

BIOE 389F / BSCI 338F
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BIOE 389F / BSCI 338F: Introduction to iGEM Research
Edward Eisenstein and Jason D. Kahn
Syllabus

I. Course Description:

This course will introduce undergraduate students to the iGEM research experience. iGEM, the International Genetically Engineered Machine competition, is the premier student synthetic biology education and research competition. Facilitated by an independent, non-profit foundation, the goals of iGEM are to introduce synthetic biology to interested students and to advance synthetic biology in a responsible way that promotes an open, collaborative community. Moreover, because the iGEM research experience is student-driven, and focused on the application or adaptation of synthetic biology to problems of societal interest to the students, advisors and mentors provide only guidance and encouragement. The field of synthetic biology as a whole aims to apply engineering principles and modern molecular biology to build complex biological systems, develop novel applications, and contribute to fundamental scientific knowledge. iGEM embraces all these tenets, and therefore a holistic view of synthetic biology in context is a thrust of the course.

The specific goals of the course are to introduce students to iGEM, to explicate key concepts in synthetic biology, to show how an iGEM team is best organized, to discuss the types of multidisciplinary collaboration that are needed for success at the Jamboree, and to make specific plans for the UMaryland iGEM team's summer project. Students will learn how to reformulate projects from a human practice perspective into an experimental framework that incorporates a design, build and test cycle. They will develop a specific application that can be accomplished in a student-run laboratory over the six-month period of an iGEM project. The course will focus on teaching students the research fundamentals and related skills they need to develop and undertake such a project, progressing from a review of recent projects at previous Jamborees that illustrate best practices and attributes of a successful team effort, to the exploration of the wider policy and research literature, to the design and execution of experiments and device construction in the laboratory, including safety, record keeping and documentation, and presentation skills. Because iGEM projects should advance the concept of synthetic biology in the public sphere, and are partially independently supported, the course will also address important components of human practice and interaction with the community at large, as well as fundraising through traditional and non-traditional approaches. The iGEM experience exposes students to the complete scientific arc: conceptualization, planning, funding, recruiting, management, budgeting, collaborating, researching, troubleshooting, communicating. Finally, the class is not a prerequisite for joining the UMaryland iGEM Team, but it is recommended for interested students; also, taking the class does not commit a student to joining the team.

II. Course Outcomes:

1. All students will obtain a working knowledge of synthetic biology and its applications. They will be able to describe the project elements, time commitment, job duties, and skills required to be successful at the International Jamboree, to be held in Boston in early November, 2019.
2. Students will be able to find relevant scientific and engineering literature, critically analyze that literature, and present their analysis to the class.

3. Students will be able to critically assess and contribute to a literature database that supports the research project and that expands student knowledge of synthetic biology.
4. All students will be able to complete weekly exercises that are structured to promote teamwork and participation in all aspects of iGEM team activities.
5. Together, students will be able to collectively assemble a written proposal that outlines a general research project, as well as outlines the human and financial resources needed to accomplish the project goals. The design of the system(s) under investigation should be substantially complete, and the modeling framework established.
6. Students who continue into the summer project will assemble themselves into project teams, including managers (e.g., laboratory sub-projects, web site maintenance, and modeling) as well as subcommittee chairs in outreach and human practices, communication, and fundraising. Students will self-assort based on based on interest, skill, and commitment to best support the overall iGEM research project.

III. Attendance:

Attendance at all class meetings is strongly recommended, since the course will be interactive and it aims to develop functional members of a close-knit team that will need to work together seamlessly to achieve success at the iGEM Jamboree. Also, the instructors will engage with students electronically in class through Mentimeter software. This simply requires students to have an electronic gadget with them such as a smart phone, tablet or computer. General questions will be asked, and although student replies are anonymous, responses will be illuminating and possibly provide ideas for future discussion.

IV. Materials

There is no textbook, but a significant amount of reading material will be assigned from the current scientific literature, from the iGEM web site, and also contributed by students. All materials will be made available on the course ELMS site. All students will become familiar with the iGEM web site, <http://igem.org/>.

V. Assignments:

Many of the assignments will be performed by teams of students to promote teamwork and interaction. Student teams will be continually reformed throughout the semester to ensure interaction among the entire class.

A. Reading and Literature Collection:

A key assignment for the class will be for students to familiarize themselves with the current synthetic biology literature. Initially, general references will be supplied by the instructors for reading and discussion and will form the basis of quizzes. During the class, students will contribute papers to the library, typically on a weekly basis, that highlight an important concept, technology or impact of synthetic biology, but especially as these aspects related to the UMaryland team's emerging iGEM project. Each deposited paper will contain a written summary by the sponsor, and each paper will be reviewed and analyzed in writing by a team of students.

B. Homework:

Occasional descriptive homework assignments will be provided to enable students to better evaluate (judge) an iGEM project and, thus, come up with a compelling project for the UMaryland team. Early in the course, students will be presented a judging rubric to evaluate iGEM proposals,

and then will provide written evaluations of previous, award-winning iGEM projects. Later in the course, group proposals of possible iGEM projects will be developed in writing. These proposals must address the specific attributes important for all iGEM projects, and a written evaluation and improvement of each proposal will be undertaken by different student teams according to the judging rubric.

C. Quizzes:

A limited number of quizzes will be administered to assure progress and comprehension of the reading material, especially at the beginning of the course.

D. Class Participation:

Lectures will be broken up with discussion on assigned readings. Students should be prepared to discuss assigned readings. Once students start contributing to the iGEM literature library, they will be called upon to present short summaries of submitted papers, highlighting the rationale for deposition, the principal findings, and how they relate to the developing UMaryland iGEM project.

E. Examinations:

There are no formal examinations scheduled.

F. Student and Advisor Contracts:

Students interested in joining the UMaryland iGEM team will be provided a student contract that explains their level of commitment, as well as a copy of the advisor contract so they understand the support system available to a successful team. It is expected that many of the students in the class will join the UMaryland team for the summer.

G. Final Project

The final project will be a written summary of the synthetic biology project to be undertaken by the UMaryland iGEM team over the summer, for participation and evaluation at the fall Jamboree.

VI. Grading:

Grades will be computed from the following components:

Judging Assignment	25%
Written iGEM Project	25%
Literature development	15%
Homework	15%
Quizzes	10%
Class Participation	<u>10%</u>
Total	100%

A more detailed breakdown of the points available for assignments above will be discussed in class. The grading scale is fairly typical, with the following breakdown of numeric/letter grades: 90-100%=A; 80-89%=B; 70-79%=C; 60-69%=D, below 60%=F.

VII. Campus Policies

It is our shared responsibility to know and abide by the University of Maryland's policies that relate to all courses, which include topics like:

- Academic integrity
- Student and instructor conduct
- Accessibility and accommodations
- Attendance and excused absences
- Grades and appeals
- Copyright and intellectual property

Please visit www.ugst.umd.edu/courserelatedpolicies.html for the Office of Undergraduate Studies' full list of campus-wide policies.

VIII. Written Communication:

Assignments will be clear as to whether they will be collected as hard copy in class or whether they will be accepted by electronic mail or uploaded to ELMS Correspondence with the instructors will be by email, written as a formal business communication with a salutation, complete sentences, capitalization and punctuation, no texting abbreviations and a closing with your full name and email address. Previous correspondence should be quoted in any email exchange. The subject line should include "BIOE 389F / BSCI 338F." All attachments should include a description of the nature of the document and your name as part of the file name, as in "**Assignment3_JaneDoe.docx**". Students may choose to establish GroupMe or Facebook or Google Hangouts or Snapchat or regular face to face meetings or other methods among themselves to facilitate communication.

IX. Course and Lecture Schedule:

A **tentative** schedule of class topics is as follows:

Date	Class Topic
	I. Introduction
January 31	Introduction: Synthetic Biology, iGEM, the Jamboree
February 7	Biological engineering: molecular cloning, protein expression
February 14	Synthetic biology: circuits, modeling
February 21	The structure of successful iGEM projects; judging rubrics
February 28	Introduction to literature review and assessment; iGEM project analysis
March 7	UMaryland iGEM: team structure, project area, and responsibilities
March 14	Safety; iGEM lab visit; mixer
March 21	Spring Break – No Class
March 28	Initial project discussion
April 4	Human practices; fundraising; collaborations, support networks, and outreach
April 11	Guest presentations; project workshop
April 18	Formal project presentations and discussion
April 25	Guest presentations; project refinement
May 2	Final project analysis and discussion
May 9	Student and advisor contracts; final UMaryland iGEM team nominations