

# Eng 100: Biotechnology and Human Values

## Request for Physician Clients

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#### **Instructors:**

Andrew Putnam ([putnam@umich.edu](mailto:putnam@umich.edu)) and Robert Sulewski ([robsul@umich.edu](mailto:robsul@umich.edu))

#### **Request:**

The University of Michigan, Department of Biomedical Engineering is looking for physicians to act as clients for our freshman introduction to engineering course, Eng 100. Our course is based on the concept that a meaningful introduction to biomedical engineering and biotechnology should include: 1.) Solving problems for a real client; 2.) Exploring the leading edges of the field; and 3.) Learning strategies to solve novel problems. Our challenge has been to turn teenagers straight out of high school into individuals with a real appreciation, based on experience, of what it takes to be a biomedical engineer. To this end, our students are formed into project teams, each assigned to a client physician at the University of Michigan Hospitals, and learn about his/her field of medicine. Over the semester, each team works with their physician to design (on paper) a novel diagnostic test to detect a disease before the onset of symptoms.

#### **Commitment:**

We are requesting that each physician participant serve as a client to one student team. To participate as a client for our Eng 100 course, the anticipated time commitment over the semester breaks down as follows:

- 2 or 3 Meetings (~1 hr/meeting, maximum of 3-4 hrs total) – First meeting should take place in by October 1, the second by mid-October, and any additional meetings by the end of October.
- Research an idea for a test (1-2 hours) – In case your team has not developed an idea for a diagnostic test by the third meeting, research a feasible idea for them to use. (*This should be a highly unlikely scenario!*).
- Electronic questions (1 hour max) – After the 3 meetings, the students may have additional questions that can be triaged via a couple of 1 hour email sessions.
- Total time commitment over the semester = ~5-7 hours

#### **Course Description:**

Our Eng 100 course is organized as a company, creatively named “Blue Genes, Inc”. The lectures introduce the students to basic molecular biology principles (e.g., transcription and translation) and emerging diagnostic technologies for detecting diseases (e.g., polymerase chain reaction (PCR), lab-on-a-chip, imaging, etc.). Course material emphasizes engineering applications of modern cellular and molecular biology, the importance of quantification in design and validation, and the economic, legal, social and ethical implications of new biotechnologies. Building on the lectures, two lab modules provide students with hands-on experience applying technologies they might use to design a diagnostic test for their physician client. In addition, students receive formal instruction in technical communications, and problem solving strategies.

### **Diagnostic Test Term Project:**

To demonstrate what engineers face every day, we developed a term project in which student teams from our contrived company, Blue Genes, Inc., must solve a problem for a real client, a physician from the University of Michigan Hospitals. Blue Genes, Inc., specializes in genotypic and/or phenotypic diagnostic tests to detect the presence of disease before the onset of symptoms. Project teams consist of 5 to 6 students. Each project team is assigned to a different physician client and is responsible for initiating contact, interviewing the client and, with the client, identifying a disease that could benefit from a novel, pre-symptomatic diagnostic test. Instructors form a management team that oversees the progress of the project, although they are not directly involved in the interaction between the project team and the physician client. Using the information learned from the interviews, lectures, lab modules, and literature searches, the students design a pre-symptomatic diagnostic test to detect the target disease. Students report their progress and results over the course of the semester two oral presentations and a formal report.

### **Past Projects:**

The Dept. of Biomedical Engineering has taught this course once per year since 2000, and has had excellent participation from UM physicians throughout. The current average enrollment of 80 students/semester creates on average of 16 student teams. Physicians from a wide variety of specialties have participated in this course in prior years, including the following:

- ❖ Nephrology
- ❖ Cardiovascular Medicine
- ❖ Pediatrics and Communicable Diseases
- ❖ Ophthalmology
- ❖ Psychiatry
- ❖ Neurology
- ❖ Orthopaedic Surgery
- ❖ Anesthesiology
- ❖ General Medicine
- ❖ Gastroenterology
- ❖ Allergy
- ❖ Pulmonary and Critical Care
- ❖ Radiology
- ❖ Sleep Medicine
- ❖ Hematology and Oncology
- ❖ Pathology
- ❖ Obstetrics and Gynecology

Please note that physicians of all areas of medicine are welcome and this list is not intended to be all-inclusive.

The diagnostic tests can be multi-stage, use genotypic and/or phenotypic technologies, apply current methods like Western blots, PCR, antibody arrays, etc., or emerging micro- and/or nanotechnologies. Additionally, the teams consider legal, ethical, and societal issues involved with the technology and conduct a cost benefit analysis of their proposed test.