Biology 312L (Fall 2022)
Molecular Biology Lab – HHMI Phage Research

Lab: F 1:00 am – 4:00 pm, RITA 145
Instructor: Dr. Christine Byrum
Email: byrumc@cofc.edu
Phone: (843) 953-7176 For lab emergencies: 911
Office Hours: Office hours by appointment, RITA 211 (email me to schedule)
Prerequisites/Co-requisites: Co-enrollment or completion of Genetics (BIOL 305) and co-enrollment or completion of Molecular Biology (BIOL 312).

Course Overview:

In collaboration with the Howard Hughes Medical Institute (HHMI) students in this upper level undergraduate course will participate in bacteriophage genomics research! This is part of a national effort to discover, isolate, and sequence genomes of previously unidentified viruses. Students participate in authentic hands-on research combining molecular genetics, microbiology techniques, and computational approaches for large-scale analysis of bacteriophage genomes. In this course students will:

- Collect environmental samples.
- Isolate bacteriophages from those samples.
- Design primers to amplify specific genes using PCR. Use PCR and restriction digests to identify different viruses.
- Use transmission electron microscopy to examine structure of the isolated viruses.
- Prepare viral DNA for sequencing.
- Send purified viruses for whole genome sequencing using Illumina technologies.
- Collaborate with other schools in the HHMI network on an online forum.
- Upload information about our viruses to a publicly accessible database.
- Contribute to scientific discovery!

Course Objectives/Student Learning Outcomes:

1) Demonstrate the ability to use and explain modern molecular biology techniques.
2) Demonstrate understanding of developing hypotheses and designing experiments.
3) Communicate, analyze, and discuss experimental results.
4) Demonstrate ability to evaluate/apply information presented in scientific journals.
5) Demonstrate the ability to utilize key tools needed in molecular biology (e.g. performing gel electrophoresis, setting up and running a PCR reaction, extracting DNA, and searching for sequences using Genbank or BLAST)
Required Supplies:
- Phage Discovery Guide - PDF is provided on OAKS free of charge. An online version of this is also available at the following website:
  https://seaphagesphagediscoveryguide.helpdocsonline.com/home
- Lab notebook (To be kept in lab during and after completion of course)

Course Policies

Attendance: Regular classroom participation is critical. If you are absent, your research cannot proceed. If you cannot attend a class be sure to inform the instructor ahead of time and get the missed information from a classmate or the instructor. Multiple unexcused absences will likely result in a failing grade.

OAKS and Other Websites: I will regularly post information, including the syllabus, assignments, and other class materials on OAKS throughout the semester. We will also utilize the HHMI SEA-PHAGES website (phagesdb.org).

Office hours: If you have questions or would like to chat, contact me by email, telephone, or in class to schedule an office hour session. I respond to telephone messages/emails within 24 hours during the week and within 48 hours on the weekend. Questions are highly encouraged and I’m happy to hear from you!

Classroom Courtesy: It is important to focus on class activities. Be sure to switch off cell phones or other disruptive devices during lab. Do not text, watch movies, shop online, or engage in other disruptive behaviors. Exceptions to cell phone restrictions will be made in extreme situations such as spouses anticipating the birth of a child or a serious emergency. Obtain permission to leave an electronic device on before class.

Recording of the Class: Class sessions may be recorded via either voice and/or video. By attending and remaining in the course, you consent to being recorded. Recordings are for instructional use only and may not be shared with those not enrolled.

Lab Safety and Attire: Before attending the next lab, each student should review the official SSM safety manual posted on OAKS. Students should be sure to dress appropriately, wearing closed-toed shoes and pants rather than shorts. Also, do not bring any food or drinks into the lab.

Additional Lab Hours: Due to the nature of this research course, you may need to come to the lab between classes or during open lab periods on the weekend (times that the instructor will be available to meet students during open lab will be posted/announced in class ahead of time). Be sure to record anything that you do during these times in your notebook as well.
Assignments/Grading:

Course Grade Calculation:
- Participation/Research Productivity: 30%
- Lab Notebook: 20%
- Quizzes/Homework: 40%
- Virus Presentation: 10%

Grading Scale:
- 93 and above: A
- 73-76.9: C
- 90-72.9: C-
- 67-69.9: D+
- 83-86.9: B
- 63-66.9: D
- 80-82.9: B-
- 60-62.9: D-
- 77-79.9: C+
- below 60: F

Participation/Research Productivity: A critical portion of your grade will be based on participation and research productivity. This grade is determined based on three criteria: A) regular attendance; B) research focus (evidence that lab work is performed correctly and that you made progress in the project or in troubleshooting if obstacles are encountered); and C) your ability to interact productively with others, actively contribute during discussions, and maintain a positive attitude. Aspects that will be considered include the following:

- Are you curious and interested in communicating discoveries?
- Have you become familiar with what is already known about the subject?
- Do you continue to work hard even after encountering challenges?
- Are you able to work independently?
- Do you help others in the class?
- Do you ask good questions during discussions?
- Do you skillfully execute experiments?
- Can you develop and clearly state hypotheses?
- Can you clearly describe results and ideas to others?
- Can you logically troubleshoot when things go wrong?
- Can you correctly interpret outcomes of experiments?

Lab Notebook: Throughout the semester, students will record their activities in a lab notebook. These lab notebooks should stay in the lab during the semester and will be kept by the instructor afterwards so that we can refer to your data as manuscripts are prepared for publication. Your phages will ultimately be archived in a National Phage Repository, so it is important that you clearly document your experiments. Lab notebooks will be evaluated twice during the semester. When grading, the instructor will consider the following:

- Did the student record all aspects of the project (are the contents complete)?
- Did the student state their aims clearly for each portion of the project?
- Are the methods stated?
- What were the results?
- Are future plans stated?
- Are drawings included and understandable?
- Is the material presented easy to interpret and understand?
- Did the student include photos of data?

**Quizzes/Homework:** Students will complete assigned exercises to be turned in at the beginning of the next class. Lab assignments will be announced in class and/or placed on OAKS prior to the week they are due. These assignments may be involve reading papers before class, preparing for discussions, completing worksheets, quiz prep, writing a short report, etc.

**Presentation:** At the start of the semester each student will select a date to do a short presentation about a virus researcher/study (~5 minutes). Depending on the investigator, you may describe recent findings, present historical information about virus research, describe mechanisms of viral activities, discuss an industrial use of viruses, etc. The information presented should be, in some way, relevant to molecular biology of viruses. Prepare your talk as a PowerPoint presentation. These talks will be presented at the start of each class and you should also submit a copy to be posted on OAKS. Feel free to discuss this with me ahead of time if you’re unsure whether your topic is suitable. Be sure that your topic differs from previously covered information.

**Academic Integrity:**

You are expected to behave in an honest and responsible manner. Violations of the honor code are offensive and will generally be dealt with severely. We will adhere to the following policy as quoted from the Honor Council’s recommended guidelines:

“Lying, cheating, attempted cheating, and plagiarism are violations of our Honor Code that, when suspected, are investigated. Each incident will be examined to determine the degree of deception involved. Incidents where the instructor determines the student’s actions are related more to misunderstanding and confusion will be handled by the instructor. The instructor designs an intervention or assigns a grade reduction to help prevent the student from repeating the error. The response is recorded on a form and signed both by the instructor and the student. It is forwarded to the Office of the Dean of Students and placed in the student’s file. Cases of suspected academic dishonesty will be reported directly by the instructor and/or others having knowledge of the incident to the Office of the Dean of Students. A student found responsible by the Honor Board for academic dishonesty may receive a XXF in the course, indicating failure of the course due to academic dishonesty. This status indicator 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 complete Honor Code and all related processes are in the Student Handbook at: http://deanofstudents.cofc.edu/honor-system/studenthandbook/index.php

Other Considerations:

Inclement Weather, Pandemic, or Substantial Interruption of Instruction: If we need to evacuate or experience disruptions due any of the listed situations, I will announce a detailed plan for any changes in modality. Be sure to take your computer and any other course materials with you. All students must have access to a computer equipped with a web camera, microphone, and internet access. If this is a problem, resources are available to provide you with these essential tools.

Center for Student Learning: Students are encouraged “to utilize the Center for Student Learning’s (CSL) academic support services for assistance in study strategies, speaking/writing strategies, and course content. This office offers tutoring, study strategy appointments, supplemental instruction, and workshops. Services are available at no additional cost. For more information regarding the CSL, see their website at http://csl.cofc.edu or call (843) 953-5635.”

Accommodations for Students with Disabilities: If you need accommodations because of a disability, please talk to me about this during the first week of classes or as soon as you have been approved for these services so that we can address this. For more information on Disability Services, please refer to the following website: http://disabilityservices.cofc.edu

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

Inclusion: I will gladly honor your request to address you by the name and gender pronouns of your choice. Please advise me of this at your earliest convenience via your college-issued email account or in person. For more resources, see http://gender-sexuality-equity.cofc.edu.

Food/Housing Insecurity: If you are not economically secure in food and housing, the College has assistance programs. Contact the Dean of Students directly, or I will be happy to provide confidential assistance.
## Lab Schedule:

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
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<tbody>
<tr>
<td>Aug. 26</td>
<td>Lecture: Introduction to HHMI and Phage Lab</td>
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<td>Lab: Collect Samples/Aseptic Technique/Pipetting</td>
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<td>Sept. 2</td>
<td>Lecture: Intro to Viruses and Bacteria/Quiz</td>
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<td>Lab: Direct and Enriched Isolation</td>
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<td>Sept. 9</td>
<td>Lecture: Notebooks/Paper Discussion (Genome Announcement)</td>
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<td>Lab: Plaque Isolation/Spot Test</td>
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<td>Sept. 16</td>
<td>Lecture: Phage Genome Features</td>
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<td>Lab: Plaque Purification (Serial Dilution and Spot Titer)</td>
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<tr>
<td>Sept. 23</td>
<td>Lecture: Genbank and BLAST/Virus, Bacteria, Genome Features/Quiz</td>
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<td>Lab: Plaque Purification (Full Titer plates)</td>
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<td>Sept. 30</td>
<td>Lecture: Titer Plates</td>
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<td></td>
<td>Lab: Plaque Purification (Pick Plaque, Do 2nd Serial Dilution/Spot Titer)</td>
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<td>Oct. 7</td>
<td>Lecture: Primer Design</td>
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<td>Lab: Full Titer Plates or Multispot Plates to Collect Lysate</td>
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<td>Oct. 14</td>
<td>Lecture: PCR</td>
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<td>Lab: Serial Dilutions to Check Lysate Concentration</td>
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<td>Set Up PCR to Detect Viral Genes</td>
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<td>Oct. 21</td>
<td>Lab: Plaque Purification</td>
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<td>Oct. 28</td>
<td>Lecture: DNA Extraction</td>
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<td>Lab: DNA Extraction</td>
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<td>Nov. 4</td>
<td>Lecture: Restriction Enzymes/Quiz</td>
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<td>Lab: Restriction Digests</td>
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<td>Nov. 11</td>
<td>Lecture: Gel Electrophoresosis</td>
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<td>Lab: Gel Electrophoresis</td>
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<td>Nov. 18</td>
<td>Lecture: TEM</td>
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<td>Lab: TEM</td>
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<td>Nov. 25</td>
<td>Thanksgiving Break</td>
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<td>Dec. 2</td>
<td>Archiving/Final Notebooks Due</td>
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*Activities may vary subject to scheduling changes and other modifications as needed.*