

COURSE NAME; NUMBER; SEMESTER; MEETING DAYS, TIMES, AND PLACE.

Methods and Applications in Molecular Biology

11:126:427 Fall 2021

Monday 11:00-12:20 (Remote Lecture using Zoom)

Section 1 and 2: Mon. 1:00-6:00 Foran 193 (Main Lab); Tues. 11:00-12:20 Foran 193 (Follow-up Lab)

Section 3 and 4: Tues. 1:00-6:00 Foran 193 (Main Lab); Wed. 11:00-12:20 Foran 193 (Follow-up Lab)

Section 5 and 6: Wed. 1:00-6:00 Foran 193 (Main Lab); Thurs. 11:00-12:20 Foran 193 (Follow-up Lab)

Section 7 and 8: Thurs. 1:00-6:00 Foran 193 (Main Lab); Fri. 11:00-12:20 Foran 193 (Follow-up Lab)

CONTACT INFORMATION:

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Course Preparator: Ralph Dapsis

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COURSE WEBSITE, RESOURCES AND MATERIALS:

Required Text and Readings: There is no required text for this course. “*Methods and Applications in Molecular Biology: A Laboratory Manual*” by W.S. Cohick, R. Di, A. Jetzt, M. Lawton, P. Meers and R. Dapsis will be available electronically through Canvas. *For tech help with Canvas, please visit <https://it.rutgers.edu/help-support>.* Reading to accompany lecture and laboratory material will be assigned through Canvas. We will also use short videos to supplement the synchronous online lectures. Lectures will be recorded. Laboratory exercises are found in the manual. ***Please print out the entire lab manual and put it in a three-ring binder before the first lab. Be sure to read the exercises thoroughly before coming to lab.***

COURSE DESCRIPTION:

This course is designed to introduce you to general techniques used in molecular biology as well as their application in research and industry. Recorded lectures will be made available on Canvas. Lectures will be used to orient you to the upcoming laboratory, teach the theory behind the techniques you will be using, and acquaint you with additional methodologies and their applications that we do not have time to cover in lab. In this course you will learn fundamentals such as cloning and DNA sequencing. We will use CRISPR gene editing technology to knock out the HSP70 gene in mammalian cells. With your lab partners, you will also conduct your own experiment to study the regulation of heat shock protein 70 (HSP70) in a mammalian cell line. You will determine how your experimental treatments regulate HSP70 mRNA and protein levels using quantitative RT-PCR and western immunoblotting, respectively. In the last laboratory session of the semester, each lab group will present their results to their classmates using a PowerPoint presentation.

MINIMUM TECHNOLOGY REQUIREMENTS:

For this course, it is recommended that you meet the technical requirements below.

- A laptop computer or mobile device (smartphone/tablet) that is less than five years old.
- Speakers/headphones/earbuds for listening to audio or videos.
- A stable Internet connection. A speed at or above 25 Mbps is recommended for smooth video stream and conferencing.
- Webcam for interacting in course activities (Zoom).

COURSE SCHEDULE:

<u>Sept 1-3</u>	No lecture or labs
<u>Sept 7-10</u>	
Lecture 1	Introduction to the course (Wednesday Sept 8)
<u>Sept 13-17</u>	
Lecture 2	CRISPR
Main Lab	CRISPR 1: Generating the guide RNA (gRNA) <i>Assign treatments for research project</i>

Follow-up Run gRNA on gel

Sept 20-24

Lecture 3 *PowerPoint presentations guidelines; CRISPR 2*

Main Lab CRISPR 2: Transfect MAC-T cells

Follow-up *Work on group proposal Powerpoint*

Sept 27-Oct 1

Lecture 4 CRISPR 3 and primer design
Role and function of HSP70 and experiment
Primer design assignment

Main Lab CRISPR 3: determining efficiency of editing

Follow-up Verify editing results by agarose gel electrophoresis

Oct 4-8

Lecture 5 Cloning in plasmid vectors

Main Lab CRISPR 4: Cloning of edited HSP70 into TOPO vector, transformation of competent cells

Follow-up Pick colonies to inoculate cultures for minipreps
Present proposal Powerpoint

Oct 11-15

Lecture 6 DNA sequencing and analysis; plasmid isolation

Main Lab CRISPR 5: plasmid preps

Follow-up Restriction digest to confirm insert; prepare plasmids to send for sequencing
Primer design assignment due

Oct 18-22

Lecture 7 Next Gen sequencing

Main Lab	Experimental setup 1
Follow-up	QUIZ 1: CRISPR
<u>Oct 25-29</u>	
Lecture 8	RNA analysis and RNA interference Sequencing assignment
Main Lab	RNA analysis part 1: isolation, quantitation, and assessment of RNA
Follow-up	
<u>Nov 1-5</u>	
Lecture 9	qRT-PCR
Main Lab	RNA analysis part 2: qRT-PCR
Follow-up	Run qRT-PCR products on gel Sequencing assignment due
<u>Nov 8-12</u>	
Lecture 10	qRT-PCR results analysis
Main Lab	Experimental setup 2
Follow-up	QUIZ 2: cloning and transformation
<u>Nov 15-19</u>	
Lecture 11	Protein quantitation
Main Lab	Protein analysis part 1: Protein assay
Follow-up	QUIZ 3: minipreps
<u>Nov 22-24</u>	
Lecture 12	SDS-PAGE and western blotting
Main Lab	Protein analysis part 2: run gel and begin western blotting (Sections 1-2)

Follow-up Complete western blotting for HSP70 and actin (Sections 1-2)

Nov 25 **THANKSGIVING**

Nov 29-Dec 3

No lecture

Main Lab Protein analysis part 2: run gel and begin western blotting (Sections 3-4, 5-6, 7-8)

Follow-up Complete western blotting for HSP70 and actin (Sections 3-4, 5-6, 7-8)

Dec 6-10

Main Lab Remote PowerPoint Presentations

Follow-up

Dec 13 **Last day of classes for the semester**

GRADING and ASSESSMENT:

Grading Component	Percent of Final Grade
Lab Notebook	20
Assignments (2)	10
Quizzes (3)	15
Proposal PowerPoint Presentation	10
Final PowerPoint Presentation	20
Final Exam	25
Total	100

Laboratory Notebooks: All students are required to keep a detailed laboratory notebook. Digital notebook entries will be turned in each week on Canvas and graded according to the provided rubric. Instructions for how to keep your lab notebook are on Canvas.

Assignments: There will be two assignments that are designed to assist you with data analysis and highlighting important concepts. Due dates will be indicated on Canvas.

Quizzes: These will be completed in person during the laboratory sessions.

Proposal and Final PowerPoint presentations for your group's experiment: A rubric describing the required components of the presentations will be provided.

Final Exam: The final exam will be given during the university final exam period.

LABORATORY NOTEBOOK AND ASSIGNMENT LATENESS POLICY

Laboratory notebook entries will not be accepted late.

Assignments will be accepted up to 2 days late. The highest grade possible for an assignment submitted one day late will be 90 out of 100. The highest grade possible for an assignment submitted two days late will be 80 out of 100. After two days the grade will be zero.

ABSENCE POLICY

You should think of this as a hybrid course with background and theoretical material provided remotely to minimize unnecessary physical interactions in the laboratory. However, the hands-on portion of the course cannot be replicated in a remote format, therefore students are expected to attend all laboratory and follow-up periods when possible. However, we do not want you to attend class if you are not feeling well or think you have been exposed to Covid-19. In these cases, please contact your instructor as soon as possible so that we may give advice if needed and assist you with making up missed work if possible.

UNDERGRADUATE MAJOR PROGRAM LEARNING GOALS:

1. Be able to describe the basic molecular concepts essential for understanding the field of biotechnology and the applications of biotechnology.
2. Demonstrate proficiency in using the tools of biotechnology in an applied laboratory setting.
3. Be able to find and read published scientific research in biotechnology and summarize and communicate that research effectively and critically.
4. Acquire knowledge of ethical aspects of biotechnology and be able to analyze alternate viewpoints.
5. Learn to work as a team in the laboratory setting or group presentations.

COURSE LEARNING GOALS:

1. To master basic laboratory techniques and the use of standard equipment used in molecular biology studies.
Assessment: quizzes, exam (PLG 2)
2. To understand the principals that underlie molecular biology techniques and their applications.
Assessment: assignments, quizzes, exam, and laboratory notebook (PLG 1)
3. To learn proper experimental design with appropriate controls.
Assessment: group research presentations
4. To learn how to formulate and test a scientific hypothesis, i.e., how to conduct hypothesis-driven research.
Assessment: group research presentations
5. To learn how to document, record, and interpret scientific data.
Assessment: laboratory notebook and group research presentations
6. To develop effective oral and written communication skills.
Assessment: short essay component of exam, group research presentations
7. To build skills required to work as a member of a team (PLG 5).
Assessment: group research presentation

ACCOMODATIONS FOR STUDENTS WITH DISABILITIES

Rutgers University welcomes students with disabilities in all educational programs of the University. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: <https://ods.rutgers.edu/students/documentation-guidelines>. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodations. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible.

Please follow the procedures outlined at <https://ods.rutgers.edu/students/registration-form>. Full policies and procedures are at <https://ods.rutgers.edu/>

ACADEMIC INTEGRITY

The university's policy on Academic Integrity is available at <http://academicintegrity.rutgers.edu/academic-integrity-policy>. The principles of academic integrity require that a student:

- properly acknowledge and cite all use of the ideas, results, or words of others.
- properly acknowledge all contributors to a given piece of work.
- make sure that all work submitted as his or her own in a course or other academic activity is produced without the aid of impermissible materials or impermissible collaboration.
- obtain all data or results by ethical means and report them accurately without suppressing any results inconsistent with his or her interpretation or conclusions.
- treat all other students in an ethical manner, respecting their integrity and right to pursue their educational goals without interference. This requires that a student neither facilitate academic dishonesty by others nor obstruct their academic progress.
- uphold the canons of the ethical or professional code of the profession for which he or she is preparing.

Adherence to these principles is necessary in order to ensure that

- everyone is given proper credit for his or her ideas, words, results, and other scholarly accomplishments.
- all student work is fairly evaluated and no student has an inappropriate advantage over others.
- the academic and ethical development of all students is fostered.
- the reputation of the University for integrity in its teaching, research, and scholarship is maintained and enhanced.

Failure to uphold these principles of academic integrity threatens both the reputation of the University and the value of the degrees awarded to its students. Every member of the University community therefore bears a responsibility for ensuring that the highest standards of academic integrity are upheld.

STUDENT WELLNESS SERVICES

Just In Case Web App <http://codu.co/cee05e>

Access helpful mental health information and resources for yourself or a friend in a mental health crisis on your smartphone or tablet and easily contact CAPS or RUPD.

Violence Prevention & Victim Assistance (VPVA)

(848) 932-1181 / 3 Bartlett Street, New Brunswick, NJ 08901 / www.vpva.rutgers.edu/

The Office for Violence Prevention and Victim Assistance provides confidential crisis intervention, counseling and advocacy for victims of sexual and relationship violence and stalking to students, staff and faculty.

Scarlet Listeners

(732) 247-5555 / <https://rutgers.campuslabs.com/engage/organization/scarletlisteners>

Free and confidential peer counseling and referral hotline, providing a comforting and supportive safe space.