BIOL 412
Capstone in Molecular Biology

Course: BIOL 412-01
Semester: Spring 2022
Faculty Instructor: Dr. Chris Korey
Course Location: RITA 147
Meeting Time: F, 8:30-11:30 am
Office Hours: By Appointment

Email: koreyc@cofc.edu
Phone: 843-953-7178
Capstone in Molecular Biology
Our Classroom is an Inclusive Community

This course will provide equal access. I am happy to work with all students to ensure that they have equal access to the educational experience of this class. Any student eligible for and needing accommodations because of a disability is requested to speak with me during the first two weeks of class or as soon as you have been approved for services so that reasonable accommodations can be arranged - [Center for Disability Services/SNAP](https://www.example.edu/disability-services).

Veterans and Active Duty Military: Veterans and active duty military personnel with special circumstances (e.g., upcoming deployments, drill requirements, disabilities) are welcome and encouraged to communicate these, in advance if possible, to the instructor.

Preferred Name and Pronoun Information: I will gladly honor your request to address you by the name and gender pronouns of your choice - mine are he/him/his. Please advise me of this early in the semester via your college-issued email account or during office hours so that I may make the appropriate notation on my class list.
Capstone in Molecular Biology

OAKs Material

We’ll use it if for:

- All Course Informational Material (Syllabus, Day by Day Detailed Course Guide)
- Course Calendar
- All Readings
- Grading Specifications for the Course and Assignments
- Pre-Class Assignments and Quizzes
- Supplemental Course Material
- Grade Book
Capstone in Molecular Biology
Delving Into The Literature

- Continue to build upon previous experience reading scientific literature
- Reinforce scientific communication skills you have developed as a molecular biology concentrator.
- Get a better understanding of grant proposals
Capstone in Molecular Biology

Readings

- We are only using primary and secondary literature
- All readings will be available on OAKs and I’ll handout a hard copy if you like reading paper versions
- I have chosen the starting review article and papers - you will an opportunity to choose your own at the end
Capstone in Molecular Biology

Antibiotic Tolerance

Targeting Antibiotic Tolerance, Pathogen by Pathogen

Sylvain Meylan,1,4,5,6 Jan W. Andreva,1,4,5,6 and James J. Collins4,5,6

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2Division of Infectious Diseases and Hospital Epidemiology, Basel University Hospital, Basel, CH-4031, Switzerland
3Wyss Institute for Biologically Inspired Engineering, Harvard University, Boston, MA 02115, USA
4Institute for Medical Engineering & Science, Department of Biological Engineering, and Synthetic Biology Center, Massachusetts Institute of Technology, Cambridge, MA 02139, USA
5Broad Institute of MIT and Harvard, Cambridge, MA 02142, USA
6Harvard-MIT Program in Health Sciences and Technology, Cambridge, MA 02139, USA

These authors contributed equally

*Correspondence: jjc@mit.edu
https://doi.org/10.1016/cell.2018.01.007

Antibiotic tolerance, the capacity of genetically susceptible bacteria to survive the lethal effects of antibiotic treatment, plays a critical and underappreciated role in the disease burden of bacterial infections. Here, we take a pathogen-by-pathogen approach to illustrate the clinical significance of antibiotic tolerance and discuss how the physiology of specific pathogens in their infection environments impacts the mechanistic underpinnings of tolerance. We describe how these insights are leading to the development of species-specific therapeutic strategies for targeting antibiotic tolerance and highlight experimental platforms that are enabling us to better understand the complexities of drug-tolerant pathogens in vivo settings.
Capstone in Molecular Biology
Molecular Techniques and Promoter Functional Analysis

- Use synthetic biology and the pClone red expression plasmid to analyze wildtype and mutant bacteriophage promoters
Capstone in Molecular Biology

Molecular Techniques

- Finding and using basic bioinformatic file types such as fastA
- Using bioinformatic research tools such as BLAST, Promoter Identification Algorithms, and other NCBI Bioinformatic Resources.
- Prokaryotic promoter identification and function
- Oligonucleotide design and ordering
- Restriction enzymes, plasmid ligation and cloning
- Basic Sterile Technique, Bacterial Transformation and Plating
- Reporter Plasmid Expression Analysis
- DNA Mini-Preparation
- Determining DNA Concentration
- Gel Electrophoresis (Agarose)
- Polymerase Chain Reaction (PCR)
- DNA Sequencing - Basic Approaches and Next Generation Sequencing
Capstone in Molecular Biology

Let’s Get to Know Each Other

1. Name

2. Something you would like me to know about you:

Three Things You Want to Know About Me or Want to Ask Me:

1. 

2. 

3.
Capstone in Molecular Biology
Detailed Course Calendar

What are important dates I should make note of in my calendar?

I maintain a comprehensive course calendar with the course topics, readings, assignments, and due dates. In the event that our schedule changes (due to weather, class cancellations, etc.), I will update the course calendar online as soon as I can. This information will also be in our OAKs course calendar.

**Syllabus Symbols:** The following symbols provide information about how the class is meeting and will be updated if changes are required due to the pandemic.

- **Normal Course Mode:** Clyde indicates the course is meeting live in-person in RITA 275 during our scheduled class time. Cloth masks that cover your nose and mouth are required to attend these sessions.

- **Course Disruption:** If the course needs to go all online due to the pandemic, the Zoom Symbol will be inserted to indicate that the course is meeting live in zoom during our scheduled class period. The Zoom links will be available in OAKs.

**Pre-Class Meeting Assignments:** All assignments that are required to be completed prior to our next class meeting will always be due by Wednesday at 10pm.
Capstone in Molecular Biology
Specifications Grading

- My grading philosophy has evolved over my time as a faculty member...
- There will be clear specifications or goals for an assignment that are provided to you with the assignment
- **None of your assignments will have grades** attached, your assignment will receive either a “**complete**” or an “**incomplete**” based on your fulfilling the specifications
- This focuses us on reaching our knowledge goals, rather than focusing on what the difference is between an B and B- on an assignment
Capstone in Molecular Biology
Final Grading and Badges

Your final grade is determined by the number of badges out of 10 you have earned during the semester. See detailed specifications grading document in OAKs.

<table>
<thead>
<tr>
<th>Badge</th>
<th>What It Shows</th>
<th>How to Earn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context</td>
<td>You can demonstrate comprehension of existing knowledge and integrate new knowledge</td>
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<td>Methods Visualization</td>
<td>You can visually illustrate scientific methods and identify critical elements of experiment or study design</td>
<td>Submit six illustrated cartoons visualizing the experimental methods for particular data that meet all grading specifications</td>
</tr>
</tbody>
</table>

Overall course grade:

9 badges = A
8 badges = B
7 badges = C
6 badges = D
5 or fewer badges = F
Capstone in Molecular Biology
Substantial Interruption of Instruction (Unlikely)

- If in-person classes are suspended, I will provide a detailed plan for a change in modality to ensure the continuity of learning.

- All students must have access to a computer equipped with a web camera, microphone, and Internet access. Resources are available to provide students with these essential tools.
Capstone in Molecular Biology
Sometimes, life happens happens…

I also understand that you all have other courses, life responsibilities, jobs, and families. You may test positive for SARS-CoV-2, develop COVID-19 symptoms, or have to quarantine/self-isolate. Sometimes, life just takes an unexpected turn.

However, that shouldn’t prevent you from being successful in this class. Please do not hesitate to talk to me about any personal issues (you do not have to provide specifics) that arise during the semester so that we can arrange for the assistance you may need and make reasonable accommodations for you to complete missed work.
Seminar in Neuroscience

*Basic COVID Protocols*

COVID-19 Positive students both on and off-campus as well as faculty and staff (regardless of vaccination status):

- 5-day isolation away from campus required.
- Your isolation period is determined from the date of the positive COVID-19 test. Day 1 of isolation begins the day after the positive test date.
- If you have no symptoms after five days and you are without fever for 24 hours and not on fever-reducing medicines, you may return to campus but MUST wear a mask while around others for an additional five days.
- If your symptoms have not improved on day 5, a full 10-day isolation away from campus is required.

Close Contact Procedures:
- See the Health and Wellness Page [here](#) for the process to follow based on vaccination status
Capstone in Molecular Biology
Contacting Me - Email!

AVERAGE TIME SPENT COMPOSING ONE E-MAIL

PROFESSORS: 1.3 SECONDS
YES.
(SEND)
NO.
(SEND)
SEE ATTACHED.
(SEND)
DO IT.
(SEND)

GRAD STUDENTS: 1.3 DAYS
DEAR (? PROF. SMITH,
I WAS WONDERING IF PERHAPS YOU MIGHT HAVE POSSIBLY GOTTEN THE CHANCE TO POTENTIALLY FIND THE TIME TO MAYBE LOOK FOR A DRAFT PAPER THAT I SENT TO YOU LAST WEEK. I DON'T THINK IT'S THERE. IF YOU ARE UNCERTAIN, YOU MIGHT HAVE MISSED IT. I DON'T KNOW IF YOU HAVE ANY OTHER QUESTIONS. WHATS NEXT?

• Email is the best way to connect with me if you have questions that are particular to just you or course questions. I’ll answer your emails within 24 hours.
  ○ Weekdays - Emails sent to me after 5pm will likely be answered the next morning.
  ○ Weekends - Emails sent after 4pm on Friday will be answered on Sunday night or Monday morning
Capstone in Molecular Biology

Honor Code and Academic Integrity

- Cases of suspected academic dishonesty will be reported directly by the instructor and/or others having knowledge of the incident to the Dean of Students.

- A student found responsible by the Honor Board for academic dishonesty will receive a XXF in the course, indicating failure of the course due to academic dishonesty. This grade will appear on the student’s transcript for two years after which the student may petition for the XX to be expunged. The F is permanent. The student may also be placed on disciplinary probation, suspended (temporary removal) or expelled (permanent removal) from the College by the Honor Board.

- Students should be aware that unauthorized collaboration--working together without permission-- is a form of cheating. Unless the instructor specifies that students can work together on an assignment, quiz and/or test, no collaboration during the completion of the assignment is permitted.

- Students can find the complete Honor Code and all related processes in the Student Handbook.
Capstone in Molecular Biology
First Assignment - Concept Mapping
Spring 2022 BIOL 412 Detailed Course Plan

Syllabus Symbols: The following symbols provide information about how the class is meeting and will be updated if changes are required due to the pandemic.

Normal Course Mode: Clyde indicates the course is meeting live in-person in RITA 275 during our scheduled class time. Masks that cover your nose and mouth are required to attend these sessions.

Course Disruption: Although highly unlikely, If the course needs to go all online due to the pandemic, the Zoom Symbol will be inserted to indicate that the course is meeting live in zoom during our scheduled class period. The Zoom links will be available in OAKs.

Pre-Class Meeting Assignments: All assignments that are required to be completed prior to our next class meeting will always be due by Wednesday at 10pm.

<table>
<thead>
<tr>
<th>Day</th>
<th>Date</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Module 0 - Introductions and Course Design</strong></td>
</tr>
<tr>
<td>F</td>
<td>1/14</td>
<td>Introductions, Course Design</td>
</tr>
</tbody>
</table>

Module One: Our first module will allow us to take a deep dive into the molecular biology of SARS-CoV-2 replication. We’ll read a recent review over two class periods and then dig deeper into the molecular mechanisms by reading and discussing three peer-reviewed research papers. We’ll use a variety of pre-class assignments and collaborative in-class activities to dissect the current state of knowledge in the field.

Module 1 - Antibiotic Resistance and Tolerance Review
Meylan, Andrews, and Collins (2018) Targeting Antibiotic Tolerance, Pathogen by Pathogen

<table>
<thead>
<tr>
<th>Day</th>
<th>Date</th>
<th>Research</th>
<th>Due Before Class:</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>1/21</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Class Discussion of pp 1228-1231</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Concept Map Assignment</td>
</tr>
<tr>
<td>F</td>
<td>1/28</td>
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<tr>
<td></td>
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<td></td>
<td>Class Discussion of pp 1231 to end</td>
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<td>●</td>
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<td></td>
<td></td>
<td></td>
<td>Concept Map Assignment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Promoter Research:</td>
<td>Oligonucleotide Annealing/GGA Cloning Introduction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lab Quiz 1</td>
</tr>
</tbody>
</table>
**Module Two:** Our second module will facilitate a close examination of a peer-reviewed research article. We’ll use a variety of pre-class assignments and collaborative in-class activities to examine experimental approaches, hypotheses, and results. This module will end with an exploration of how we fund science in the US.

<table>
<thead>
<tr>
<th>Module 2 - Research Article #1 Discussion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F</strong></td>
</tr>
<tr>
<td><em>Research:</em> Discussion of Introduction and First Half of Results/ Figures</td>
</tr>
<tr>
<td>● <em>Due Before Class:</em> Introduction Concept Map, Figure Analysis Activity</td>
</tr>
<tr>
<td><em>Promoter Research:</em> GGA Ligation</td>
</tr>
<tr>
<td>● <em>Due Before Class:</em> Lab Quiz 2</td>
</tr>
<tr>
<td><strong>F</strong></td>
</tr>
<tr>
<td><em>Research:</em> Second Half of Results/ Figures</td>
</tr>
<tr>
<td>● <em>Due Before Class:</em> Figure Analysis Activity</td>
</tr>
<tr>
<td><em>Promoter Research:</em> Transformation and Plating of GGA Ligation</td>
</tr>
<tr>
<td>● <em>Due Before Class:</em> Lab Quiz 3</td>
</tr>
<tr>
<td><strong>F</strong></td>
</tr>
<tr>
<td><em>Research:</em> Discussion/Future Experiments; How Science Gets Funded in the US</td>
</tr>
<tr>
<td>● <em>Due Before Class:</em> Expand Concept Map, List of Discussion Points</td>
</tr>
<tr>
<td><em>Research:</em> How Science Gets Funded in the US</td>
</tr>
<tr>
<td>● <em>Due Before Class:</em> Grant Panel Review Criteria Ideas</td>
</tr>
<tr>
<td><strong>F</strong></td>
</tr>
<tr>
<td><em>Research:</em> Grant Panel Discussion; 5 Questions for Authors</td>
</tr>
<tr>
<td>● <em>Due Before Class:</em> Next Experiment Mini-Proposal</td>
</tr>
</tbody>
</table>

**Module Three:** Our third module will facilitate a close examination of a peer-reviewed research article. We’ll use a variety of pre-class assignments and collaborative in-class activities to examine experimental approaches, hypotheses, and results. This module will end with a second exploration of how we fund science in the US.

<table>
<thead>
<tr>
<th>Module 3 - Research Article #2 Discussion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottery <em>et al.</em> (2021) Inter-species interactions alter antibiotic efficacy in bacterial communities</td>
</tr>
<tr>
<td><strong>F</strong></td>
</tr>
<tr>
<td><em>Research:</em> Discussion of Introduction and First Half of Results/ Figures</td>
</tr>
<tr>
<td>● <em>Due Before Class:</em> Introduction Concept Map, Figure Analysis Activity</td>
</tr>
<tr>
<td><em>Promoter Research:</em> Culturing No Color Colonies/ Re-Plating Red Colonies</td>
</tr>
<tr>
<td>● <em>Due Before Class:</em> Lab Quiz 4</td>
</tr>
<tr>
<td><strong>F</strong></td>
</tr>
<tr>
<td><em>Research:</em> Second Half of Results/ Figures</td>
</tr>
<tr>
<td>● <em>Due Before Class:</em> Figure Analysis Activity</td>
</tr>
<tr>
<td><em>Promoter Research:</em> DNA Plasmid Mini-preparation/RFP Expression</td>
</tr>
<tr>
<td>● <em>Due Before Class:</em> Lab Quiz 5</td>
</tr>
</tbody>
</table>
### Week 10
**3/25**

**Research:** Discussion/Future Experiments;
- **Due Before Class:** Expand Concept Map, List of Discussion Points

**Promoter Research:** PCR Reactions and Restriction Enzyme Digests
- **Due Before Class:** Lab Quiz 6

### Week 11
**4/1**

**Research:** Grant Panel Discussion; 5 Questions for Authors
- **Due Before Class:** Next Experiment Mini-Proposal

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**Module Four:** Our fourth module will ask you to choose a recent paper that explores new molecular technologies and their role in pushing the field forward. This section will end with you giving a 10 minute conference style talk to fill us in on what you learned from your paper. We’ll end by reflecting on what we have learned about the path to being a professional in science from the responses that authors may have sent us.

### Module 4 - Research Presentations

<table>
<thead>
<tr>
<th>Week 12</th>
<th>4/8</th>
<th>Research: Presentation Working Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td></td>
<td>- <strong>Due Before Class:</strong> Introduction Concept Map</td>
</tr>
</tbody>
</table>

**Promoter Research:** Gel Electrophoresis and Analysis
- **Due Before Class:** Lab Quiz 7

<table>
<thead>
<tr>
<th>Week 13</th>
<th>4/15</th>
<th>Research: Presentation Working Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td></td>
<td>- <strong>Due Before Class:</strong> Key Figure Analysis Activity</td>
</tr>
</tbody>
</table>

**Promoter Research:** Final Discussion of Results
- **Due Before Class:** Lab Quiz 8

<table>
<thead>
<tr>
<th>Week 14</th>
<th>4/22</th>
<th>Research: Paper Presentations</th>
</tr>
</thead>
</table>
How is my final grade calculated?

As explained in the syllabus, your overall course grade is determined by how many course badges you earn during the semester. Listed below are the ten badges offered in the course, what these badges demonstrate about your learning, and what it takes to earn them.

9 badges = A
8 badges = B
7 badges = C
6 badges = D
5 or fewer badges = F

1 halfway completed badge = next highest plus grade
2+ halfway completed badges = next highest minus grade

Review the syllabus and the information provided here to devise a plan for achieving the course grade you’re aiming for. I’ll keep track of updated grades information in OAKS, but I’ve also included at the end of this handout a worksheet you can use to keep track of your grade.

This approach provides some flexibility about which badges you would like to choose to complete the course. There are four badges that are required to earn an A or B in the class - Experimental Design, Lab Technical Skills, and Science Communication.

<table>
<thead>
<tr>
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<td>Context</td>
<td>You can demonstrate comprehension of existing knowledge and integrate new knowledge</td>
<td>Submit six annotated concepts maps of the review and two primary article introductions that meet all grading specifications</td>
</tr>
<tr>
<td>Methods Visualization</td>
<td>You can visually illustrate scientific methods and identify critical elements of experiment or study design</td>
<td>Submit four illustrated cartoons visualizing the experimental methods for particular data that meet all grading specifications</td>
</tr>
<tr>
<td>Data Annotation</td>
<td>You can apply critical reading to connect methods, figure legends, and results You can critically evaluate methods and data presentation formats</td>
<td>Submit four figure annotation activities that meet all grading specifications</td>
</tr>
<tr>
<td>Data Evaluation</td>
<td>You can examine and discuss author interpretations and claims with scientific colleagues</td>
<td>Participate in weekly in-class data discussion activities that meet all grading specifications</td>
</tr>
<tr>
<td>Experimental Design</td>
<td>You can demonstrate scientific process skills (generating hypotheses and experimental design) and synthetic thinking</td>
<td>Submit two next experiment mini-grant proposals that meet all grading specifications</td>
</tr>
<tr>
<td>Course</td>
<td>Description</td>
<td>Requirements</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>Grant Panel</td>
<td>You can apply analytical thinking skills and clearly communicate that analysis to scientific colleagues</td>
<td>Actively participate in both in-class grant panel activities</td>
</tr>
<tr>
<td>Life Exploration</td>
<td>You have gained insight into the career path of professionals in the biomedical sciences</td>
<td>You submit two sets of author questions and a final reflection on their responses.</td>
</tr>
<tr>
<td>Lab Preparation</td>
<td>You prepared for daily lab work and reviewed technical information from previous labs</td>
<td>You complete 7 of 8 Pre-Class Quizzes (∋80%)</td>
</tr>
<tr>
<td>Lab Technical Skills</td>
<td>You understand the principles of and have demonstrated proficiency in key molecular techniques</td>
<td>You complete 14 of 15 technical lab learning outcomes on the final practical exam</td>
</tr>
<tr>
<td>Science Communication</td>
<td>You can clearly summarize and communicate the findings of a research project/paper</td>
<td>Complete all steps in the development of the presentation and present your 10 minute talk to the class</td>
</tr>
</tbody>
</table>
What Are Ethos Points?
You will start the class with three ethos points, which are tokens you can use to get a 24 hour extension on assignment or resubmit within two weeks of the original due date an assignment you submitted that did not meet all expectations or was submitted late and was therefore graded incomplete.

How Will Plus/Minus Grade Options Be Handled?
If you recall from the syllabus, your overall course grade is based on the number of badges you complete. Nine badges equals an A, eight a B, and so on. Plus/minus grades will be determined based on the number of badges you’ve attempted, made 50% progress on or more, but haven’t fully completed. One of these types of not-yet-complete badges raises your grade to the next highest plus grade; two or more raise your grade to the next highest minus grade. The only badge excluded from counting as in-progress is the Lab Technical Skills badge.

What Will This Look Like in OAKS?
I will use the Grades page in OAKS to track your progress toward each badge. Rather than earning a letter grade, each individual assignment and badge will earn a grade of either complete or incomplete. I will enter your progress toward a badge (or leave blank if unattempted) until it is complete. Your running total of ethos points will be tracked in real time.

If you do not meet these specifications by midterm, I will estimate your course grade based on your progress toward badges and your remaining ethos points, and explain this estimate in feedback provided in the OAKS Grades page.
Course Badges Progress Tracker

Total number of fully earned badges: __________

Total number of halfway completed badges: __________

**Context:** Concept Map 1 __ Concept Map 2 __ Concept Map 3 __ Concept Map 4 __
Concept Map 5 __ Concept Map 6 __

**Methods Visualization:** Exp. Cartoon 1 __ Exp. Cartoon 2 __ Exp. Cartoon 3 __
Exp. Cartoon 4 __

**Data Annotation:** Figure Analysis 1 __ Figure Analysis 2 __ Figure Analysis 3 __
Figure Analysis 4 __

**Data Evaluation:** Week 2 __ Week 3 __ Week 4 __ Week 5 __ Week 6 __
Week 7 __ Week 8 __ Week 9 __ Week 10 __ Week 11 __

**Experimental Design:** Mini-Grant 1 __ Mini-Grant 2 __

**Grant Panel:** Review Criteria 1 __ Panel 1 __ Review Criteria 2 __ Panel 2 __

**Life Exploration:** Author Questions 1 __ Author Questions 2 __ Reflection __

**Lab Preparation:** Quiz 1 __ Quiz 2 __ Quiz 3 __ Quiz 4 __ Quiz 5 __ Quiz 6 __
Quiz 7 __ Quiz 8 __

**Lab Technical Skills:** ___ /15 Skills

**Science Communication:** Paper Choice __ Concept Map __ Key Figure Activity __ Draft Slides __ Presentation __