



Honors Virus Hunters – Bioinformatics IDH 3910 CRN 12976 - Spring 2018 (3 credit hrs.)

This syllabus is subject to change

Class: M/W/F 9:30-10:20 am – Seidler Hall room 114

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Office hours: M/W/F 10:20-11:00 and by appointment

Course description: This non-traditional Honors course is designed to provide you with an opportunity to conduct an authentic research project using a hands-on approach, the way professional scientists do. In this course, you will first annotate and analyze the genomes of two newly discovered *Gordonia terrae* bacteriophage isolated by a previous FGCU class. As a group, you will publish these annotated genomes in a national database, GenBank (the National Institutes of Health genetic sequence database, an annotated collection of all publicly available DNA sequences) <https://www.ncbi.nlm.nih.gov/genbank/>. You may also annotate additional phage genomes as they become available. The course uses a student-centered learning approach, is inquiry based with fully integrated research experiences and assignments that emphasize active learning strategies, teamwork, communication, and peer-review using real-world scenarios.

FGCU was one of 8 universities chosen through a competitive process in 2013 to participate in an exciting initiative developed by the Howard Hughes Medical Institute's (HHMI) Science Education Alliance (SEA) <http://www.hhmi.org/programs/science-education-alliance/sea-phages-program-adds-eight-new-schools>. FGCU is now one of approximately 120 schools nationwide that participate in this initiative, the Phage Hunters Advancing Genomics & Evolutionary Science (PHAGES) program. Each participating institution will sequence the genome of one or more of the phages discovered by its students and annotate the sequenced genomes. At least one of you will be selected to present our class' research findings at the 2018 National SEA-PHAGES Symposium that will be held in June at the Howard Hughes Medical Institute Janelia Farm Research Campus, Ashburn, Virginia along with students and faculty from each of the other institutions. There is no cost to the student(s). The number of students attending the conference from each institution will be determined by HHMI SEA.

Computer/Software: A laptop computer either PC or Mac with the minimum requirements outlined in the table below is required. **Please bring your computer to class everyday along with any necessary power cords and cables required to connect to the podium projector.** You will need to install two genome analyses software programs: SEA Virtual Machine (which contains Starterator and Phamerator and runs on Linux Ubuntu) and DNA Master that runs on Windows.

DNA Master requires a Windows operating system. If you use a Mac or other type of operating system, DNA Master can be installed and run on an emulator (like [Virtual Box](#)) with a Windows virtual machine. You will need to purchase Windows software for your computer, if you have a Mac.

| Mac Minimum Requirements (using Windows virtual machine): | PC minimum Requirements: |
|---|---|
| Mac OS X 10.6 or higher Dual-core processor, 1.8 GHz (Intel-based Macs ONLY) 2 GB RAM 128 MB video memory 25 GB free hard-drive space Internet connection FULL ADMINISTRATOR RIGHTS* | Windows XP or Vista or Windows 7+ Dual-core processor, 1.8 GHz 1 GB RAM (if using XP) 2 GB RAM (if using Vista/Windows 7+) 128 MB video memory 5 GB free hard-drive space Internet connection FULL ADMINISTRATOR RIGHTS* |
| * In many cases, problems have been caused by permissions settings that limit DNA Master's abilities. To avoid these common issues, make sure you run DNA Master as an administrator . The install guide has instructions on how to create a Desktop shortcut that will always execute DNA Master as an administrator. | |

Textbook: The SEA-PHAGES Annotation and Bioinformatics Analysis of Bacteriophage Genomes: A User Guide to DNA Master (DNA Master Annotation Guide) by Jacobs-Sera, Pope, Russell, Cresawn, and Hatfull (2015 revision) is available in the Mycobacteriophage Database and on Canvas.

Website: You will find information for our course on Canvas <http://canvas.fgcu.edu>, including announcements, the syllabus, schedule of activities, assignment due dates, the DNA Master Annotation Guide, reading assignments, etc. You will submit most course assignments electronically via Canvas. You will need your FGCU e-mail address and password to log in.

Other course resources: You will routinely access the following websites for your research: the Mycobacteriophage Database <http://phagesdb.org>, National Center for Biotechnology Information (NCBI) BLAST https://blast.ncbi.nlm.nih.gov/Blast.cgi?CMD=Web&PAGE_TYPE=BlastHome, GeneMark.hmm for Prokaryotes <http://opal.biology.gatech.edu/genemark/gmhmm.cgi>, Max Planck Institute Bioinformatics Toolkit homology detection and structure prediction (HHPred) <http://toolkit.tuebingen.mpg.de/hhpred> and Phage Evidence Collection And Annotation Network (PECAAN) <https://discover.kbrinsgd.org/login>. You will also read primary literature papers and supplemental readings. These will be available on Canvas or through various search engines.

Course prerequisites: None.

Learning Outcomes:

Upon completion of the course students will be able to:

- Annotate and analyze a previously uncharacterized bacteriophage genome.
- Develop testable scientific hypotheses using realistic constraints.
- Communicate results and significance of research.
- Take ownership of and responsibility for learning.

- Design and implement real-world experiments.
- Work effectively in interdisciplinary teams.
- Critically evaluate methodology, process, and experimental outcomes.
- Engage in active peer-review of research.
- Publish an annotated genome in a national DNA sequence database.

Topics Covered:

- Phage biology
- Bacteriophage genomes
- Auto-annotation using DNA Master and PECAAN
- BLASTing genomes
- Assembly and finishing genomes
- Gene calling using GeneMark and gene start site considerations
- Adding, deleting, and modifying a gene
- Assigning gene functions using HHPred and BLASTp
- Merging annotation data
- Finding consensus in merged data and resolving discrepancies
- Submitting final files for review and GenBank submission
- Using Phamerator
- Interpreting primary literature papers
- Experimental design
- Technical proficiency
- Troubleshooting
- Electronic scientific record keeping
- Data analysis
- Interpretation and presentation of results
- Broader impacts of research
- Developing scientific collaborations

Assignments and Grading:

Coursework will focus on five specific aims: Genome Annotation, completion of a Group Poster, completion of a Class Poster, Literature Reviews (3), and a Literature Presentation. Organization and direction of this work will occur in class, but a substantial amount of the work will be finished outside of class on your own or in groups. Further details are below. These will count towards the course grade as follows:

| | | |
|--------------------------------|------------|------------------------------------|
| Annotation | 20% | satisfactory/unsatisfactory |
| Group Poster | 20% | satisfactory/unsatisfactory |
| Class Poster | 20% | satisfactory/unsatisfactory |
| Literature Reviews (3) | 30% | graded |
| Literature Presentation | 10% | graded |

Annotation. Genome annotation is the process of identifying the important genetic elements in an organism's genome. This includes the confirming the positions of all protein coding regions, transfer RNAs and other elements, as well as determining the putative functions of each element, especially the resulting proteins expressed from each coding region. Some of this can be

automated based on the known genetics of other organisms, but human inspection of automated annotation substantially improves the final outcome. Even after we have completed the annotations to our best abilities, we will be left with many unanswered questions about the genomes and especially the genome functions of our phage. Most of the annotation work will be accomplished using a relatively new online software package called PECAAN, developed by researchers at Western Kentucky University. Participating in finishing the annotation of at least one phage genome is a minimum requirement of this course and will count on a satisfactory/unsatisfactory basis as 20% of the course grade.

Group Poster. Based on the unanswered questions from our genome annotations, students will work in small groups to investigate hypothesis-driven bioinformatics experiments about our phage. Each group will focus on a particular area of investigation that will form the basis for a research poster and presentation. The poster presentation will take place either at the annual Florida SEA PHAGES conference (date and location to be decided) or at a venue at FGCU. Participating in the group poster investigation and presentation is a minimum requirement of this course and will count on a satisfactory/unsatisfactory basis as 20% of the course grade.

Class Poster. The investigations of each of our class groups will be combined to prepare a single poster and possible oral presentation at the annual SEA PHAGES symposium at Janelia Farm, Virginia in June. One or possibly two students will be chosen from our class to travel to Virginia to represent FGCU along with students and faculty from the other 120 collaborating institutions. Each group will produce a single or a small number of figures and accompanying text for the combined class poster. Participating in the class poster is a minimum requirement of this course and will count on a satisfactory/unsatisfactory basis as 20% of the course grade.

Literature Reviews. Reading other scientists' results in the field will help you put your research into context. Specific primary literature papers will enable you to see what scientists (some of them students) have discovered about other bacteriophage. You will each individually read three primary literature papers, and write a brief summary of each paper.

The literature review report format will consist of concise responses to the following questions:

- What is the hypothesis that was being tested?
- What was the experimental approach?
- What were the observations?
- What is the significance of the findings?

Reports should not exceed two pages. Longer is not necessarily better. The emphasis is on understanding and being able to communicate the basic findings in the papers to others.

The process for completing a report will include: 1) writing an initial draft, 2) getting critical feedback from another class member, and 3) writing a final report that addresses all of the suggestions from the critique. The initial draft, critique, and final report will be turned in together, along with the name of the student who provided the critique. Each report will count towards 10% of the course grade - one third of the grade for the draft, one third for the critique, and one third for the final report. The grade for the critique will be applied to the student who provided the critique. More details about how to find and read primary literature papers will be provided.

Literature Presentation. Sharing knowledge is a critical part of scientific progress. Each student will pick one literature paper and prepare a 20-30 minute oral presentation using Power Point or similar software. The purpose will be to share information with the rest of the class on

possible research areas for the group and class posters. These presentations have the likely outcome of determining the research directions for the class, so these presentations will be scheduled during the beginning of the semester. Literature presentations will count towards 10% of the final course grade. Students presenting early will be graded more leniently than students who present later. Later presentations will be required to take into account information shared in earlier presentations. More details about how to prepare and present on scientific literature will be provided.

Participation. Your work cannot go on when you are not present. Excused absences (either emergency or known in advance) must be officially documented. You must notify me before the next class period following an absence. You are allowed two excused absences. You are allowed two late arrivals. Your final semester grade will be reduced for late arrivals (2% off the final semester grade, each occurrence) and unexcused absences (5% off the final semester grade, each occurrence). Participation is not only about showing up, but also about how you interact in class and what you accomplish. Are you or do you:

1. Curious about the world and interested in communicating discoveries
2. Familiar with what is already known
3. Willing to fail multiple times and not give up
4. Independent and objective
5. Ask good questions
6. Critically evaluate existing explanations
7. Distinguish reliable observations from the unreliable ones and able to deal with ambiguity or conflicting results
8. Design experiments that can be interpreted
9. Skillful in executing experiments
10. Manipulate hypotheses using new information
11. Communicate results and ideas
12. Collaborate with your classmates

Professionalism: You will be expected to participate in all aspects of the coursework and research activities. You may be expected to complete your research projects outside of scheduled course times. A professional meets deadlines, shows up on time, meets commitments, carries through with promises, shows respect for colleagues, and is not disruptive.

Academic Behavior Standards and Academic Dishonesty: All students are expected to demonstrate honesty in their academic pursuits. The university policies regarding issues of honesty can be found in the FGCU Student Guidebook under the Student Code of Conduct and Policies and Procedures sections. All students are expected to study this document which outlines their responsibilities and consequences for violations of the policy. The FGCU Student Guidebook is available online at <http://studentservices.fgcu.edu/judicialaffairs/new.html> Students agree that by taking this course written assignments may be subject to submission for textual similarity review to Turnitin.com for the detection of plagiarism.

Disability Accommodations Services: Florida Gulf Coast University, in accordance with the Americans with Disabilities Act and the university's guiding principles, will provide classroom and academic accommodations to students with documented disabilities. If you need to request an accommodation in this class due to a disability, or you suspect that your academic performance is affected by a disability, please see me or contact the Office of Adaptive Services. The Office of Adaptive Services is located in Howard Hall, room 137. The phone

number is 590-7956 or TTY 590-7930. In addition to classroom and campus accommodations, individuals with disabilities are encouraged to create their personal emergency evacuation plan and FGCU is committed to providing information on emergency notification procedures. You can find information on the emergency exits and Areas of Rescue Assistance for each building, as well as other emergency preparedness materials on the Environmental Health and Safety and University Police Department websites. If you will need assistance in the event of an emergency due to a disability, please contact Adaptive Services for available services and information.

Student Observance of Religious Holidays: All students at Florida Gulf Coast University have a right to expect that the University will reasonably accommodate their religious observances, practices, and beliefs. Students, upon prior notification to their instructors, shall be excused from class or other scheduled academic activity to observe a religious holy day of their faith. Students shall be permitted a reasonable amount of time to make up the material or activities covered in their absence. Students shall not be penalized due to absence from class or other scheduled academic activity because of religious observances. Where practicable, major examinations, major assignments, and University ceremonies will not be scheduled on a major religious holy day. A student who is to be excused from class for a religious observance is not required to provide a second party certification of the reason for the absence.