



BME 4110:
Science and Technology Approaches to Problems in Human Health
An Innovative New Course in Biomedical Engineering

Course co-directors:
Chris Schaffer (Biomedical Engineering, Cornell)
Mike Kaplitt (Neurological Surgery, Weill)

 Cornell University
Department of
Biomedical Engineering

<http://www.bme.cornell.edu/>




BME 4110 Overview

New course team taught by faculty from Cornell at both the Weill Medical College and Ithaca campuses

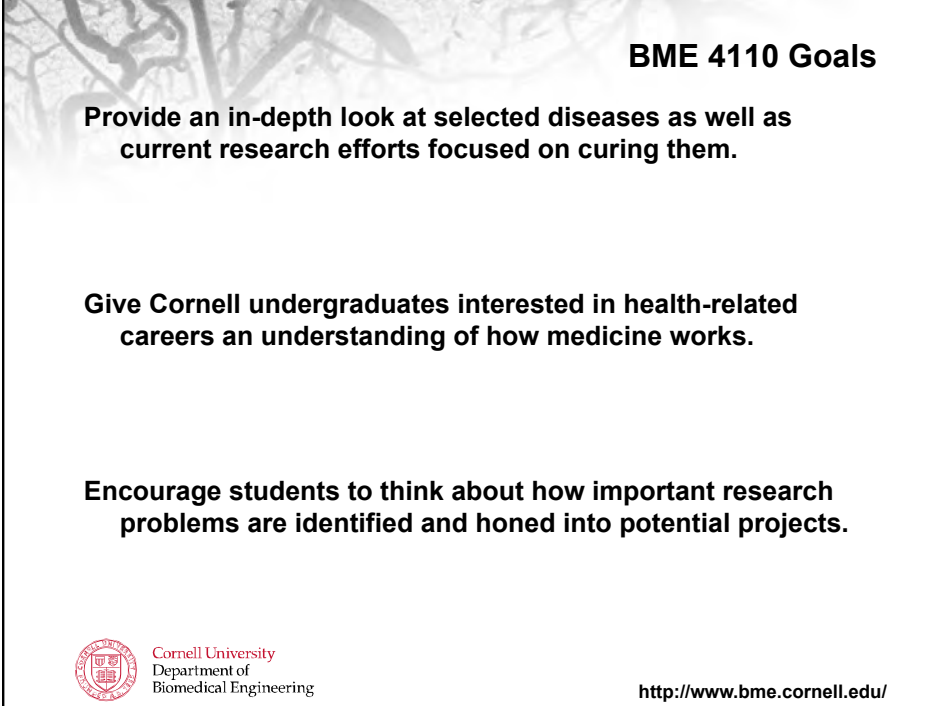
Organized by BME and Neurological Surgery

Offered in Fall 2007, 2008, 2009, planning underway for 2010

About **325 (!) students completed the course so far**

 Cornell University
Department of
Biomedical Engineering

<http://www.bme.cornell.edu/>




BME 4110 Goals

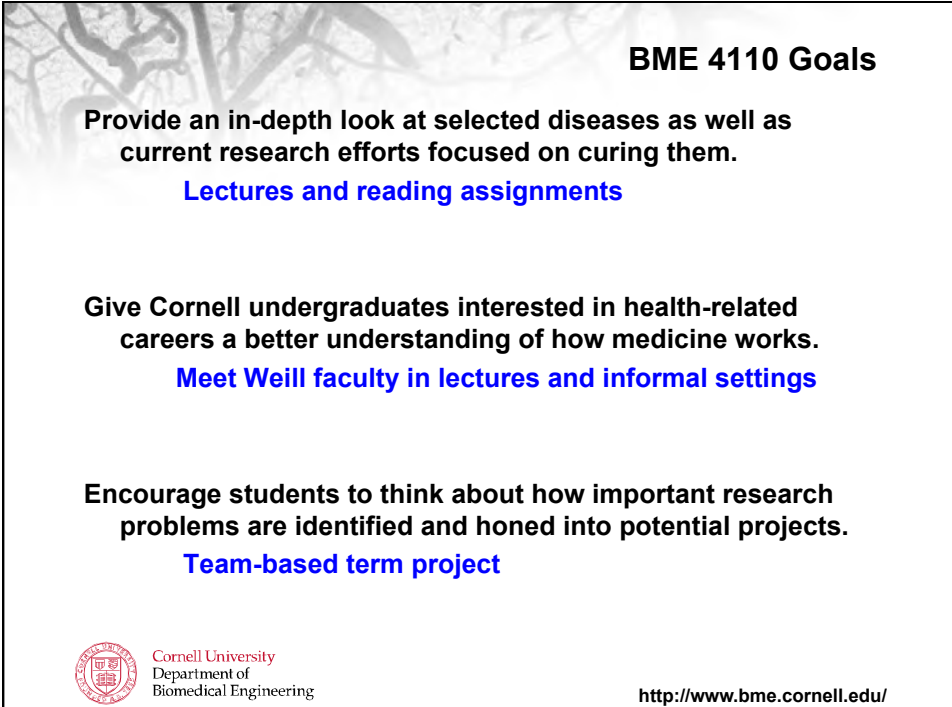
Provide an in-depth look at selected diseases as well as current research efforts focused on curing them.

Give Cornell undergraduates interested in health-related careers an understanding of how medicine works.

Encourage students to think about how important research problems are identified and honed into potential projects.

 Cornell University
Department of
Biomedical Engineering

<http://www.bme.cornell.edu/>



BME 4110 Goals

Provide an in-depth look at selected diseases as well as current research efforts focused on curing them.


Lectures and reading assignments

Give Cornell undergraduates interested in health-related careers a better understanding of how medicine works.

Meet Weill faculty in lectures and informal settings

Encourage students to think about how important research problems are identified and honed into potential projects.

Team-based term project

 Cornell University
Department of
Biomedical Engineering

<http://www.bme.cornell.edu/>

Lectures and reading assignments

Goal: In depth knowledge about selected diseases and research aimed at curing them

Challenges:

- Topic selection
- **Coherence** of material presented by different lecturers
- **Diverse** student backgrounds
 - 1/3 engineering
 - 1/3 biology
 - 1/3 other
- **Personalized** instruction in a large class



Cornell University
Department of
Biomedical Engineering

<http://www.bme.cornell.edu/>

Topic selection and course coherence

Careful staging of speakers, grouped into “modules”

Modules centered on a few selected diseases

In one module:

Weill speaker(s) describes:

1. normal and disease state physiology
2. current diagnosis, treatment options
3. problems or unmet needs, clinical research

Ithaca speaker(s) follow:

1. research approach and results
2. how work may improve patient outcomes




Cornell University
Department of
Biomedical Engineering

<http://www.bme.cornell.edu/>

Modules

- Infectious disease**
- Cancer**
- Cardiovascular disease**
- Neurological disease**
- Orthopedic disease**
- Ethanol dependence**



Cornell University
Department of
Biomedical Engineering

<http://www.bme.cornell.edu/>

Lectures

Date	Lecturer	Topic
08/23/07	Prof. Mike Kaplitt Prof. Chris Schaffer	Introduction
08/28/07	Prof. Beth Rhoades	Infectious disease: Tuberculosis:
08/30/07	Prof. Susana Mendez	Infectious disease: Leishmania
09/04/07	Prof. Mike Kaplitt	Infectious disease: Virology
09/06/07	Prof. Mark Souweidane	Targeted drug delivery in brain cancer
09/11/07	Prof. Jonathan Butcher	Heart valve disease and treatment
09/13/07	Prof. Mike Kotlikoff	Stem cell therapy in heart disease
09/18/07	Prof. Bill Olbricht	Convection enhanced drug delivery in the brain
09/20/07	Prof. Joe Fetcho	Spinal cord injury
09/25/07	Prof. Ted Schwartz	Surgical treatments for epilepsy
09/27/07	Prof. Chris Schaffer	Animal studies of small stroke
10/02/07	Prof. Steven Goldring	Orthopedic surgery
10/4/07	Prof. Roger Hartl	Spine surgery
10/11/07	Prof. Larry Bonassar	Tissue engineering




Cornell University
Department of
Biomedical Engineering

<http://www.bme.cornell.edu/>

Lectures

Date	Lecturer	Topic
10/16/07	Prof. Sean O'Connor	Ethanol dependence
10/18/07	Prof. Peter Doerschuck	Ethanol biosensors and pharmacokinetics
10/23/07	Prof. Mike Kaplitt	Parkinson's disease and gene therapy
10/25/07	Prof. Moonsoo Jin	Protein engineering for therapeutics
10/30/07	Prof. Phil Steig	Arteriovenous malformations
11/1/07	Prof. Susan Pannullo	Brain cancer
11/1/07	Prof. Mike Shuler	Evaluating cancer therapeutics
11/6/07	Prof. Warren Zipfel	Optical imaging of cancer
11/8/07	Prof. Claudia Fischback-Teschl	Tissue engineered tumor models
11/13/07	Prof. John Boockvar	Stem cells and cancer
11/15/07	Prof. Pierre Gobin	Brain vascular disorders
11/20/07	Dr. David Fischell	Stents for coronary vascular disease
11/27/07	Prof. Robin Davisson	Hypertension and pregnancy
11/29/07	Prof. David Skorton	Clinical cardiac imaging


 Cornell University
 Department of
 Biomedical Engineering

<http://www.bme.cornell.edu/>

Diverse preparations and personalized instruction

Weekly background readings help with different backgrounds:


- Carefully selected to get students ready for the lectures
- Enforce student reading with web-based quizzes (50% of grade)
- Questions focus on the reading for the **next week's lecture** as well as the material covered in the previous week's lectures

Lunches, one-on-one project meetings, office hours, etc. with students personalizes class

Asked every week in web quiz:

“Tell us what you found confusing. If nothing was confusing, describe something you found interesting.”

- **Responses summarized** for faculty before their lecture
- Common questions addressed in a posted document
- Uncommon questions addressed through a direct email


 Cornell University
 Department of
 Biomedical Engineering

<http://www.bme.cornell.edu/>

Providing exposure to medical field

Goal: Give students an understanding of how medical care is given in the US and the role of a physician, the lifestyle, etc.

Accomplished through **formal and informal interactions** with physicians from Weill:

Formal interactions:

- About half the lectures given by faculty with clinical work

Informal interactions:

- **14 lunches** with clinical faculty that many students attended
- informal **question sessions** after each class
- Evening **career talks**: “life as a neurosurgeon,” “what medical schools are looking for,” “so you want to be a professor...”



Cornell University
Department of
Biomedical Engineering

<http://www.bme.cornell.edu/>

Team-based term project

Goal: Help students understand how biomedical research is done and what is its relevance

Course project in teams of 3 (**at least 1 engineer, 1 biologist**)

Write a proposal for original health-related research, NIH style

Three stages:

1. “Specific Aims” page / summary (10% of grade)
2. Short presentation and meeting with faculty (20% of grade)
students talked for 5 min., and got 15 min. of questions/
comments from Schaffer and Kaplitt
3. Five page final proposal (30% of grade)



Cornell University
Department of
Biomedical Engineering

<http://www.bme.cornell.edu/>

FGF-2 Modulation of Myofibroblast Activity in Tissue Engineered Aortic Heart Valves

Department of Biological and Environmental Engineering, Cornell University

Introduction:
 Tissue engineered heart valves (TEHV) have been developed in an attempt to overcome limitations of existing valve replacements options including thromboembolism in mechanical prostheses and structural dysfunction in biological prosthetic heart valves [1, 2]. Recently, a biodegradable TEHV seeded with ovine mesenchymal stem cells (MSC's) was successfully implanted in sheep models [5]. During the culture process, MSCs differentiated into a combination of fibroblasts, myofibroblasts, and smooth muscle cells, which together constitute valvular interstitial cells (VICs). These cells differ from fibroblasts in that they have a more contractile phenotype and are able to produce extracellular matrix components *in vitro*, though they do not contract *in vitro* [6]. One of the main goals of this research is to improve the TE leaflet product.


The Use of RNA Aptamers as a Therapeutic Strategy to Treat Alzheimer's Disease

BME 411, 11/30/07

Laura Child, Christina...

***Bifidobacterium* as a Drug Delivery System Targeting HER2-plus Metastatic Breast Cancer**

Introduction and Specific Aims:
 Approximately 20-30% of women diagnosed with breast cancer overexpress the transmembrane growth factor receptor HER2 [1]. HER2-positive breast cancer is associated with a more aggressive phenotype and is less responsive to traditional chemotherapeutic and hormonal treatments. However, the humanized monoclonal antibody trastuzumab has shown great promise in targeting cells that overexpress HER2 in recent clinical trials. The binding of trastuzumab prevents the dimerization of HER2/ErbB2 tyrosine kinase, preventing further cell proliferation, and targets the cell for degradation.

 Cornell University
 Department of
 Biomedical Engineering

<http://www.bme.cornell.edu/>


Students benefited from the course

Term projects were taken very seriously, almost all students said they enjoyed the **opportunity to be creative in a science/engineering class. Students worked hard on their projects, going well beyond anything we covered in class**

This course was the first time many students **read original scientific papers**

For almost ALL students, this course was the first time they had to **sift through scientific papers on their own**

Many students really got a taste of what the planning/ conceptual stages of research is like

 Cornell University
 Department of
 Biomedical Engineering

<http://www.bme.cornell.edu/>

Faculty liked lecturing in the course

“One thing I liked about participating in BME 4110 was the wide variety of student backgrounds... forced me to consider a more broad-based approach to the material... **I thought the conception and execution of the course were terrific.**”

“I liked knowing that the students had read an article or two before the lecture... **The questions I got seemed to come from well informed students.**”

“One thing I liked very much about BME 4110 was the **keen interest from the students**... Most of the questions were related to the future of translational research in this area, with a number of insightful ideas. It's fun to interact with students who are really interested.”



Cornell University
Department of
Biomedical Engineering

<http://www.bme.cornell.edu/>

Students liked taking the course

“**Interesting lecturers** from all fields of medical research.”

“Very enjoyable course with lots of interesting material.”

“Really stimulated my interest in medicine and biomedical research... **The project was a great opportunity** to work in a team to develop an innovative idea in the field of medicine.”

“The strength of this course is the overall exposure to current research in medical engineering. You really do get a good feel of the field and where it's going.”

“**Overall, the best course that I've taken at Cornell.**”



Cornell University
Department of
Biomedical Engineering

<http://www.bme.cornell.edu/>

... Or most of them did...

“I really liked the final reception for the class on the last day, but I was little bit disappointed because there were no cheese cubes, which I think is an essential component of any reception.”

There were some we didn't reach:

“I am not that interested in research so I found that aspect rather boring... I don't want to learn all this stuff, I just want to be a doctor”



Cornell University
Department of
Biomedical Engineering

<http://www.bme.cornell.edu/>

BME 411 Goals

Provide an in-depth look at selected diseases as well as current research efforts focused on curing them.

Lectures and reading assignments

Give Cornell undergraduates interested in health-related careers a better understanding of how medicine works.

Meet Weill faculty in lectures and informal settings

Encourage students to think about how important research problems are identified and honed into potential projects.

Team-based term project



Cornell University
Department of
Biomedical Engineering

<http://www.bme.cornell.edu/>

