

# Molecular Biology of Insects and Nematodes

ENY 4905/6905, 3 credits (with lab) / 2 credits (without lab)

Fall 2018

## Overview

**“Let’s learn molecular biology in a fun and innovative way – through bugs and worms!”**

### Course description and learning objectives

This course will introduce molecular biology, genetics and omics through insects and nematodes. Students will acquire fundamental knowledge and practice skills through a series of lectures, laboratory and computational activities.

After taking the course, students will be able to:

- Define “The Central Dogma”.
- Explain the advantages and limitations of different model organisms (*Drosophila melanogaster*, *C. elegans*) in research.
- Describe the working principles of common molecular techniques to study DNA, RNA and proteins, including PCR, qPCR, Sanger sequencing and Western blot.
- Design PCR primers for different molecular applications.
- Troubleshoot problems in nucleic acid extraction and PCR.
- Compare high throughput sequencing technologies.
- Execute nucleic acid sequence identification through BLAST search.
- Organize and analyze high throughput sequence datasets.
- Give examples of genetic techniques used in insect and nematode management.
- Propose an omics approach to characterize insect-associated microbiomes.
- Propose a novel or improved molecular strategy to manage insects/nematodes.
- **Sequence a genome or microbiome!**

### What is special about this course?

Do you know...

- An insect (*Drosophila melanogaster*) and a nematode (*Caenorhabditis elegans*) have contributed to numerous groundbreaking discoveries and generated 15 Nobel laureates in the past century?
- Our knowledge of smell, taste, even sleep, was profoundly advanced by molecular studies in insects?
- Scientists are developing different genetic and molecular techniques to control insect pests and disease vectors?

If your answer is “no” to any of the questions, or, if you are simply intrigued by the idea of studying molecular biology from an entomo- or nemato- logical perspective, this course may be ideal for you! We will walk through a journey of basic molecular biology concepts, the impact of insect and nematode models in research, the recent rise of high throughput sequencing and big data science, the classic and cutting-edge genetic techniques (e.g. RNAi and CRISPR) and their applications. Lectures will be complemented by a series of case studies and laboratory exercises such as “let’s sequence a genome!” and “Insect/nematode microbiome detectives”. Students will have opportunities to access the latest sequencing technologies, execute basic molecular techniques such as DNA/RNA extraction and Polymerase chain reactions (PCR), as well as manage big data.

### Instructors

Dr. Adam CN Wong

Room 3105, Steinmetz Hall, Bldg. 970, Natural Area Drive

[adamcnwong@ufl.edu](mailto:adamcnwong@ufl.edu)

### Class period:

Wednesday and Thursday Period 6 - 7 (12:50 PM - 2:45 PM)

### Lecture:

Wednesday: 2216 Steinmetz Hall; Thursday: 3118 Steinmetz Hall

### Office hours

Immediately after class and by email appointment

### Prerequisite

There is no formal prerequisite for this course. However, basic knowledge of Molecular Biology obtained from a college-level biology course is highly recommended.

### Readings:

- Marjorie A. Hoy, Insect Molecular Genetics: An Introduction to Principles and Applications (4<sup>th</sup> Edition)
- Model Organism Encyclopedia of DNA Elements (modENCODE). <http://modencode.sciencemag.org/>
- Flybase: an online bioinformatics database and the primary repository of genetic and molecular data for the insect family *Drosophilidae*, especially the model organism *Drosophila melanogaster*. <http://flybase.org/>
- WormBase: an international consortium of biologists and computer scientists dedicated to providing the research community with accurate, current, accessible information concerning the genetics, genomics and biology of *C. elegans* and related nematodes. <http://www.wormbase.org/>
- Clauvis Nji TiziTaning et al., 2017. CRISPR/Cas9 in insects: Applications, best practices and biosafety concerns. *Journal of Insect Physiology*. 98. 245-257.
- Shi et al., 2010. Molecular approaches to study the insect gut symbiotic microbiota at the 'omics' age. *Insect Sci.* 17(3): 199-219.

## Fall Schedule (Tentative)

Week	Topic	Active learning exercises	Required reading	Online quiz?
1	The Central Dogma – DNA, RNA, proteins	A “mysterious” movie clip followed by discussions		Y
2	Concepts of genotype and phenotype	Pictionary game		Y
3	Mechanisms of gene regulation	Fun facts and group discussions		-
4	Model insect in research – The fruit fly <i>Drosophila</i> <ul style="list-style-type: none"> <li>• fly genetics and GWAS</li> <li>• Guest: Rincon-Limas</li> </ul>	Case studies		Y
5	<ul style="list-style-type: none"> <li>• fly microbiome</li> </ul>			-
6	Model nematode in research –The <i>C. elegans</i> <ul style="list-style-type: none"> <li>• Guest: Digennaro</li> </ul>	Lab exercise (lab safety, pipetting skills, general handling of samples)		Y
7	Midterm			
8	Molecular techniques <ul style="list-style-type: none"> <li>• PCR, qPCR, cloning, Sanger sequencing</li> </ul>	Case studies		Y
9		Lab exercise (nucleic acid extraction)		-
10	Introduction to Next Gen sequencing and omics <ul style="list-style-type: none"> <li>• Working principles of Illumina, Nanopore and PacBio</li> <li>• Concept of multiplexing</li> </ul>	Case Studies		Y
11	<ul style="list-style-type: none"> <li>• Genomics, Transcriptomics, Proteomics and Metabolomics</li> </ul>	Lab exercise (Let's sequence a genome/microbiome!)		-
12	Basic data science			Y
13	Applications of molecular genetics in agriculture <ul style="list-style-type: none"> <li>• GMO</li> <li>• RNAi and CRISPR</li> </ul>	Group Debates/Discussion		-
14	<ul style="list-style-type: none"> <li>• Gene drive</li> <li>• Paratransgenesis</li> </ul>	Case studies		Y

15	Group presentations		-
16			-
17	Final exam		-

## Course Policies

### Grading

This course will be graded on the following scale. Graduate and undergraduate students will be graded separately:

A	93-100
A-	90-92.9
B+	87-89.9
B	83-86.9
B-	80-82.9
C+	77-79.9
C	73-76.9
C-	70-72.9
D	60-69.9
E	≤59.9

	Undergrads	Grads
Midterms	25	20
Final	25	20
Lab reports (3 in total)	10	10
Group Presentation	10	10
Quizzes (7 in total)	15	10
Case Studies summary (4 in total)	15	15
Literature review	-	15

For information on current UF policies for assigning grades, please visit:

<https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/>

### Absences and Make-Up Work

If you missed a lecture, you will be responsible to get notes from other classmates.

Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies, please visit:

<https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/#absencestext>

In the cases of extenuating circumstances (e.g. accidents, sickness, family emergency), students shall make every effort to notify the instructors as soon as possible of these circumstances and make arrangements.

### Assignments

Assignments will include case study summaries, quizzes, lab reports and a literature review report (grad students only).

Case study summaries must be submitted during the class. Biweekly online quizzes are due in 1 week after they are available. Lab reports and literature review must be submitted by email before the due date indicated by the instructors.

Late submission will receive a 5% grade reduction per day. Students who submit assignments more than 5 days late will receive a grade of zero except for the university approved extenuating circumstances.

### Presentation

There will be a group presentation exercise toward the end of the course, graded according to the evaluation criteria of the Entomological Society of America (ESA) for oral ten-minute paper competitions

([http://entsoc.org/awards/student/competition\\_oral\\_info](http://entsoc.org/awards/student/competition_oral_info)). A handout of evaluation criteria for presentation will be emailed to students a week prior to the presentation exercise.

### Online Course Evaluation Process

Student assessment of instruction is an important part of efforts to improve teaching and learning. At the end of the semester, students are expected to provide feedback on the quality of instruction in this course using a standard set of university and college criteria. These evaluations are conducted online at <https://evaluations.ufl.edu>. Evaluations are typically open for students to complete during the last two or three weeks of the semester; students will be notified of the specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results>.

## Academic Integrity and Class Rules

Each student in the course is expected to abide by the UF Code of Academic Integrity. For information, please visit: <https://sccr.dso.ufl.edu/students/student-conduct-code/>

### Academic Honesty

As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity." You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see:

<http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code>.

### Software Use

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

### General Class Rules

- Respect the instructors and call them by their title (Dr)
- Keep electronic device at silence mode during lectures and lab exercises.
- No food or drink will be allowed in lab exercises.
- Discussions about grade shall be made during office hours.
- Students shall bring their own lab coats to lab exercises. Please follow UF's laboratory safety guidance for proper lab clothing when attending a laboratory exercise: <http://webfiles.ehs.ufl.edu/labsafe.pdf>.

## Additional Resources

### Services for Students with Disabilities

The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation.

0001 Reid Hall, 352-392-8565, [www.dso.ufl.edu/drc](http://www.dso.ufl.edu/drc)

### Campus Helping Resources

Students experiencing crises or personal problems that interfere with their general wellbeing are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

- University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, [www.counseling.ufl.edu/cwc/](http://www.counseling.ufl.edu/cwc/)  
Counseling Services Groups and Workshops Outreach and Consultation Self-Help Library Wellness Coaching
- U Matter We Care, [www.umatter.ufl.edu/](http://www.umatter.ufl.edu/)
- Career Resource Center, First Floor JWRU, 392-1601, [www.crc.ufl.edu/](http://www.crc.ufl.edu/)

**Student Complaints**

- Residential Course: [https://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf)
- Online Course: <http://www.distance.ufl.edu/student-complaint-process>

## Evaluation of Oral Presentations

Student name \_\_\_\_\_

Title \_\_\_\_\_

Category	Scoring Criteria	Total Points
<b>Content (30%)</b>	Interesting subject matter; informative introduction.	/10
	Well developed lay out of the problem/question.	/10
	Strong ending and conclusions; good timing.	/10
<b>Organization (20%)</b>	No redundancy.	/10
	Logical and smooth transitions and flow.	/10
<b>Delivery (20%)</b>	Good eye contact with the audience and good body language	/5
	Speaker uses a clear, audible voice.	/5
	Delivery is poised, controlled, and smooth.	/5
	Good language skills and pronunciation are used.	/5
<b>Visual aids (15%)</b>	Visual aids are well prepared, informative, effective, and not distracting.	/5
	Effective slide layout; font adequate size; well proofed.	/10
<b>Handling questions (15%)</b>	Repeat question.	/5
	Friendly and professional response.	/5
	Answers shows a clear understanding on the subject matter.	/5
	<b>Total Points (out of 100)</b>	

### Evaluation of Lab Reports

Objective/Criteria	Performance Indicators			
	Exceptional	Meets Expectations	Needs Improvement	Unacceptable
<b>Quality of Information</b>	(20 points) Contains: Title, Your Name, Instructor's Name, Course Period, Date. Neatly finished- no errors	(15 points) Missing 1 component OR minor typos/errors.	(10 points) Missing 2 – 4 components OR major typos/errors.	(5 points) Missing >4 components, Information has little or nothing to do with the main topic.
<b>Question and Rationale</b>	(20 points) Question and rationale clearly described.	(15 points) Identifies the question and rationale but descriptions can be improved.	(10 points) Identifies only part of the question. Little or no rationale described	(5 points) Irrelevant questions and rationale.
<b>Materials and methods</b>	(20 points) Lists all materials and steps in a detailed, sequential order that are easily followed. All safety precautions and warnings are provided.	(15 points) Lists all materials and steps in sequential order that can be followed, but will require explaining. All safety precautions and warnings are provided.	(10 points) Lists all materials and steps in sequential but they are hard to follow. Part or all of safety precautions and warnings are missing.	(5 points) Lists materials and steps in an order that are not sequential, not easily followed, or largely incomplete. Safety precautions and warnings are not sufficiently provided.

<b>Results</b>	(20 points) All data is recorded and organized in a clear manner. All visible observations are provided. Complete and correct analysis of data is	(15 points) All data is recorded and organized in a clear manner. All visible observations are provided. Analysis of data is provided with a few errors	(10 points) All data is recorded and organized in a clear manner. Visible observations are missing. Analysis of data is provided with a few errors. Errors	(5 points) Data not properly recorded. Errors in analyses and experimentation. provided.
<b>Conclusion</b>	(20 points) Clear conclusion that accurately reflect the results. Provide alternative explanation and suggestions for improvement.	(15 points) Clear conclusion that accurately reflect the results. Little information on alternative explanation or suggestions for improvement.	(10 points) Conclusion is reasonable but can be more explicit. No information on alternative explanation or suggestions for improvement.	(5 points) Conclusion does not reflect the results properly. No information on alternative explanation or suggestions for improvement.
				out of 100