouraged to come to office hours or schedule a meeting with the course directors or TAs to discuss your ideas and ask for critical feedback. You should also come to some of the lunches and special seminars we will set up with lecturing faculty, especially those working in an area relevant for your proposal.

For all three parts of the project, you will also complete a short assessment of your own and your teammates' contributions. This assessment will be completed as a quiz on the course website on Blackboard. You must complete the assessment to receive credit for your work on the project. This report is not so much for our grading purposes, but to help you critically think about how you are working together as a team and what you could do to be most efficient and effective.

Grading:

Reading and lecture quizzes (taken weekly on the course website): 50%
Project outline (**due Friday, Sept. 28**): 10%
Project presentation (**to be scheduled during the week of Oct. 22**): 10%
Final project report (**due Friday, Nov. 30**): 30%

Academic integrity:

Academic integrity is expected of all students of Cornell University at all times, whether in the presence or absence of members of the faculty. Violations of the code of academic integrity will be prosecuted through the Academic Integrity Hearing Board. For more information, see the following page on academic integrity: http://cuinfo.cornell.edu/Academic/AIC.html.

Blackboard Basics:

To Enroll in a Blackboard Site:

1. In a web browser, go to http://blackboard.cornell.edu.
2. Click the Login button.
3. Enter your Blackboard user name and password and click the Login button.
    - If you don't have a Blackboard account, you will need to get one before you can enroll. Click the "Create Blackboard Account" link near the top of the page and follow the instructions.
4. Click on the "All Blackboard Sites" tab along the top of the page.
5. Click on the "Browse Course Catalog" link on the right. Courses are listed by school and department.
6. Locate "Science and Technology Approaches to Problems in Human Health (BME 411)" by navigating first to "Engineering" then to "Biomedical Engineering."
7. Click the Enroll button to the right of the course listing. A confirmation screen will appear.
8. **When asked for an Access Code, enter "987654".**
9. Click the Submit button to enroll in the site.
10. Click the OK button on the next screen to go straight to the site. From now on, a link to the site will appear in the course list on your My Blackboard page when you log in.

Preliminary lecture schedule:

Date	Lecturer	Affiliation	Topic
08/23/07	Prof. Mike Kaplitt Prof. Chris Schaffer	Weill Cornell Medical College, Neurological Surgery Cornell University, Biomedical Engineering	Motivation for course Course mechanics
08/28/07	Prof. Beth Rhoades	Cornell Veterinary College, Microbiology and Immunology	Infectious disease: Tuberculosis:
08/30/07	Prof. Susana Mendez	Cornell Veterinary College, Baker Institute for Animal Health	Infectious disease: Leishmania
09/04/07	Prof. Mike Kaplitt	Weill Cornell Medical College, Neurological Surgery	Infectious disease: Virology
09/06/07	Prof. Mark Souweidane	Weill Cornell Medical College, Neurological Surgery	Targeted drug delivery in brain cancer
09/11/07	Prof. Jonathan Butcher	Cornell University, Biomedical Engineering	Heart valve disease and treatment
09/13/07	Prof. Mike Kotlikoff	Cornell Veterinary College, Dean	Stem cell therapy in heart disease
09/18/07	Prof. Bill Olbricht	Cornell University, Biomedical Engineering	Convection enhanced drug delivery in the brain
09/20/07	Prof. Joe Fetcho	Cornell University, Neurobiology	Spinal cord injury
09/25/07	Prof. Ted Schwartz	Weill Cornell Medical College, Neurological Surgery	Surgical treatments for epilepsy
09/27/07	Prof. Chris Schaffer	Cornell University, Biomedical Engineering	Animal studies of small stroke
10/02/07	Prof. Steven Goldring	Hospital for Special Surgery, Chief Scientific Officer	Orthopedic surgery
10/4/07	Prof. Roger Hartl	Weill Cornell Medical College, Neurological Surgery	Spine surgery
10/11/07	Prof. Larry Bonassar	Cornell University, Biomedical Engineering	Tissue engineering
10/16/07	Prof. Sean O'Connor	Indiana University School of Medicine	Ethanol dependence
10/18/07	Prof. Peter Doerschuck	Cornell University, Biomedical Engineering	Ethanol biosensors and pharmacokinetics
10/23/07	Prof. Mike Kaplitt	Weill Cornell Medical College, Neurological Surgery	Parkinson's disease and gene therapy
10/25/07	Prof. Moonsoo Jin	Cornell University, Biomedical Engineering	Protein engineering for therapeutics
10/30/07	Prof. Phil Steig	Weill Cornell Medical College, Neurological Surgery, Chair	Stroke
11/1/07	Prof. Susan Pannullo	Weill Cornell Medical College, Neurological Surgery	Brain cancer
11/6/07	Prof. Warren Zipfel	Cornell University, Biomedical Engineering	Optical imaging of cancer in research and medicine
11/8/07	Prof. Claudia Fischback-Teschl	Cornell University, Biomedical Engineering	Tissue engineered tumor models
11/13/07	Prof. John Boockvar	Weill Cornell Medical College, Neurological Surgery	Stem cells and cancer
11/15/07	Prof. Pierre Gobin	Weill Cornell Medical College, Neurological Surgery	Intravascular treatment of brain vascular disorders
11/20/07	Dr. David Fischell	Angel Medical Systems, Inc.	Stents for coronary vascular disease
11/27/07	Prof. Robin Davisson	Cornell Veterinary College, Biomedical Sciences	Hypertension
11/29/07	Prof. Mike Shuler	Cornell University, Biomedical Engineering	Evaluating cancer therapeutics
Special evening lecture; Date TBA	Prof. David Skorton	Cornell University, President	Clinical cardiac imaging