

# SYLLABUS

## MOLECULAR BIOLOGY LAB (BIOL312L)

### PHAGE GENOMICS RESEARCH

#### BACKGROUND

THE **HOWARD HUGHES MEDICAL INSTITUTE** (HHMI) SELECTED THE COLLEGE OF CHARLESTON AS ONE OF TEN COHORTS OF SCHOOLS TO BE MEMBERS OF THE **NATIONAL GENOMICS RESEARCH INITIATIVE** OTHERWISE KNOWN AS PHAGE HUNTERS.

**PHAGE HUNTERS** IS THE FIRST MAJOR INITIATIVE FROM HHMI'S **SCIENCE EDUCATION ALLIANCE**. THE PROGRAM CREATES **AUTHENTIC HANDS-ON RESEARCH** OPPORTUNITIES FOR STUDENTS.

#### STUDENT SCIENTISTS

STUDENTS WILL PARTICIPATE IN **BIOLOGICAL INVESTIGATION** THROUGH A RESEARCH PROJECT IN BACTERIOPHAGE GENOMICS. GENOMICS COMBINES EXPERIMENTAL GENETICS AND COMPUTATIONAL APPROACHES FOR **LARGE-SCALE ANALYSIS** OF THE BIOLOGICAL INFORMATION CONTAINED IN **DNA SEQUENCES**.

#### PHAGE IS THE RAGE

BACTERIOPHAGES ARE VIRUSES THAT INFECT BACTERIA. THEY ARE CONSIDERED THE MOST ABUNDANT BIOLOGICAL ENTITIES ON EARTH. THEIR ENORMOUS DIVERSITY AND NUMBER MAKE THEM IMPORTANT MODELS FOR THE STUDY OF GENE STRUCTURE, FUNCTION AND REGULATION, POPULATION GENETICS, AND EVOLUTION. IN ADDITION, THEY ARE EMERGING AS IMPORTANT TOOLS IN BIOTECHNOLOGY.

#### LOCATION

SSMB141

MONDAY 8:30 – 11:30 (SECTION 1)

TUESDAY 9:00 – 12:00 (SECTION 2)



#### INSTRUCTOR

ANA ZIMMERMAN ([zimmermana@cofc.edu](mailto:zimmermana@cofc.edu)).

OFFICE HOURS: TUESDAYS 12-1, SSMB141 AND BY APPT.

#### PREREQUISITES

CO-ENROLLMENT OR COMPLETION OF GENETICS (BIOL305) AND CO-ENROLLMENT OR COMPLETION OF MOLECULAR BIOLOGY (BIOL312).

#### MOLECULAR BIOLOGY – THE FUN NEVER ENDS!

OVER THE SEMESTER STUDENTS WILL:

- COLLECT ENVIRONMENTAL SAMPLES.
- ISOLATE PHAGES FROM COLLECTED SAMPLES.
- USE PCR AND RESTRICTION ENZYMES TO IDENTIFY DIFFERENT VIRUSES.
- VISUALIZE VIRUSES BY ELECTRON MICROSCOPY.
- PREPARE VIRAL DNA FOR SEQUENCING.
- SEND PURIFIED VIRUSES FOR WHOLE GENOME SEQUENCING BY NEXT GENERATION ILLUMINA TECHNOLOGIES.
- ANNOTATE AND COMPARE THE SEQUENCED GENOMES UTILIZING BIOINFORMATICS.
- COLLABORATE WITH OTHER SCHOOLS IN THE HHMI NETWORK ON AN ONLINE FORUM.
- UPLOAD THE VIRAL SEQUENCES TO PUBLICLY ACCESSIBLE DATABASES.
- PRESENT FINDINGS AT HHMI CONFERENCE.
- CONTRIBUTE TO SCIENTIFIC DISCOVERY!

## STUDENT LEARNING OUTCOMES

DEMONSTRATE THE ABILITY TO USE AND EXPLAIN MODERN MOLECULAR BIOLOGY TECHNIQUES.

DEMONSTRATE AN UNDERSTANDING OF DEVELOPING HYPOTHESES AND DESIGNING EXPERIMENTS.

COMMUNICATE, ANALYZE, AND DISCUSS EXPERIMENTAL RESULTS.

DEMONSTRATE THE ABILITY TO EVALUATE AND APPLY INFORMATION PRESENTED IN SCIENTIFIC JOURNALS.

## GRADE DISTRIBUTION:

<u>REQUIREMENT</u>	<u>% GRADE</u>
PARTICIPATION	30
(ATTENDANCE      10	
RESEARCH FOCUS    10	
FEARLESS BIOLOGIST 10)	
LABORATORY SKILLS ASSESSMENT QUIZZES	50
NOTEBOOK	10
<u>POSTER PRESENTATION</u>	<u>10</u>
<b>TOTAL</b>	<b>100</b>

THE MOST IMPORTANT COMPONENT OF YOUR GRADE IN THIS COURSE IS PARTICIPATION. YOU WILL BE EVALUATED BY PARTICIPATION, EVIDENCE OF LAB WORK ACCOMPLISHED, MAINTAINING YOUR LABORATORY NOTEBOOK, AND YOUR ABILITY TO READ AND DISCUSS SCHOLARLY ARTICLES. A POSTER AND SHORT GROUP PRESENTATION WILL BE REQUIRED AT THE END OF THE SEMESTER.

WE ARE EMBARKING ON A REAL RESEARCH PROJECT INVOLVING COLLABORATORS ACROSS THE COUNTRY, AS YOU WILL SOON COME TO APPRECIATE WE ARE PART OF SOMETHING LARGER THAN JUST OUR CLASS. THE FEARLESS BIOLOGIST POINTS WILL BE TIED TO THE QUESTION OF THE WEEK AND THE VIRTUAL JOURNAL CLUB. EVERY WEEK A SCIENTIFIC PAPER WILL BE POSTED ON OAKS WITH AN ACCOMPANYING QUESTION OF THE WEEK. IT IS EXPECTED THAT EVERYONE IN OUR CLASS POSTS AN ANSWER TO THE QUESTION OF THE WEEK (NOTE: YOUR ANSWERS NEED NOT ALWAYS BE CORRECT, I WILL TRY TO HAVE SOME DIFFICULT QUESTIONS, IT IS HOWEVER IMPORTANT TO TRY). PART OF THIS COURSE IS TO INTERACT WITH OTHER STUDENTS IN OUR CLASS ON TOPICS FOR WHICH WE MAY HAVE A LIMITED KNOWLEDGE THUS BECOMING FEARLESS BIOLOGISTS.

**WEBSITE:** WE WILL ROUTINELY USE HHMI'S WEBSITE PHAGESDB.ORG AS WELL AS OUR CLASS WEBPAGE ON OAKS.

### **ADDITIONAL LAB HOURS**

YOU WILL OCCASIONALLY NEED TO COME TO THE LAB BETWEEN CLASSES. WE WILL MAINTAIN AN OPEN LAB TIME, AND ALSO POST TIMES WHEN THE INSTRUCTOR WILL BE AVAILABLE TO HELP YOU AND WHICH WILL NOT INTERFERE WITH OTHER CLASSES. YOU SHOULD RECORD ALL WORK IN YOUR NOTEBOOK, INCLUDING THE DATES AND TIMES YOU ARE IN THE LAB.

### **ATTENDANCE**

OBVIOUSLY YOUR WORK CANNOT GO ON WHEN YOU ARE NOT PRESENT. EXCUSED ABSENCES (EITHER EMERGENCY OR KNOWN IN ADVANCE) MUST BE OFFICIALLY DOCUMENTED. UNEXCUSED ABSENCES WILL RESULT IN LOWER PARTICIPATION GRADES.

GRADING OF PARTICIPATION WILL BE ASSESSED BASED ON THE FOLLOWING CRITERIA. YOUR PRESENCE AND POSITIVE ATTITUDE IN CLASS IS A MAJOR FACTOR IN PARTICIPATION. WE WILL ALSO ASSESS PARTICIPATION BASED ON YOUR PURSUANCE OF RESEARCH HABITS OF MIND, WHICH INCLUDE, BUT ARE NOT LIMITED TO:

- INTRINSIC CURIOSITY ABOUT THE WORLD / INTEREST IN COMMUNICATING DISCOVERIES
- FAMILIARITY WITH WHAT IS ALREADY KNOWN
- WILLINGNESS TO FAIL MULTIPLE TIMES BEFORE GIVING UP
- INDEPENDENCE AND OBJECTIVITY
- ASKING GOOD QUESTIONS (EVERYONE NEEDS TO PARTICIPATE IN THE LAB DISCUSSIONS)

PARTICIPATION WILL ALSO BE ASSESSED BY THE DEVELOPMENT OF YOUR RESEARCH SKILLS, REGARDLESS OF LABORATORY BENCHMARKS THAT HAVE BEEN ATTAINED, INCLUDING:

- CRITICAL EVALUATION OF EXISTING EXPLANATIONS
- DISTINGUISHING RELIABLE OBSERVATIONS FROM THE UNRELIABLE AND THE ABILITY TO DEAL WITH AMBIGUITY OR CONFLICTING RESULTS
- DESIGN OF EXPERIMENTS THAT CAN BE INTERPRETED
- SKILL IN EXECUTING EXPERIMENTS
- MANIPULATION OF HYPOTHESES USING NEW INFORMATION
- COMMUNICATION OF RESULTS AND IDEAS
- SUBMISSION TO QUESTION OF THE WEEK ON OAKS.

### **NOTEBOOK**

YOU WILL BE REQUIRED TO KEEP A DETAILED RECORD OF ALL THAT YOU DO IN THE PHAGE LAB. THIS IS REAL RESEARCH THAT WILL ONE DAY BE PUBLISHED, AND YOUR PHAGES WILL ULTIMATELY BE ARCHIVED IN A NATIONAL PHAGE REPOSITORY, YOU HAVE A RESPONSIBILITY TO PROPERLY DOCUMENT YOUR EXPERIMENTS.

### **RELIGIOUS HOLIDAYS, STUDENT ATHLETES, AND STUDENTS WITH DISABILITIES**

STUDENTS WITH SPECIAL REQUIREMENTS ARE ENCOURAGED TO SEEK OUT ACCOMMODATIONS FROM THE COLLEGE AND ARE ENCOURAGED TO NOTIFY YOUR INSTRUCTOR (DR. ZIMMERMAN) SO THAT YOUR NEEDS CAN BE MET.

### **ACADEMIC DISHONESTY**

CHEATING OF ANY KIND, INCLUDING PLAGIARISM, WILL NOT BE TOLERATED. IF YOU THINK IT'S A BAD IDEA, IT PROBABLY IS. IT WOULD BE MOST UNFORTUNATE FOR EVERYONE INVOLVED AND AS A FACULTY MEMBER OF THE 2016-2017 COLLEGE OF CHARLESTON HONOR BOARD I WOULD REALLY NOT LIKE TO SEE ANYONE IN MY CLASS IN AN HONOR BOARD HEARING THIS SEMESTER. THE HONOR BOARD HEARINGS ARE NOT FUN FOR ANYONE INVOLVED SO LET'S KEEP IT FUN. MORE IMPORTANTLY, OUR INTEGRITY IS THE ONLY THING WE TRULY OWN. HAVING INTEGRITY IS A REWARD OF BEING A GOOD PERSON AND IT IS FUN, EVEN MORE FUN THAN MOLECULAR BIOLOGY, FOR WHICH THE FUN NEVER ENDS.

### **FINALLY**

PLEASE BE ASSURED THAT I WANT EACH AND EVERY STUDENT TO REACH THE GOALS THAT THEY SET FOR THEMSELVES. IF YOU FIND YOURSELF HAVING UNDUE DIFFICULTY WITH ANY PORTION OF THE MATERIAL IN THIS COURSE PLEASE MAKE AN APPOINTMENT WITH ME FOR ADDITIONAL HELP.

## TENTATIVE SCHEDULE OF LAB ACTIVITIES

**PROJECT BENCHMARKS MUST BE COMPLETED BY THE INDICATED DEADLINES IN ORDER TO ENSURE TIMELY GENOME SEQUENCE**

DATE	DEADLINES	ACTIVITIES	
WEEK ONE	HHMI information	<b>Capture</b> <ul style="list-style-type: none"> <li>Learn basic lab techniques</li> <li>Collect soil samples</li> <li>Direct and enrichment plating</li> </ul>	<b>Tame</b> <ul style="list-style-type: none"> <li>Plaque isolation</li> <li>Plaque purification and titer</li> </ul>
WEEK TWO	Begin on Phage Isolations		
WEEK THREE	Identification of phage plaque		
	Notebook turn in		
WEEK FOUR	Purification of phage		
WEEK FIVE	High Titer Lysate collected	<b>Dissect</b> <ul style="list-style-type: none"> <li>DNA purification</li> <li>DNA restriction digest and QC gel</li> <li>Electron microscopy</li> </ul>	<b>Communicate</b> <ul style="list-style-type: none"> <li>Posters</li> <li>Presentations</li> <li>Celebrations</li> </ul>
WEEK SIX	DNA Purification and Quantification		
TO BE DETERMINED BASED ON RESULTS THUS FAR	DNA Quality Control Gel and Restriction Digest		
	EM Preps of Phage		
	DNA at Sequencing Facility CELEBRATION!!!		
	Upload info to phagesdb.org		
	Notebooks Due Final Presentations		

## Laboratory Skills Assessments

(Please print and put in lab notebook front cover)

	<b>Skill</b>	<b>Date/Notebook page</b>	<b>Initials</b>
1	Pipetting		
2	Aseptic technique		
3	Identification of plaque		
4	Purification of plaque		
5	Isolation of high-titer lysate		
6	DNA purification		
7	DNA calculations		
8	Restriction digest		
9	EM Visualization		
10	Uploaded to Phagesdb.org		