

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. THIS 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/REGULATION, POPULATION GENETICS, AND EVOLUTION. IN ADDITION, THEY ARE EMERGING AS IMPORTANT TOOLS IN BIOTECHNOLOGY.

LOCATION

SSMB141

TUESDAY 9:00 – 12:00PM (SECTION 5)

TUESDAY 1:40 - 4:40PM (SECTION 4)



INSTRUCTOR

CHRISTINE BYRUM (byrumc@cofc.edu)

OFFICE HOURS: TUESDAY 12:00 – 1:00PM IN SSMB 141 AND BY APPOINTMENT.

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

THE MOST IMPORTANT COMPONENT OF YOUR GRADE IN THIS COURSE IS PARTICIPATION. YOU WILL BE EVALUATED BY PARTICIPATION, EVIDENCE OF LAB WORK ACCOMPLISHED, MAINTANANCE OF YOUR LAB 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. YOU WILL BE 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. IF IS EXPECTED THAT EVERYONE IN OUR CLASS WILL POST AN ANSWER TO THE QUESTION OF THE WEEK (NOTE: YOUR ANSWERS NEED NOT ALWAYS BE CORRECT SINCE SOME QUESTIONS POSED WILL BE QUITE DIFFICULT. IT IS MORE IMPORTANT THAT YOU ALWAYS TRY). PART OF THIS COURSE IS TO INTERACT WITH OTHER STUDENTS IN OUR CLASS ON TOPICS IN WHICH YOUR KNOWLEDGE IS LIMITED....THUS BECOMING A FEARLESS BIOLOGIST!

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 POST TIMES WHEN THE INSTRUCTOR WILL BE AVAILABLE TO HELP. THIS WILL NOT INTERFERE WITH OTHER CLASSES. RECORD ALL WORK IN YOUR NOTEBOOK, INCLUDING THE DATES/TIMES YOU ARE IN THE LAB.

ATTENDANCE: OBVIOUSLY YOUR WORK CANNOT PROCEED WHEN YOU ARE ABSENT. EXCUSED ABSENCES (EITHER EMERGENCY OR KNOW 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 PURSUING RESEARCH HABITS OF THE MIND, WHICH INCLUDE, BUT ARE NOT LIMITED TO:

- INTRINSIC CURIOSITY ABOUT THE WORLD/INTEREST IN COMMUNICATING YOUR 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 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 OF RESPONSES 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. BYRUM) 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. MOST IMPORTANTLY, OUR INTEGRITY IS THE ONLY THING THAT WE TRULY OWN AND HAVING THIS INTEGRITY CARRIES WITH IT THE REWARD OF BEING A GOOD PERSON.

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	Capture <ul style="list-style-type: none"> Learn basic lab techniques Collect soil samples Direct and enrichment plating 	Tame <ul style="list-style-type: none"> Plaque isolation Plaque purification and titer
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		
WEEK SIX	DNA Purification and Quantification		
		Dissect <ul style="list-style-type: none"> DNA purification DNA restriction digest and QC gel Electron microscopy 	Communicate <ul style="list-style-type: none"> Posters Presentations Celebrations
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)

	Skill	Date/Notebook page	Initials
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		