

UN3052 Project Lab in Molecular Genetics, Spring 2023
MW 1:10-5:00PM, Teaching lab: Mudd 743

Instructor: Dr. Michelle Attner, ma3325@columbia.edu, Office: 744D Mudd
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Course description and prerequisites:

Multicellular animals contain a diverse array of cell types, yet start from a single cell. How do cells decide what kind of cell to be? In this lab course, we will use the tools of molecular biology and genetics to explore this fascinating question. We will use the nematode *Caenorhabditis elegans*, a powerful model organism used in hundreds of research labs. The course will be divided into three modules: *C. elegans* genetics, molecular cloning, and genetic screening. Laboratory techniques will include PCR, gel electrophoresis, restriction digest, ligation, transformation, RNAi, and *C. elegans* maintenance. Students will pursue original projects; emphasis will be placed on scientific thinking and scientific communication. SPS and TC students may register for this course, but they must first obtain the written permission of the instructor, by filling out a paper Registration Adjustment Form (Add/Drop form).

Prerequisites: UN2005/UN2401 and UN2006/UN2402, or the equivalent at a different institution.

Learning outcomes:

At the end of this course, you will be able to:

- Work with *C. elegans*: set up crosses, genotype progeny, use low-magnification light microscope
- Apply principles of eukaryotic genetics to working with *C. elegans*
- Use online tools such as Wormbase and BLAST
- Design and carry out a molecular cloning strategy
- Perform an experiment with a hypothesis and appropriate controls
- Interpret results of experiments and conduct statistical analyses
- Analyze primary literature
- Synthesize and communicate results, in both written and oral forms

Texts: No required texts. Relevant protocols, manuals, readings, articles, and videos will be posted to the Courseworks (Canvas) site. Readings and videos will be posted by Friday at noon the week before they are to be read/watched. We will use Lab Archives for our lab notebooks.

Micropublications: You will be reading and answering questions about three micropublications throughout the semester (<https://www.micropublication.org>). Micropublications are short peer-reviewed articles with only one figure, designed to put research findings into the public domain quickly. We will use micropublications to learn how to read scientific literature, and you will prepare your final paper in the format of a micropublication.

Grading:

Students will be assessed with graded worksheets, graded assignments based on micropublications, a lab write-up, a lab midterm, a final written paper, a final oral presentation, and participation. Participation will include responses to occasional pre-lab questions.

Worksheets (8 total)	80 points
Micropublications (3 total)	30 points
Lab midterm	65 points
Lab write-up – Molecular Cloning	60 points
Final paper – Independent projects	100 points
Final presentation – Independent projects	25 points
Participation	<u>40 points</u>
	400 points

Attendance:

This is a laboratory course, and attendance is required. Students with more than two unexcused absences will receive a failing grade.

Class Schedule: All dates subject to change based on experimental progress. Please keep up with any changes on our Courseworks (Canvas) site.

Overview	Goals in the Lab	Reading/Watching (short questions due at start of class on Canvas)	Other Assignments (Due 5PM on Fridays)
Week 1: Introduction	W 1/18 1. Intro to our project 2. Intro to <i>C. elegans</i> 3. Making solutions		Dilution worksheet Due 1/20
Week 2: Tools for molecular cloning and lab basics	M 1/23 1. Pouring plates 2. Pipetting 3. BLAST 4. Picking worms W 1/25 1. Picking worms 2. Setting up crosses 3. Seeding plates 4. Cloning strategies/ApE	BLAST tutorial <i>C. elegans</i> resources	BLAST worksheet and ApE worksheet Due 1/27
Week 3: Worm Genetics I	M 1/30 1. Picking worms 2. Setting up crosses 3. Primer design W 2/1 1. Observe mutants 2. Analyze crosses	<i>C. elegans</i> resources Micropublication #1 Nyaanga et al., 2022	
Week 4: Worm Genetics II	M 2/6 1. Observe mutants 2. Analyze crosses W 2/8 1. Set up crosses 2. PCR to amplify promoter 3. Pour LB-AMP plates	PCR resources	Genetics worksheet Due 2/10
Week 5: Cloning I	M 2/13 1. Analyze crosses 2. Restriction digest 3. Run agarose gel W 2/15 1. Ligation 2. Transformation 3. Plate	Cloning manual	PCR worksheet Due 2/17
Week 6: Cloning II	M 2/20 1. Miniprep 2. Diagnostic digest 3. Send for sequencing W 2/22 1. Analyze sequence	Sequencing resources	Cloning worksheet Due 2/24

	2. Troubleshooting		
Week 7: Catch-up	M 2/27 1. Catch-up 2. Observe mutants W 3/1 1. Worm lysis practice 2. PCR genotyping practice		
Week 8: Midterm Worm Genetics III	M 3/6 Lab midterm W 3/8 1. Worm lysis 2. PCR genotyping F2s	Cross strategy manual	Lab write-up Due 3/10
Week 9 Worm Genetics IV	M 3/20 1. Genetic crosses 2. PCR genotyping W 3/22 1. Genetic crosses 2. PCR genotyping	Micropublication #2 Medwig-Kinney et al., 2021	Transgene and genotyping worksheet Due 3/24
Week 10 RNAi I	M 3/27 1. Paper discussion 2. Set up RNAi control experiment W 3/29 1. Analyze RNAi control experiment	Fire et al., 1998	
Week 11 RNAi II	M 4/3 and W 4/5 Individual RNAi experiments	RNAi manual	
Week 12 RNAi III	M 4/10 and W 4/12 Individual RNAi experiments	Micropublication #3 TBA based on student interest	RNAi worksheet Due 4/14
Week 13 RNAi and Cloning	M 4/17 and W 4/19 Individual RNAi experiments and cloning project		
Week 14 RNAi and Cloning	M 4/24 and W 4/26 Individual RNAi experiments and cloning project		
Week 15 Final presentations	M 5/1 – Final presentations		Research paper (due TBD)

Statement on Academic Integrity:

Your full observance of the Faculty Statement on Integrity and Columbia College Honor Code is expected. Both can be found [here](#). This Honor Code will apply to all students, regardless of their affiliation. If we detect cheating, we will take disciplinary action.

Office of Disability Services:

To receive disability-related accommodations for this course, students must be registered with their school Disability Services (DS) office. Please see this site for more information:

<https://health.columbia.edu/content/disability-services>.