ENY 6651C
Insect Toxicology
Every Even Fall
3 credits

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Special Note on Contact via Email: Due to UF privacy laws, you must use your GatorLink account or the Canvas mail system when emailing the Instructor or TA. Emails sent from other accounts (gmail, hotmail, etc.) will not be answered by the Instructor or TA.

Office Hours: By appointment.

Course Description: This course will introduce students to concepts associated with the toxicology, chemistry, formulation, modes of action, and metabolism of insecticides. Additionally, this course will also explore issues affecting the environmental impacts associated with pesticide use as well as the management of insecticide resistance in the field.

Course Learning Objectives:
1. Define toxicology and describe the classification system used to classify insecticides.
2. Create a research proposal applying toxicological principles one might use to control an insect pest.
3. Describe the potential mechanisms insects use to chemically metabolize insecticides.
4. Compare the different types of insecticides and describe their modes of action against insect physiological systems.
5. Interpret the findings from various pesticide research publications and discuss the implications they may have on insect pests and the environment.
6. Identify the different mechanisms of insect resistance to toxicants and hypothesize ways we might appropriately manage insecticide resistance.

Required Readings:
1. Ostiguy et al. (2019) Honey Bee Exposure to Pesticides: A Four-Year Nationwide Study. *Insects*. 10. doi:10.3390
2. Balabanidou et al. (2018) Insect cuticle: A critical determinant of insecticide resistance. *Current Opinion in Insect Science*. 27. https://doi.org/10.1016/j.cois.2018.03.001
3. Jack et al. (2021) Testing new compounds for efficacy against *Varroa destructor* and safety to honey bees (*Apis mellifera*). *Pest Management Science*. 78. https://doi.org/10.1002/ps.6617
4. Perry et al. (2021) Role of nicotinic acetylcholine receptor subunits in the mode of action of neonicotinoid, sulfoximine and spinosyn insecticides in *Drosophila melanogaster*. *Insect Biochemistry and Molecular Biology*. 131. Doi: 103547

5. Jindra and Bittova (2019) The juvenile hormone receptor as a target of juvenoid "insect growth regulators". *Archives of Insect Biochemistry and Physiology*. 103. https://doi.org/10.1002/arch.21615
6. Zhang et al. (2021) Decline in symbiont-dependent host detoxification metabolism contributes to increased insecticide susceptibility of insects under high temperature. *ISME*. 15. https://doi.org/10.1038/s41396-021-01046-1

Textbooks (*Recommended*):

Yu, S. 2015. *The Toxicology and Biochemistry of Insecticides*, 2nd edition, CRC, Boca Raton, 357 pp.

Klaassen, C. D. (Ed.). 2013. *Casarett and Doull's Toxicology: The Basic Science of Poisons*, 8th edition, McGraw Hill. https://accessbiomedicalscience.mhmedical.com/book.aspx?bookid=958

Lectures: This is a fully online, Canvas-based course. The website for the syllabus, all lectures, reading materials, announcements, tests, etc. will be posted on eLearning: http://lss.at.ufl.edu. All lectures for this course are narrated presentations and will include videos and supplemental readings. I will provide text from all the narrated presentations, but you should pay close attention, as knowing and understanding the spoken information is critical for success in this course. All lectures and tests will be delivered online in Canvas.

Please note that all video clips and photographs are copyrighted and are NOT to be used outside of this class and may be used only this semester. Please do not copy or distribute these photographs or video clips. All class notes are provided for educational use only.

Course Notifications and Communication: All course communications (assignments, announcements, test information, etc.) will be made via the Announcements in Canvas. Please ensure that your Canvas profile is set to receive notifications (i.e. please check the appropriate box to receive all notifications). To do this, click on your name in the upper right corner of the Canvas homepage after logging into Canvas. Next, click "notifications" on the left. This will take you to the Notification Preferences page. Then, click the check symbol for at least the following notifications: Due Date, Course Content, Announcement, and Grading.

Students are encouraged to post general questions on topics taught in the class under the General Questions thread. The instructor and/or the TAs will respond to the questions. Other students are also encouraged to respond to the questions. Private questions should be sent to the TAa via e-mail.

Everyone is busy, so please do not expect immediate responses to emails or discussion posts. The instructor and TAs will do our best to respond within 24 hours during the week and 48 hours on weekends. We will also do our best to grade assignments within one week of the due date.

Course Schedule: This course is offered via Canvas as a distance education course. To stay on track, students must adhere to the course schedule.

Module #	Module	Video Content	Weekly Readings	Module Assessments	Critical Thinking Exercises	Perusall Readings	Research Proposal
Getting Started	Getting Started	Welcome video; How to be successful in this course	Course syllabus; Tips for success	Late August			
1	Introduction to Toxicology	Toxicology definition and classification; Pesticides; Exposure	Klaassen Txt: Ch. 1 Ostiguy et al. (2019)	Early Sept		Early Sept	
2	Physiochemical Properties and Classification	Evaluation of toxicity; Physiochemical Properties of Insecticides; Insecticide Classes	Klaassen Txt: Ch. 2	Early Sept	Early Sept		Research Proposal Topic
3	Insecticide Penetration	Toxicodynamics; Movement through Biological Membranes; Insecticide Penetration -Part 1; Insecticide Penetration -Part 2	Yu Txt: p. 123-130 Balabanidou et al. (2018)	Mid Sept		Mid Sept	
4	Metabolism	Introduction to Metabolism; Cytochrome P450; Microsomal Oxidation of Insecticides; Extramicrosomal Phase I Metabolism; Conjugation	Yu Txt: p. 175-192	Mid Sept	Mid Sept		Research Proposal Outline
5	Neurophysiology	Intro to Neurophysiology; Signal Transmission and Membrane Potential; Graded and Action Potentials; Excitatory and Inhibitory Synaptic Transmission; Neurohormones	Jack et al. (2021)	Late Sept		Late Sept	
6	GABA Receptor and Anticholinesterases	Insecticides Affecting the GABA-gated Cl Channel; Anticholinesterases: OPs; Anticholinesterases: Carb; MOA of Anticholinesterases	Yu Txt: p. 141-149	Early Oct	Early Oct		
7	Sodium Channel Toxins	DDT; Pyrethrins; Pyrethroids Oxadiazines	Yu Txt: p. 133-138	Mid Oct			1st Submission

8	Nicotinic Acetylcholine Receptor Toxins	Nicotine/Neonicotinoids Sulfoximines Spinosyns Nereistoxin	Yu Txt: p. 150-153 Perry et al. (2021)	Mid Oct	Mid Oct	Mid Oct	Peer Review
9	Other Neurotoxic Insecticides	Avermectins; Amitraz; Diamides; Other Neurotoxins	Yu Txt: p. 139-141; 147-150; 153-154; 163-164	Late Oct			
10	Insecticides Affecting Respiration and Growth	Inhibitors of Mitochondrial ATP Synthase; Uncouplers of Oxidative Phosphorylation; Mitochondrial Complex Electron Transport Inhibitors Acylureas; Endocrine-based Insecticides; Ecdysteroids	Yu Txt: p. 154-155; 157-163; 164 Jindra and Bittova (2019)	Early Nov	Early Nov	Early Nov	
11	Microbial Insecticides and Chemical Synergists	Advantages and Disadvantages of Microbial Insecticides; Bacteria; Viruses and Fungi; Chemical Synergists	Yu Txt: p. 155-157; 241-245	Late Nov			Final Submission
12	Insecticide Resistance Management	Intro to Insecticide Resistance Management; Genetics of Resistance; Mechanisms of Resistance; Management of Resistance	Yu Txt: p. 257-304 Zhang et al. (2021)	Early Dec	Early Dec	Early Dec	

Evaluation: The course grade is based on total points earned out of 650 possible points.

Module assessments	15 points each × 12 assessments	180 points
Section critical thinking exercises	40 points each × 6 exercises	240 points
Perusall reading assignments	10 points × 6 readings	60 points
Select Topic for Research Proposal	10 points	10 points
Outline of Research Proposal	40 points	40 points
Peer evaluations of Research Proposals	10 points × 2 peer reviews	20 points
Final draft of Research Proposal	100 points	100 points
	Total Course Points	650 points

Grades and Grade Points
For information on current UF policies for assigning grade points, see catalog.ufl.edu/UGRD/academic-regulations/grades-gradingpolicies/.

FINAL GRADING		
% grade	Letter grade	Points needed to achieve letter grade
100-93	A	≥ 604
90-92	A-	585 – 598
87-89	B+	565 – 578
83-86	B	539 – 559
80-82	B-	520 – 533
77-79	C+	500 – 513
73-76	C	474 – 494
70-72	C-	455 – 468
67-69	D+	435 – 4448
63-66	D	409 – 429
60-62	D-	390 – 403
0-59	E	0 – 383

Assignments:

(1) Module Assessments: There is a 15-point assessment associated with each of the twelve modules in this course. These assessments are ***open note*** (i.e. you ***are*** allowed to use class lectures, books, websites, etc. while taking the assessments). The assessments will be composed of true/false and multiple choice questions. **The assessments 1) open the Saturday morning after the previous section ends, 2) are timed (30 minutes each), and 3) are due on the following Friday at 11:59 pm on the date listed in the course schedule.** These are individual assessments so please do your own work and do not work in groups or share your answers. There is a large bank of test questions for each assessment and the assessment questions are selected randomly for each student. You will receive a 5-point deduction for each day a module assessment is late.

The first module assessment is a syllabus quiz on the "Getting Started" module. You need to read the syllabus and answer quiz questions related to it before you are able to advance to the next module. This quiz will show you how your online assessments will be formatted as well as allow you to demonstrate that you understand how this course works and important due dates.

(2) Critical Thinking Exercises: The exercises are designed to encourage you to think critically about the content presented in the module lectures. The critical thinking exercises are worth 40 points each. These are

individual exercises so please do your own work and do not work in groups or share your answers. All of the critical thinking exercises are open note and untimed. You can close and reopen the exercise as many times as you would like until the due date (see course schedule), but you will not be able to make any changes once you have officially submitted your final exercise. **The exercises are due at 11:59 pm on the date listed in the course schedule.** You will receive a 5 deduction for each day a module assessment is late.

(3) Perusall Reading Assignments: Students will be required to read six scientific research articles that we discuss as a class. The idea of these assignments is to expose students to current toxicology research literature in a way that helps them learn by collectively annotating readings in threads, responding to each other's comments, and interacting. There are three questions or tasks associated with each reading and each assignment is worth 10 points. To receive full credit, you must respond to each prompt. Remember to be respectful and courteous as you respond to your classmates' posts.

4) Research Proposal: One of the most useful skills in any profession is writing. Furthermore, convincing others to provide you funding for your research ideas is valuable to all those who will ever enter any kind of profession requiring research. As such, you are required to produce a toxicological research proposal based on your own research interests. This proposal should be novel to the scientific field and be as realistic as possible. Students will need to be familiar with the current peer-reviewed literature related to their research topic. Selected topics should be related to toxicology and arthropod management. We want the topics to be specific to a particular question, but some general topics to consider include (pesticide impacts on non-target species, mode of actions for new bio-pesticides, efficacy of a specific chemical class on a significant insect pest, etc.) Your research proposal should be written to have the potential for submission to a funding agency. You **must** check with the instructor before beginning your proposal so that they can verify that your research question is both novel and realistic. The instructor can provide ideas for selecting a topic, but the topics will be reserved on a first come first serve basis. **A grading rubric will be provided in Canvas to facilitate the development of your research proposal.**

Your Research Proposal should be written for a scientific audience. **Each Research Proposal is limited to 5 pages in length**, thus, your writing should be clear and succinct. As writing space is limited, figures are extremely helpful in proposals, and students are encouraged to include a couple figures as necessary to explain their proposal. You must also cite the relevant literature and make a strong argument as to the benefit your research will have on the world.

There are four components of the Research Proposal that compose the completed assignment. Due dates for each component are listed in the course schedule.

1) Select Topic Due – The student should identify the topic of their Research Proposal by completing the Canvas assignment "Select Research Proposal Topic".

2) Research Proposal Outline – Here, students will provide an outline of their Research Proposal, including: Title, Overview and Objectives, Rationale and Significance, Review of the Relevant Literature, Research Plan, Expected Outcomes. Some detail and plans should be specified in the outline.

3) 1st Submission – This is not a rough draft, but rather is what the student considers the completed document. This is not a graded assignment, however, in order to be assigned other proposals to review, students must submit their own proposal for review.

4) Peer Review – The 1st submission will be shared with other students in the class who will provide a peer review of the proposal by the due date listed in the course schedule. Each student will peer review two research proposals, providing meaningful helpful comments to receive full points.

5) Final Submission – Students are expected to revise their research proposals as per the relevant comments provided during the peer review process. The final proposal must be submitted by the due date shown in the course schedule.

A grading rubric will be provided in Canvas to facilitate development and peer review of the Research Proposal assignments. **Five points will be deducted from the final project score every day past the due dates that any of the information requested above is late, regardless of the excuse**. Please do not wait until the last minute to produce your proposal or meet any of the other deadlines.

Absences and Make-Up Work: Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at: catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/

Online Course Evaluation Process: Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at gatorevals.aa.ufl.edu/public-results/.

Academic Honesty: UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students 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." The Honor Code (sccr.dso.ufl.edu/process/student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Services for Students with Disabilities: Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, dso.ufl.edu/drc) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Campus Resources:

Health and Wellness

U Matter, We Care: If you or someone you know is in distress, please contact mailto:umatter@ufl.edu, 352-392-1575, or visit umatter.ufl.edu/ to refer or report a concern and a team member will reach out to the student in distress.

Counseling and Wellness Center: Visit counseling.ufl.edu/ or call 352-392-1575 for information on crisis services as well as non-crisis services.

Student Health Care Center: Call 352-392-1161 for 24/7 information to help you find the care you need, or visit shcc.ufl.edu/.

University Police Department: Visit police.ufl.edu/ or call 352-392-1111 (or 9-1-1 for emergencies).

UF Health Shands Emergency Room / Trauma Center: For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; ufhealth.org/emergency-room-trauma-center.

Academic Resources

E-learning technical support: Contact the UF Computing Help Desk at 352-392-4357 or via e-mail at helpdesk@ufl.edu.

Career Connections Center: Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services career.ufl.edu/.

Library Support: cms.uflib.ufl.edu/ask various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center: Broward Hall, 352-392-2010 or to make an appointment 352- 392-6420. General study skills and tutoring. teachingcenter.ufl.edu/

Writing Studio: 2215 Turlington Hall, 352-846-1138. Help brainstorming, formatting, and writing papers. writing.ufl.edu/writing-studio/

Student Complaints On-Campus: sccr.dso.ufl.edu/policies/student-honor- codestudent-conduct-code/

On-Line Students Complaints: distance.ufl.edu/student-complaint-process/