# University of Guelph, School of Environmental Sciences ENVS\*4180 [0.50 credits]

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**Instructor: Professor Jonathan M. Schmidt**

**Class Times and Location:**

LECTURES: Mon, Wed, Fri 12:30PM - 01:20PM MACK, Room 235

SEMINAR: Mon 01:30PM - 02:20PM MACK, Room 235

# Prerequisites & Restrictions:

Prerequisite(s): Minimum of 12.00 credits

Restriction(s): ENVB\*4240, Registration in the BAS, BBRM, BSC, BSC(Agr) or BSC(Env) program.

# Contact details: Instructor:

Prof. J.M. Schmidt

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# Office Hours:

Instructor: By Appointment Only. Please contact by e-mail.

**Teaching Assistant:** Aaron Fairweather fairweaa@uoguelph.ca Bovey 2101

519-226-821-4064 (cell)

# Office Hours:

By Appointment Only. Please contact by e-mail.

# Course Material:

* **There is no textbook for this course**. A useful general reference is: Gilbert, L. I. and Gill, S. S. (Editors) (2010) Insect Control: Biological and Synthetic Agents. Academic Press. ***Available on-line .***
* Another recently published reference work is: Yu, S.J. (2015) The Toxicology and Biochemistry of Insecticides. CRC Press.
* Take-Home Assignments will be posted on CourseLink.
* All lecture materials will be made available on CourseLink.
* Sample questions for discussions will be provided on CourseLink.
* Students are strongly encouraged to refer to the lists of current articles on specific groups of pesticides that are provided with each lecture. All of these are available electronically through the University of Guelph Library. Assignments will make use of the primary literature.
* A summary of essential organic chemistry for the course has been posted on CourseLink. Please review these notes carefully.

# Course Description:

This course explores the diverse modes of action of botanical, microbial and synthetic insecticides, acaricides and nematicides. Detoxification mechanisms, selectivity, resistance management and the process of pesticide discovery and development are also considered. The course includes a review of insect physiological systems and discussion of the stability and distribution of pesticides in the environment.

# Statement of Learning Outcomes:

1. Be able to **classify** into groups and **compare** common, currently used insecticides, acaricides and nematicides based on:
	1. Chemical structure,
	2. Mode of Action,
	3. Origin (botanical, microbial, synthetic, semisynthetic),
	4. Environmental stability and
	5. Human toxicity.
2. Be able to identify and discuss the vulnerabilities of the specific **physiological processes** targeted by insecticides, acaricides and nematicides.
3. Be able to describe the mode of action of insecticides, acaricides and nematicides and relate the symptoms they cause to their interactions with specific **molecular targets**.
4. Be prepared to discuss the basis of **insecticidal and acaricidal selectivity** in terms of physicochemical properties, mode of action and detoxification mechanisms.
5. Be able to discuss, using specific examples, the relationship between the chemical structures of insecticides, acaricides and nematicides and their interactions with their molecular targets (**structure-activity relationships**).
6. Be able to describe the biochemical and physiological mechanisms by which insects and mites

**avoid** intoxication and **relate** these to the occurrence of **resistance**.

1. Be able to propose and discuss methods of **managing** insecticide **resistance** based on an understanding of its underlying biochemical, physiological and behavioral mechanisms.
2. Be prepared to discuss, with appropriate historical examples, the significance of efficacy, selectivity, applicability and environmental stability in the **development of** insecticides, acaricides and nematicides.
3. Be able to discuss, with specific examples, the **environmental and ecological context** of insecticide development and use, including the significance of naturally-occurring insecticidal compounds and their relevance to pest control and resistance management.
4. Be familiar with some of the **key current literature** discussing insecticide and acaricide modes of action and resistance.
5. Be able to write accurately and effectively about the biological and environmental effects of insecticides, acaricides and nematicides using appropriate primary references.

# Mark Allocations:

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| --- | --- | --- | --- |
| **Assignment/Exam** | **Value** | **Due Date** | **Learning Objectives** |
| Take-home | 20% | Feb. 16 (Assigned Jan. 29) | All\* |
| Assignment 1 |  |  |  |
| *Covers lectures 1-11* |  |  |  |
| Take-home | 25% | March 23 (Assigned March 2) | All\* |
| Assignment 2 |  |  |  |
| *Covers lectures 12-21* |  |  |  |
| Take-home | 20% | March 28 (Assigned March 16) | All\* |
| Assignment 3 |  |  |  |
| *Covers lectures 22-27* |  |  |  |
| Final Exam | 35% | Monday, April 9, 2018 | All\* |
| 02:30PM - 04:30PM |

\*Each assignment has components assessing each of the course learning outcomes.

* **Final exam will cover material presented in the lectures, seminars and assignments**.
* For the final exam students will not be expected to draw chemical structures, but should be able to recognize representative compounds from each of the major groups of pesticides discussed.
* Re-evaluations: Students have 5 class-days upon receiving the evaluated assignment to appeal the grade received. The entire assignment will be re-evaluated for accuracy.

# Policy on Late Assignments:

All take-home assignments are due at the beginning of class on the dates specified. A penalty of 10% per day will be deducted for late assignments. Requests for academic consideration due to illness or a compassionate nature must be made in writing.

# Course Policy on Group Work:

All students must submit independently written assignments.

# Copies of out-of-class assignments

Keep paper and/or other reliable electronic back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

# Academic Misconduct Statement:

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The University expects that you are familiar with the University’s policy on Academic Misconduct 0 and that you will conduct yourself in an appropriate manner. We do not accept “I didn’t know” as an excuse. We take this seriously. We expect that you will have taken the self-test available here and that you understand all of the answers: <http://www.academicintegrity.uoguelph.ca/integrity_quiz.cfm>]

# Academic Consideration:

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. See the undergraduate calendar for information on regulations and procedures for Academic Consideration: <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

# Accessibility:

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact the Centre for Students with Disabilities as soon as possible.

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: <http://www.csd.uoguelph.ca/csd/>

# Recording of Materials:

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the written permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

# Course Evaluations:

The School of Environmental Sciences takes student feedback seriously. The SES Director sees all student feedback and discusses this feedback with the faculty where appropriate. Numerical scores and *signed* student comments are reviewed by the School’s Tenure & Promotion Committee, and are considered in our evaluation of the faculty member for the granting of tenure, advancement in rank, and performance related salary increases. This committee will NOT see comments that are not signed by the student. *Faculty members are not able to access their own teaching evaluations until after their final grades are submitted to the registrar.*

# Lectures (timing subject to change)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| January | 8 | M | 1 | Introduction to Insecticide Science and Toxicology |
| January | 10 | W | 2 | The Basics: Insect Physiological Systems |
| January | 12 | F | 3 | The Basics: How Insects Die |
| January | 15 | M | 4 | The Biological Context: Botanical and Fungal Defensive Compounds |
| January | 17 | W | 5 | Insect Defences: Behavioural and Physiological Mechanisms |
| January | 19 | F | 6 | Metabolic Detoxification: Introduction |
| January | 22 | M | 7 | Metabolic Detoxification: Mechanisms and Synergists |
| January | 24 | W | 8 | Insect Nervous System I: Resting Potentials |
| January | 26 | F | 9 | Respiratory Toxins I: Cellular Respiration |
| January | 29 | M | 10 | Respiratory Toxins II: METIs |
| January | 31 | W | 11 | Respiratory Toxins III: Uncouplers and ATP Synthesis Inhibitors |
| February | 2 | F | 12 | Insect Nervous System II: Action Potential Generation |
| February | 5 | M | 13 | The Voltage-gated Ion Channels |
| February | 7 | W | 14 | Organochlorines I: DDT-like Compounds |
| February | 9 | F | 15 | A short history of DDT and the environmental movement |
| February | 12 | M | 16 | Pyrethroids I: Origins, Activity and Structure |
| February | 14 | W | 17 | Pyrethroids II: Target Site, Mode of Action and Resistance |
| February | 16 | F | 18 | Other Sodium Channel Modulators: Veratrotoxins, Indoxacarb, Semicarbazones, N-Alkylamides |
|  |  | February 19 to 23 READING WEEK |  |
| February | 26 | M | 19 | Insect Nervous System III: Excitatory Neurotransmission, The Acetylcholine Receptor and the Botanical Nicotinoids |
| February | 28 | W | 20 | Neonicotinoids and Sulfoxaflor |
| March | 2 | F | 21 | Other Acetylcholine Receptor Toxins: Cartap, Spinosyns, Muscarine, Atropine |
| March | 5 | M | 22 | Acetylcholinesterase |
| March | 7 | W | 23 | Organophosphorus Insecticides |
| March | 9 | F | 24 | Carbamates and Triazamate |
| March | 12 | M | 25 | Insect Nervous System IV: Inhibitory Neurotransmission |
| March | 14 | W | 26 | Targeting the GABA Receptor: Organochlorines II and Fiproles |
| March | 16 | F | 27 | Targeting the Glutamate Receptor: Avermectins and Milbemycins |
| March | 19 | M | 28 | Insect Muscles and Ryanodine Receptors: Novel Targets |
| March | 21 | W | 29 | Synthetic Diamide Ryanoids |
| March | 23 | F | 30 | The Arthropod Exoskeleton |
| March | 26 | M | 31 | Disrupting Moulting: Chitin Synthesis, Lipid Synthesis, Sclerotization |

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| March | 28 | W | 32 | Ecdysteroids and Related Growth Regulators |
|  |  | March 30 Good Friday |  |
| April | 2 | M | 33 | Metamorphosis |
| April | 4 | W | 34 | Juvenile Hormone Mimics and Antagonists |
| April | 6 | F | 35 | Resistance Management: A synthesis |

**Schedule of Seminars**

Date Topic

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| --- | --- |
| January 8 | Seminar: Background Preparation Quiz and Discussion |
| January 15 | Special Presentation: Murder, Mayhem and Medicine in the Garden: The cultural consequences of plant defenses |
| January 22 | Demonstration: An introduction to electrophysiological methods |
| January 29 | Problem Solving and Review 1 |
| February 5 | Case Study: The environmental fate of insecticides: Where do they go? |
| February 12 | Class Debate: Is DDT a “bad” pesticide? |
| February 26 | Problem Solving and Review 2 |
| March 5 | Case Study: The ecotoxicology of neonicotinoids: What do we need to know? (Class Discussion) |
| March 12 | Special Lecture: Novel and Failed neurotoxic insecticides |
| March 19 | Special Lecture: *Bacillus thuringiensis:* Mode of Action |
| March 26 | Case Study: Is Resistance Management Possible? Case Study: GMOs and resistance to *Bacillus thuringiensis* (Article Discussion) |
| April 2 | Problem Solving and Final Review |