**MMBio 551R – Microbial Genetics**

**2012 BYU IGEM team**

Winter Semester, 2012, Credit Hours: 3

12:00am-1:50 Tuesday, 12:00-4:00 Thursday, 12:00-1:50 Friday, 888WIDB

**Instructor:** Dr. Julianne H. Grose, 751 WIDB, 422-4940, [julianne\_grose@byu.edu](mailto:julianne_grose@byu.edu)

**Advisor:** Dr. David Kooyman, 302B WIDB, 422-6399, david\_kooyman@byu.edu

**TA:** Julie Roberts, Julie-a-roberts@hotmail.com

***Course Description***

This course is designed to give you a research and presentation experience as you conceptualize and develop a genetically engineered machine for the International Genetically Engineered Machine (IGEM) competition.

***Course Purpose***

This course presents up-to-date research in bioengineering.  You will better understand the research process, how to analyze primary literature and data, how to perform basic scientific techniques, and how to prepare and present your research for dissemination of information to others. This course should substantially improve your performance in other courses by bringing concepts from the classroom to life.

***Prerequisites***

Interview

Accepted into the program

***Required Materials***

Lab Book (hardbound composition book, $2)

Pen

***Classroom Procedures***

Lab begins at noon and may or may not last the entire scheduled class period. You are expected to come to lab every time we meet. Students will be mentored through the basic steps of scientific method beginning with identifying a current environmental or health need, researching that need and possible solutions, developing a theory on how synthetic biology can serve that need, and then building the synthetic biology machine out of cells such as *E. coli* and or yeast. The machine will then be characterized (experimentally) and mathematically modeled. The first few weeks of January will be dedicated to brainstorming, researching and voting on a project. The class will be split into two teams, one team will continue with last years project (*E. colonoscopy*) while the other will pursue a new team project. Both may be presented at the Regional IGEM meeting in October 2012.

In addition to providing students with an independent yet mentored research experience, the MMBIO551 course is designed to teach students basic molecular biology and synthetic biology techniques while providing them with a group of peers dedicated to the same project.

#### COURSE LEARNING OUTCOMES

Students completing this course will:

1. Learn how to identify and develop a novel, compelling synthetic biology research project.
2. Learn how to read and analyze scientific articles.
3. Learn basic molecular biology techniques, including but not limited to:

* Plasmid construction
* PCR
* Primer design
* Cloning procedures
* DNA transformation procedures
* Basic bacterial growth protocols
* Enzyme assays (B-gal, etc.)
* Maintaining and modifying primer, plasmid and strain databases
* Maintaining a proper notebook

1. Design and conduct research experiments with appropriate positive and negative controls.
2. Design experimental protocols based by adapting similar protocols or analyzing primary literature.
3. Analyze and draw conclusions from primary scientific data.
4. Design and implement solutions to issues identified during data analysis.
5. Prepare an abstract for a presentation of research data
6. Prepare and present research presentation (oral and poster) at the Intermountain ASM branch meeting in preparation

for the Regional IGEM meeting in October 2012.

**SPECIFIC LEARNING OUTCOMES FOR THE MICROBIOLOGY MAJOR**

Outcomes highlighted in **bold** will be addressed, in part, in MMBIO 551R

Students graduating with a B.S. degree in microbiology will:

**1. Exhibit mastery of four of the following six principal areas of the discipline:** microbial physiology, **microbial genetics,** microbial ecology,medical microbiology, virology, and immunology.

2. **Devise experiments with appropriate hypotheses and controls**.

**3. Interpret experiments from primary scientific (biological) literature, analyzing the use of the scientific method, critiquing the rationale, methods, and conclusions in light of relevant scientific principles.**

**4. Communicate scientific information using both oral and written methods.**

**5. Reflect/discuss/explore how faith in the Lord and Christ-like living are affected by an understanding of fundamental biological principles.**

**AIMS OF A BYU EDUCATION**

“BYU seeks to develop students of faith, intellect, and character who have the skills and the desire to continue learning and to serve others throughout their lives.” “A BYU education should be (1) spiritually strengthening, (2) intellectually enlarging, and (3) character building, leading to (4) lifelong learning and service.”

This course is designed to develop skills and desire in students to continue their study of microbiology and molecular biology so that it will bless them and allow them to serve others. To this end, the instructors aim to provide an environment that strengthens faith, challenges intellect, allows students to do their best work, and lays a foundation for lifelong learning.

***Student Learning Goals***

We encourage you to make a couple of goals for your own learning in this course:

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***Course Schedule***

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| --- | --- | --- |
| Date | Notebook entry & Other Assignments | Lecture Topics & Lab Work |
| Jan. 5 | Write a basic explain of the 2011 IGEM project in your notebook.  Record the PCR experiment in your notebook. | Student presentation of 2011 IGEM project (1 hour)  Intro to course/IGEM and team members (1 hour)  Notebook discussion, PCR discussion, set-up TAQ mutagenesis of thermosensors and perform pipetting exercise. (1-2 hours) |
| 6 | Record results of TAQ mutagenic PCR. | Lecture on cloning, cloning exercise.  Run 5 uL PCR samples on gel during presentations to check for product.  Discussion of what makes a good IGEM project. Brainstorming for projects. |
| 10 | Write a basic explanation of all 3 projects, including strengths and weaknesses of the project. | Watch and discuss top 3 IGEM projects from 2011. Critical review of each project. |
|  |  |  |
| 12 | Record plate pouring protocol and restriction digest protocol in notebook.  Record brainstorming ideas in notebook | Pour plates for thermosensor mutagenic screen (X-gal, arabinose, LB). Each person will pour 1L for a total of ~500 plates. Precipitate PCR DNA set-up restriction digest of PCR DNA and plasmid while agar is autoclaving.  Brainstorm project ideas and split into groups to research the ideas. |
| 13 | Record ligation protocl and brainstorming ideas in notebook as well as group findings | Run out restriction digests on gel and set-up DNA ligations.  Discussion of possible projects, more brainstorming and group assignments  **Weekly check of lab notebooks begins.** |
| 17 | Group work- record findings in your notebook | Group meetings, prepare for group project presentations |
|  | Record transformation protocol in notebook.  Group presentations | Discussion of Plasmids and trial transformation of ligation into *E. coli*  *Place plates at 30’C (for mutagenesis of 5-3) and 35’C*  *(for mutagenesis of 10-1)*  Group presentations and voting on projects  Discussion and voting on project. |
| 19 |  |  |
| 20 | Record results of transformation. | Group discussion and voting on project cont. Break into groups.  **Weekly check of lab notebooks.** |
| 24 | Record transformation into notebook. | Large scale transformations of thermosensor library produced by mutagenic TAQ PCR, into *E. coli*. Place plates at 30’C and 35’C as necessary. Workout plate- checking schedule for Thursday. **Plates must be moved by TA to 42’C on Thursday morning. Blue colonies must be marked!!** |
| 26 | Record transformation results | Analyze all transformation plates at time intervals on Thursday as per Tuesdays schedule. All plates must be analyzed and marked! |
|  |  | Discussion of Projects. Split into groups for the rest of the semester. |
| 27 |  | **TA must move screen plates to 4°C**  **Weekly notebook check** |
| 31 |  | Groups must strategize and begin experimental design  Thermosensor group must streak all hits from the screen and reanalyze hits.  Semester from here on out is group work |
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| Feb. 2 |  |  |
| 3 |  | **Weekly notebook check** |
| 7 |  |  |
| 9 |  |  |
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| 10 |  | **Weekly notebook check** |
| 14 |  |  |
| 16 |  |  |
|  |  |  |
| 17 |  | **Weekly notebook check** |
| 21 | NO CLASS – Monday Class Day | NO CLASS – MONDAY INSTRUCTION |
| 23 |  |  |
|  |  |  |
| 24 |  | **Weekly notebook check** |
| 28 |  |  |
| Mar. 1 |  |  |
| Mar. 2 |  | Intro to Poster preparation  Work on ABSTRACTS/Poster preparation  **Weekly notebook check** |
| 6 | First Abstract Due (by midnight to Dr. Grose) | Work on ABSTRACT preparation as a group |
| 8 |  | Group project work |
| 9 |  | Work on ABSTRACTS/Poster preparation with feedback from Dr. Grose/  Dr. Kooyman  **Weekly notebook check** |
| 13 |  | Work on ABSTRACTS/Poster preparation, group project work |
| 15 | Final Abstract Due (by midnight to Dr. Grose) |  |
| 16 |  | **Weekly notebook check** |
| 20 |  | Work on Poster preparation, group project work |
| 22 | First Poster Due (by midnight to Dr. Grose) |  |
| 23 |  | Work on Poster with evaluation from Dr. Grose/ Dr. Kooyman |
| 27 |  | Work on Oral/Poster group project work |
| 29 |  | Work on Oral/Poster preparation, group project work |
| 30 |  | Work on Poster with evaluation from Dr. Grose/ Dr. Kooyman |
| Apr. 3 |  | Work on Oral/Poster preparation, group project work |
| Apr. 5 | Final Poster due by 2:00 pm | **Finalize posters. TA will print posters for Intermountain ASM meeting.**  Finalize Oral presentations |
| **6** |  | **In-Class Oral Presentations** (15 minutes per team + 3 minutes q&a) |
|  |  |  |
|  |  |  |
| (Sat.) 7 |  | **Presentations at:** American Society for Microbiology (ASM)  Intermountain Branch Conference |
| 10 |  | Last day of class- party and planning for spring semester |

The Course Schedule and Grading Policy are tentative and subject to change according to the progress of the research project and student needs. This syllabus is intended to describe the course, define requirements and evaluation methods used, and outline the schedule for the semester.  Since this course is based on research, the schedule will fluctuate according to experiments.

***Grading Procedures***

Students must earn points according to the assessment breakdown defined in this syllabus. Letter grades are based on the following: 95% and above will be an A, 90-95% will be an A-, 87-90% will be a B+, 83-87% will be a B, 80-82% will be a B-, etc.

***Participation***

Readiness to learn means that you will come to class with questions and insights.  I expect you to be prepared to discuss the concepts and experiments from the readings. If you are struggling with the concepts or material, be sure to voice your concerns so that we can assist you (that counts as participation). If you see a fellow IGEMer struggling and you can help, please do! Remember, this is a research project and we are a team. You will enjoy your work and earn a better grade if you do the following:

-Read through lecture material and ask questions

-Enthusiastically participate in discussions and activities in class

-Make progress on your research project and be an asset to your team

Students are expected to use all of the class period towards IGEM research. You should not be working on class assignments from another course, checking email, instant message chatting, surfing, gaming, or any other non-scholarly activity during class. Students found engaged in non-research activities during class will lose attendance/participation points for the day (10 points). Repeated offenses will result in the loss of attendance/participation points in an additive manner (10, 20, 10 until the points are gone – of 300 points in this category it is possible to destroy your grade by breaking this rule).

Students who have influenza-like illness should stay away from others [for at least 24 hours after their fever is gone](http://www.cdc.gov/h1n1flu/guidance/exclusion.htm) except to get medical care or for other necessities. Your fever should be gone without the use of a fever-reducing medicine, such as tylenol. If you are legitimately ill, the instructor will make all possible accommodations so that your grade is not unduly affected. If you have samples that need to be cared for, you should email the instructors and/or TA’s so that arrangements can be made with classmates to do what is needed.

***Assessment Breakdown***

|  |  |
| --- | --- |
| Assessments | Points Possible |
| Lab Notebook  Weekly checks (10 weeks x 10 pts per week) | 100 |
| Attendance and participation (30 classes x 10 pts per class) | 300 |
| Abstract Writing (individual participation points)    First Research Abstract  Final Research Abstract | 50  50 |
| Poster Preparation (individual participation points)  First Research Poster  Final Research Poster | 50  50 |
| In Class Presentations  Oral Presentation with PowerPoint  Poster Presentation | 50  50 |
| Total: | 700 |

***Assignment Descriptions***

**Lab Notebook**

Students are expected to keep a lab book throughout the semester. Online Google Doc files will also be posted and used for research. In the lab book, you are required to keep notes on the parameters and results of online research, as well as entries you make in the Google Doc files. You want your lab book to contain information that will be useful as a future reference to prevent the need to re-run the same analysis. Lab books are to be written in ‘real time’; which means that the lab book should always be current. The **Weekly Lab Book Check** will ensure that all lab books are kept current. The TA will observe the lab books of each student to determine whether the book is current, will look over the content and review Google Doc entries. Weekly lab book checks are intended to help each student better understand what is being done, troubleshoot problems, share successes and expand critical thinking skills.

**Attendance**

Attendance is expected during scheduled class time. Please do not attend lab if you have the flu. Make-up lab work can substitute for lost time due to illness or excused absences. TA will monitor attendance and organize any needed extra work. Students must actively participate in the daily research projects during class time or attendance points will be deducted.

**Fine Print:**

**Academic Honesty**

The first injunction of the BYU Honor Code is the call to be honest. Students come to the university not only to improve their minds, gain knowledge, and develop skills that will assist them in their life’s work, but also to build character. President David O. McKay taught that “character is the highest aim of education” (The Aims of a BYU Education, p. 6). BYU students should seek to be totally honest in their dealings with others. They should complete their own work and be evaluated based upon that work. Avoid academic dishonesty and misconduct in all its forms, including but not limited to plagiarism, fabrication or falsification, cheating, and other academic misconduct.

**Honor Code**

In keeping with the principles of the BYU Honor Code, students are expected to be honest in all of their academic work. Academic honesty means, most fundamentally, that any work you present as your own must in fact be your own work and not that of another. Violations of this principle may result in a failing grade in the course and additional disciplinary action by the university. Students are also expected to adhere to the Dress and Grooming Standards. Adherence demonstrates respect for yourself and others and ensures an effective learning and working environment. It is the university’s expectation, and my own expectation in class, that each student will abide by all Honor Code standards. Please call the Honor Code Office at 422-2847 if you have questions about those standards.

**Plagiarism**

Writing submitted for credit at BYU must consist of the student's own ideas presented in sentences and paragraphs of his or her own construction. The work of other writers or speakers may be included when appropriate (as in a research paper or book review), but such material must support the student's own work (not substitute for it) and must be clearly identified by appropriate introduction and punctuation and by footnoting or other standard referencing.

**Preventing Sexual Harassment**

Title IX of the Education Amendments of 1972 prohibits sex discrimination against any participant in an educational program or activity that receives federal funds. The act is intended to eliminate sex discrimination in education. Title IX covers discrimination in programs, admissions, activities, and student-to-student sexual harassment. BYU’s policy against sexual harassment extends not only to employees of the university, but to students as well. If you encounter unlawful sexual harassment or gender-based discrimination, please talk to your professor; contact the Equal Employment Office at 422-5895 or 367-5689 (24-hours); or contact the Honor Code Office at 422-2847.

**Students with Disabilities**

If you have any disability which may impair your ability to complete this course successfully, please contact the Services for Students with Disabilities Office (422-2767). Reasonable academic accommodations are reviewed for all students who have qualified, documented disabilities. Services are coordinated with the student and instructor by the SSD Office. If you need assistance or if you feel you have been unlawfully discriminated against on the basis of disability, you may seek resolution through established grievance policy and procedures by contacting the Equal Employment Office at 422-5895, D-285 ASB.

**Use of Technology in the Classroom**

Technology is an essential part of today’s learning environment. However, when used inappropriately, technology can hinder learning. Using laptops or PDA’s in class to legitimately take notes or work on class projects is allowed, but all other use of laptops or PDA’s in class is prohibited. Please be sure that cell phones are turned off or muted and stored.

**Devotional and Forum Attendance**

As Elder Dallin H. Oaks stated, "You neglect your education and fail to use a unique resource of this university if you miss a single one" (from the address *Challenges for the Year Ahead*, 6 September, 1973). Your attendance at each forum and devotional is strongly encouraged.