

Microbiology 405: Biotechnology and Synthetic Biology

Course Outline (4 PAGES) - Fall 2015

Read carefully. The course is not presented and organized in the traditional manner, but rather is a “flipped classroom”. This format has students learn basic material on their own, and uses classroom time for projects. You will alternatively show up to rooms ECS104 and ECS128. See course calendar for your group’s formal meeting dates. I will attend all of these and note students’ attendance and participation.

1. All lectures are available both as PDFs and as audio presentations of the Power Point presentations. They are available at the M405 “Course Space” site.

Course Space can be found at

<https://www.uvic.ca/cas/login?service=http%3A%2F%2Fcoursespaces.uvic.ca%2Flogin%2Findex.php>

You are expected to view either the PDFs or the audio lectures (or both) on your own. The lectures are divided into groups corresponding to the material that will be covered in each midterm.

2. The projects are meant to inspire both independent and group learning. A reasonable effort should result in a good grade.

3 Classroom time will be devoted primarily to smaller group meetings of a subset of the class. (people outside of a particular group can attend as observers). See the class calendar to determine which days you are expected to attend with your group.

The final grades will be determined as follows:

(25%) Midterm exam. October 26.

(10%) Group iGEM presentations.

(30%) Group project & written abstract.

(35%) Final exam (Comprehensive, but focused on last half of course.)

Supplementary (free) Text book

Title: Bacterial and bacteriophage genetics [electronic resource] / Edward A. Birge.

Author: [Birge, Edward A. \(Edward Asahel\)](#)

Publisher: New York : Springer, c2006. Edition: 5th ed.

Web Link (from UVic or via sign on from your home):

<http://ezproxy.library.uvic.ca/login?url=http://dx.doi.org/10.1007/0-387-31489-X>

For a review of basic concepts in bacterial genetics see Chapter 1. For a review of the basics of transcription and translation, see Chapter 4. Other chapters have information that may provide a basic review relevant to other topics in the course. You will NOT be examined directly on material from the textbook, but you will be expected to know the basics of bacterial gene regulation and genetics that you learned in lower level course in the Department of Biochemistry and Microbiology.

Winning iGEM projects can be found at <http://igem.synbioreview.com/all/>

Section 1. Cloning, PCR & Sequencing.

Introduction.

Enzymes used in biotechnology

PCR basics

Plasmid cloning.

Making a plasmid clone bank

Specialized plasmid cloning vectors and systems.

Lambda (λ) cloning.

Section 2. DNA sequencing and other technologies.

cDNA cloning.

Fosmids, BACs and YACs.

Sanger DNA sequencing.

Sequencing strategies

Next-gen sequencing.

DNA amplification and genome walking.

Section 3. Elements of genetic circuits.

Natural and synthetic promoters; attenuation and termination.

Codon usage, Operons, RBSs and their relevance to biotechnology

sRNA and ribolocks.

Hybrid systems.

Section 4. DNA and Genomic Assembly

Biobricks and Golden Gate

In vitro genome assembly methods (F-PCR, Gibson, SLIC, Pox)

In vivo genome assembly methods (red-gam/ TAR)

Approaches to Bacterial Genome Engineering

Bacterial Genome Assembly.

Sidebar: Counter-selection (a “side-bar” means an extra bit of information that is examinable for the concepts; e.g. what is counter-selection and how you use it, 1 example; but NOT the list of counter-selection genes.)

Section 5 Recombineering and Genome engineering.

Recombineering for eukaryotes

TALES and Zn-finger proteins.

CRISPR-based engineering

TetR regulation of genes.

Recombinases used in genome engineering.

iRNA used to control gene expression

Sidebar: CRISPR gone crazy.

Section 6. Making and expressing proteins.

Directed evolution

Recombinant antibody display

Recombinant expression

Bioreactors

Sidebar: Inclusion bodies.

Section 7. Examples of applications.

Proteins with Un-natural amino acids.

Metabolic Engineering

Recombinant vaccines

Sidebar: Expanding the genetic code with new nucleobases.

Sidebar: Intellectual property related to biotechnology.

For section 7 you must read these 2 articles. You simply need to read them, not study them. You’ll be asked a very basic question on the final exam to verify that you have read them. The questions will be so basic that if you have read them with the care that you might use to read a newspaper article, you’ll be able to answer the questions.

1. Microbial engineering for the production of advanced biofuels. Pamela P. Peralta-Yahya, Fuzhong Zhang, Stephen B. del Cardayre & Jay D. Keasling. Nature 488: 320-328 (2012). doi: 10.1038/nature11478
<http://www.nature.com/nature/journal/v488/n7411/full/nature11478.html>

2. Refactoring biological parts, devices and chassis for delivery of therapeutic agents.

Grades will be assigned as follows:

A⁺	90 - 100	B⁺	77 - 79	C⁺	65 - 69	F	< 50
A	85 - 89	B	73 - 76	C	60 - 64	N **	< 50
A⁻	80 - 84	B⁻	70 - 72	D	50 - 59		

**** N grades**

Students who have completed the following elements will be considered to have completed the course and will be assigned a final grade:

One midterm “exam”, which will be 1 hour long, essay answer exam.

Group project & written abstract.

Final exam (Comprehensive, but focused on last half of course.)

DEPARTMENT INFORMATION AND POLICIES

1. The Department of Biochemistry and Microbiology upholds and enforces the University’s policies on academic integrity. These policies are described in the current University Calendar. All students are advised to read this section.
2. Cell phones, computers, and other electronic devices must be turned off at all times unless being used for a purpose relevant to the class. Students having a cell phone, tablet, or computer on their person during an exam will be assumed to have it for the purpose of cheating.
3. Any recordings of lectures may only be performed with written permission of the instructor, and are for personal use only. The instructor retains copyright to such recordings and all lecture materials provided for the class (electronic and otherwise); these materials must not be shared or reposted on the Internet.
4. Students are expected to be present for the midterm and final exams. Instructors may grant deferrals for midterm examinations for illness, accident, or family affliction, and students must provide appropriate documentation 48 hours after the midterm exam. The Department of Biochemistry and Microbiology considers it a breach of academic integrity for a student taking a deferred examination to discuss the exam with classmates. Similarly, students who reveal the contents of an examination to students taking a deferred examination are considered to be in violation of the University of Victoria policy on academic integrity (see current University Calendar). Deferral of a final exam must be requested with an Academic Concession form and submitted directly to Undergraduate Records. Deferred final exams for fall term courses will be arranged by the instructor. Deferred final exams for spring term courses will be arranged through Undergraduate Records and must be written before the end of the summer term as stipulated in the University Calendar.
5. Scan sheets for multiple choice exams (bubble sheets) will not be made available for review. Therefore, in addition to filling in answers on the scan sheet, students should also circle their answers in ink on their exam.

6. Professors may refuse to review/remark exams not written in ink. In addition, requests for review/remark of a midterm exam must be made within one week of the exam being returned. Students are expected to promptly pick up midterm exams after marking has been completed, either in class or from the instructor.
7. Examination papers that have pages removed, or are mutilated will not be marked.

Standard UVic statement on the Course Experience Survey (CES)

“I value your feedback on this course. Towards the end of term, as in all other courses at UVic, you will have the opportunity to complete an anonymous survey regarding your learning experience (CES). The survey is vital to providing feedback to me regarding the course and my teaching, as well as to help the department improve the overall program for students in the future. The survey is accessed via MyPage and can be done on your laptop, tablet, or mobile device. I will remind you and provide you with more detailed information nearer the time but please be thinking about this important activity during the course.”

I (FN) actually do value your feedback, but I just wanted you to know that the statement was written by someone else, most likely a robot.

September 2015

~ September 2015 ~						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
	Note: ECS 104 is our "main" room. ECS 128 is "breakout" room for group meetings.	1	2 On Day 1 get your group together and figure out how you will communicate, e.g., Facebook.	3 Develop a plan to choose your iGEM project to present Oct 5 and how to choose you group project.	4	5
6	7 Labour Day	8	9	10-1 First class Organize groups. Groups 1&2 break-out to ECS 128.	11	12
13	14-2 Groups 1: Rm 104 Group 2: Rm 128	15	16	17-3 Groups 3: Rm 104 Group 4: Rm 128	18	19
20	21-4 Deadline for project decisions!!! Groups 5: Rm 104 Group 6: Rm 128	22	23	24-5 Groups 2: Rm 104 Group 1: Rm 128	25	26
27	28-6 Groups 4: Rm 104 Group 3: Rm 128	29	30	Notes: You iGEM presentation is of a good iGEM project that you can find on the web. This is a "practice project/presentation." By September 21 all groups should have decided on their unique "real" project. Those groups still indecisive will be assigned a project.		

More Calendars with US Holidays: [Oct 2015](#), [Nov 2015](#), [PDF Calendar](#)

Notes:

1. ECS 104 is our "main" room. ECS 128 is "breakout" room for group meetings. Your group will alternate using the two rooms as Rm 128 is much more fun.
2. On Day 1 of classes get your group together and figure out how you will communicate, e.g., Facebook.
3. Develop a plan to choose you iGEM project to present Oct 5 and how to choose you group project.
4. Organize groups. Groups 1&2 break-out to ECS 128. We'll re-balance the groups as people drop/add the course. There should be 7-8 people in each group.

~ October 2015 ~						
◀ September 2015						Nov 2015 ▶
Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1-7 Groups 6: Rm 104 Group 5: Rm 128	2	3
4	5-8 iGEM presentations, all groups.	6	7	8-9 Groups 1: Rm 104 Group 2: Rm 128	9	10
11	12 Thanksgiving	13	14	15-10 Groups 3: Rm 104 Group 4: Rm 128	16	17
18	19-11 Groups 5: Rm 104 Group 6: Rm 128	20	21	22-12 Groups 2: Rm 104 Group 1: Rm 128	23	24
25	26-13 MIDTERM EXAM	27	28	29-14 Groups 4: Rm 104 Group 3: Rm 128	30	31

More Calendars with US Holidays: [Nov 2015](#), [Dec 2015](#), [PDF Calendar](#)

Notes on final presentations. Any number of students can present

November 2015

This is a blank and printable November Calendar. Courtesy of WinCalendar.com

~ November 2015 ~						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2-15 Groups 6: Rm 104 Group 5: Rm 128	3	4	5-16 Groups 1: Rm 104 Group 2: Rm 128	6	7
8	9	10 Reading	11 Break	12-17 Groups 3: Rm 104 Group 4: Rm 128	13	14
15	16-18 Groups 5: Rm 104 Group 6: Rm 128	17	18	19-19 Groups 2: Rm 104 Group 1: Rm 128	20	21
22	23-20 Groups 4: Rm 104 Group 3: Rm 128	24	25	26-21 Groups 6: Rm 104 Group 5: Rm 128	27	28
29	30	Notes:				

More Calendars with US Holidays: [Dec 2015](#), [Jan 2016](#), [PDF Calendar](#)

Created with [WinCalendar](#) Calendar Creator for Word and Excel

December 2015

This is a blank and printable December Calendar. From WinCalendar.com

~ December 2015 ~						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1-22 Groups 1, 2 and 3 present.	2	3	4-23 Last day of classes. Groups 3, 4 and 5 present. All abstracts due via e-mail. Send as Word/Word-like documents, NOT PDF.	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	Notes:	

Marking scheme for the group project and presentation.

I will combine my evaluations for group participation, slide preparations and for the written abstract to generate the “presentation grade.” I will start by assigning everyone a grade of 80%. I will then look at all of the components and ask if a student’s performance pushes them above or below the 80% mark. For most students their score will not stray from the 80% very much; it’s the presumed class average for this section of the course. However, one would certainly not want to do a half-hearted job on any of these parts of the course and throw out some percentage points.

For the presentation I want everyone to contribute 2-3 slides to the final, edited presentation. Indicate your work by putting your initials in the “invisible” comment section of Power Point-like slides. Often there will be a set of 2 or more initials of students and that is fine. Also, towards the end of the course I will hand out a comment sheet to each member of a group and ask that they write positive comments about especially good group participants. This is one of the ways that I will be alerted to the efforts of some students who generously contribute to the group outside of the classroom.

A group is allowed to make their presentation into a video using something like Camtasia Studio. The group would show this video during their presentation time. This can work well for groups that do not have people who enjoy public speaking, and having the video production skill might be an asset during job hunting, especially if you all agree to share the video as part of your resumes. However, this is a lot of extra work and it requires a reasonable level of computer skills.

A further comment on the abstract assignment is warranted. It’s only three or four sentences, so it should not be too time-consuming. The assignment is my way of forcing you to write well, and to appreciate the fact that you can often dramatically improve the clarity of your writing. It should take you about an hour. Anyone is allowed to help you with this (I can’t control cheating) and you will not be checked for performance-enhancing drugs. However, good writing is an essential skill for most interesting jobs, and you will benefit by going through the exercise.