

BIO199: Introduction to Biological Thinking: Synthetic Biology

University of Richmond

Spring 2019

Course Information

Instructor: B Daniel Pierce, Ph.D.

Office Hours: Gottwald B116, Mondays 1-3 PM or by appointment (just email and we'll find a time)

Course website: <http://dpierce.populr.me/syntheticbio>

Email: bpierce@richmond.edu

I respond quickly to emails, and should email you back within 24 hours if not much sooner. *If I don't email you back in this time frame, please check to make sure your email went through properly!*

Course Meeting Time and Location

Lecture: Gottwald Hall Room B207

Lab: Gottwald Hall Lab Room B207

Days and Time: Tuesday/Thursday 10:30-11:45 AM; Tuesday 1:30-4:20 PM

Course Description

Exploration of the molecular manipulation of organisms. This course introduces students to biological hypothesis formation and experimental design through student laboratory manipulation of bacterial genes. Students will gain a historical perspective of molecular biology and develop an understanding of how this field affects our world. Additionally, the ethics of creating novel life forms and consumable genetically modified organisms will be discussed.

Course Objectives

The primary aim of this course is to introduce students to the thinking that is necessary to solve biological problems. To achieve this aim, we will explore synthetic biology—that is, the molecular manipulation of organisms that serves a multitude of scientific disciplines. Following the revolution of molecular biology decades ago, scientists have capitalized on the information to their benefit their experiments. Through laboratory exploration, data analysis, and classroom discussion, this course will allow students to critically think through all that encompasses this burgeoning field.

Student Learning Outcomes

Upon completion of the course and independent laboratory research, students will be able to . . .

- Define synthetic biology and explain its significance
- Learn molecular biology techniques, including but not limited to pipetting, PCR, and plasmid manipulation
- Understand the ethical debate behind several immediate and future applications of synthetic biology
- Interpret data and present it in a clear manner
- Develop synthesis, critical thinking, and presentation skills

Course Requirements/Student Expectations

This course is based on active learning, and therefore necessitates student engagement away from class. Student-directed learning will be done outside of class through readings and additional online resources, with applications and deeper engagement with the material during class time. **Class attendance (arriving on time) and participation are essential and required.** If you have an unexcused absence or are late to the start of class, deductions to your participation grade may be made.

We live in an increasingly connected world where we are constantly engaged in our electronic devices. This course hopes to capitalize on this engagement and occasionally there will be designated time for computer/cell phone use in class. However, when Dr. Pierce and/or students are presenting, cell phones are expected to be off in order to provide optimal instruction time. Computer use for notes/papers is fine, as long as the student remains engaged with the presenter, on-task, and it does not become a distraction for other students.

Assignments should be emailed or handed to Dr. Pierce on the due date according to his instructions.

Assignments not received on the due date and time will be regarded as "late" and receive a 10% reduction in grade for each successive day it is late.

Course Readings

There will be no required texts in this course, just assigned readings posted three places: blackboard, box.richmond.edu, and our course page: <http://dpierce.populr.me/syntheticbio>.

Recommended texts:

- *A Short Guide to Writing About Biology*. (2015) Jan A. Pechenik. ISBN 978-0431984258
This resource will serve you throughout your career in biology (or other scientific disciplines), so I highly recommend it.
- *A Crack in Creation: Gene Editing and the Unthinkable Power to Control Evolution*. (2018) Jennifer Doudna and Samuel Sternberg. ISBN 978-1784702762

Optional texts:

- *Regenesis*. (2014) George Church and Ed Regis. ISBN 978-0465075706
- *The Gene*. (2016) Siddhartha Mukherjee. ISBN 978-8416863181
- *Synthetic Biology - A Primer*. (2012) Baldwin, et. al. ISBN 978-1848168633
- *The Eighth Day of Creation: Makers of the Revolution in Biology*. (1979) Horace Freeland Judson. ISBN 978-0879694784

As we learn about synthetic biology, these books will provide necessary information for our discussions. I will provide electronic reprints, but these books are certainly worth reading in full!

Grading

Exams:	2 x 100	200	A: 940-1000 points
Reading checks/classwork/participation:		200	A-: 900-939 points
Data Thursdays	5 x 20	100	B+: 870-899 points
iGEM Presentation		50	B: 830-869 points
Lab quizzes/participation/reports/notebook:		200	B-: 800-829 points
Lab poster/presentations:		100	C+: 770-799 points
Final Exam:		150	C: 730-769 points
Total:		1000 points	C-: 700-729 points D+: 670-699 points D: 600-669 points F: 0-599 points

Class Schedule

** Dr. Pierce reserves the right to change to change the syllabus as necessary! Please refer to the updated syllabus online at <http://dpierce.populr.me/syntheticbio!>**

Date	Topic	Readings/Assignments Due
1/15	Introduction to synthetic biology Definition of life	
1/17	Evolution/A brief synopsis of size and time	Take and report VARK assessment Read <i>How to Get the Most Out of College</i> Email Dr. Pierce VARK results
1/22	DNA introduction (a historical perspective)	Read <i>Synthetic Biology</i> , pgs. 1-4 <i>8th Day</i> reading, pgs. 10-16 Read <i>The Gene</i> , pgs. 111-114, 133-137
1/24	Data interpretation DNA continued	<u>Data Thursday #1</u> due on 1/23 at midnight Review <i>Synthetic Biology</i> , pgs. 1-4
1/29	DNA/RNA/Central Dogma Intro to Plasmids	Read <i>The Gene</i> , pgs. 172-184 Read <i>Synthetic Biology</i> , pgs. 6-17
1/31	DNA/RNA/Central Dogma continued Plasmids continued	<u>Data Thursday #2</u> due on 1/30 at midnight Review <i>Synthetic Biology</i> , pgs. 6-17
2/5	Restriction Enzymes DNA as modules	Read <i>The Gene</i> , pgs. 203-214 Listen to Staph podcast and answer Guided Questions Watch the basics of cloning DNA Observe figure of a plasmid Read <i>Synthetic Biology</i> , pg. 152-153
2/7	CRISPR PCR/DNA manipulation	<u>Data Thursday #3</u> due on 2/6 at midnight Listen to CRISPR podcast Turn in CRISPR guided questions
2/12	Extension/Stations	Read <i>Synthetic Biology</i> , pgs. 4-6 & 41-46 Review previous material
2/14	In-class Exam #1 portion given	Take home Exam #1 portion given
2/19	Data discussion Popular cases of "synthetic biology"	Take home Exam #1 portion due
2/21	Introduction to iGEM Presentation skills	Read <i>Synthetic Biology</i> , pgs. 119-121
2/26	E. coli synthetic biology iGEM project Review Exam	Read <i>Synthetic Biology</i> , pgs. 109-117 Read about landmine plants Listen to Synthetic Bio podcast
2/28	Data presentations	Prepare for Data presentations
3/5	Integrated Genomic Circuits	<u>Data Thursday #4</u> due on 3/4 at midnight Read <i>Genomics</i> , pgs. 394-400

3/7	Integrated Genomic Circuits	Read <i>Genomics</i> , pgs. 400-404
3/12	NO CLASS: SPRING BREAK	
3/14	NO CLASS: SPRING BREAK	
3/19	Integrated Genomic Circuits	Read <i>Genomics</i> , pgs. 404-407
3/21	iGEM presentations	Prepare for iGEM presentations
3/26	Extension/Stations	<u>Data Thursday #5</u> due on 3/25 at midnight Review previous material
3/28	In-class Exam #2 portion given	Take home Exam #2 given
4/2	GATTACA	Take home Exam #2 due
4/4	GATTACA	Complete GATTACA guided questions
4/9	Engineering humans, CRISPR revisited	Read <i>The Gene</i> , pgs. 263-283 <i>Regenesis</i> , Chapter 9
4/11	Synthetic life	<u>Data Thursday #6</u> due on 4/10 at midnight Read <i>Synthetic Biology</i> , pgs. 61-71 Watch Venter TED talk
4/16	GMOs	<i>Regenesis</i> , Chapter 7
4/18	Extinction	<u>Data Thursday #7</u> <i>Regenesis</i> , Chapter 8
4/23	Society and Synthetic Biology	<i>Regenesis</i> , Epilogue
4/25	Extensions View from 30,000 feet	Course wrap-up
5/2	Final Exam, 9-12	

Syllabus Specifics

- Please note the days for exams and presentations. I will do everything in my power to keep these dates the way that they appear here – please make sure you are on time and, should extenuating circumstances arise, you **contact me as soon as possible** so we can work out a solution. I will deal with these circumstances on a case by case basis and reserve the right to deduct points if you are not present for exams and presentations.
- There will be seven (7) “Data Thursdays” throughout the semester, where you are presented with data and asked a series of questions through Blackboard. They will be posted one (1) week before they are due. Submit these to Dr. Pierce on Blackboard by midnight of the previous Wednesday (10.5 hours before class time Thursday). These may be graded for accuracy or effort, and only your best five (5) scores will be counted.

Lab Schedule

** Dr. Pierce reserves the right to change to change the lab schedule as necessary! Please refer to the updated syllabus online at <http://dpierce.populr.me/syntheticbio!>**

Week	Date	Topic	Readings/Assignments Due
#1	1/15	Safety 96 Well Plates O' Fun	Watch Pipetting video Sign and turn in Lab Safety Sheet Bio-Maps and BioSquare (bring laptop to class)
#2	1/22	Measurement Pipetting Accuracy Lab	Read Lab Calculations Sheet Turn in Practice Lab Calculations
#3	1/29	Pipetting Accuracy Lab continued Plasmid Lab	Lab Quiz #1 Read Pechenik, Ch. 4, Statistical Essentials Email Dr. Pierce a screenshot of your Excel graph
#4	2/5	Plasmid Lab continued	Turn in Pipetting Accuracy Lab Report
#5	2/12	Electronics Lab Plasmid Lab wrapup	
#6	2/19	Begin pClone Lab continued	Turn in Plasmid Lab Do pClone Pre-Lab work
#7	2/26	pClone Lab continued	
#8	3/5	pClone Lab continued	Lab Quiz #2
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#9	3/19	pClone Lab wrapup Begin independent research Using Pubmed Plagiarism	Present pClone Lab findings Read/review <i>Synthetic Biology</i> , pgs. 153-155 Discuss Annotated Bibliography
#10	3/26	Independent Research: TBD Presentations	
#11	4/2	Continue independent research	
#12	4/9	Continue independent research	Turn in Annotated Bibliography
#13	4/16	Continue independent research	
#14	4/23	Finish independent research	In-class Powerpoint Presentation

Disability Statement

If you have an accommodation that requires academic coordination and planning, please let your professor know as soon as possible. Or if you believe that you have a disability requires an accommodation, please contact the Office of Disability Services at 804-289-8032. The following link may also be helpful:

<https://disability.richmond.edu/students/current/index.html>

If you experience difficulties in this course, do not hesitate to consult with me. There are also other resources that can support you in your efforts to meet course requirements.

Academic Skills Center (<http://asc.richmond.edu> or 289-8626) helps students assess their academic strengths and weaknesses; hone their academic skills through teaching effective test preparation, critical reading and thinking, information processing, concentration, and related techniques; work on specific subject areas (e.g., calculus, chemistry, accounting, etc.); and encourage campus and community involvement.

Career Development Center (<http://cdc.richmond.edu/> or 289-8547) can assist you in exploring your interests and abilities, choosing a major, connecting with internships and learning experiences, investigating graduate and professional school options, and landing your first job. We encourage you to schedule an appointment with a career advisor during your first year.

Counseling and Psychological Services (<http://caps.richmond.edu> or 289-8119) assists students in meeting academic, personal, or emotional challenges. Services include assessment, short-term counseling and psychotherapy, crisis intervention and related services.

Speech Center (<http://speech.richmond.edu> or 289-6409): Assists with preparation and practice in the pursuit of excellence in public expression. Recording, playback, coaching and critique sessions offered by teams of student consultants trained to assist in developing ideas, arranging key points for more effective organization, improving style and delivery, and handling multimedia aids for individual and group presentations.

Writing Center assists writers at all levels of experience, across all majors. Students can schedule appointments with trained writing consultants who offer friendly critiques of written work:

<http://writing.richmond.edu>.

Boatwright Library Research Librarians assist students with identifying and locating the best resources for class assignments, research papers and other course projects. Librarians also assist students with questions about citing sources correctly. Students can schedule a personal research appointment, meet with librarians at the library's main service desk, email, text or IM. Link to <http://library.richmond.edu/help/ask.html> or call 289-8669.