**University of Guelph, School of Environmental Sciences**

**ENVS\*4180 [0.50 credits]**



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**Instructor: Aaron Fairweather MSc. (They/Them)**

**Class Times and Location:**

LECTURES: Mon, Wed, Fri 08:30AM - 09:20AM

Zoom Meeting Link: <https://zoom.us/j/6240687357?pwd=MUw4Y3dCWThqVVRPSk96a01yLzZlUT09>

Meeting ID: 624 068 7357
Passcode: 3uCz6k

**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:**

Aaron Fairweather (They/Them)

fairweaa@uoguelph.ca

519-994-2992 (cell)

**Office Hours:**

Instructor: 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.
* The bulk of lecture material has been made available as a series of youtube videos. The links to these will be provided on Courselink.

**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
	5. Human toxicity
	6. Investigate resistance to these compounds
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**.
7. Be able to propose and discuss methods of **managing** insecticide **resistance** based on an understanding of its underlying biochemical, physiological and behavioral mechanisms.
8. 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.
9. 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.
10. Be familiar with some of the **key current literature** discussing insecticide and acaricide modes of action and resistance.
11. 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 Assignment 1*Covers lectures 1-11* | 20% | Feb. 12th (Assigned Jan. 29th) | All\* |
| Take-home Assignment 2*Covers lectures 12-21* | 20% | March 17th (Assigned Feb 26th) | All\* |
| Take-home Assignment 3 *Covers lectures 22-27* | 20% | April 5th (Assigned March 19th) | All\* |
| Take-homeAssignment 4*Covers All Lectures, with a focus on 28-36*Weekly Participation | 30%10% | April 21st (Assigned April 7th)Throughout the course | All\*All\* |

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

* The 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.
* Weekly Participation will be based on short form multiple choice quizzes. These quizzes will be a review of the assigned weekly lectures and be posted via Courselink announcements (see schedule at the end of the document). These quizzes will not be graded and are intended to let me know how well you all are following the material, and what to review during out lecture times.

**Policy on Late Assignments:**

All take-home assignments are due by midnight (00:00 EST) to the Courselink dropbox the night they are due. A penalty of 10% per day will be deducted for late assignments without excuse. Due to the challenging environment and circumstances of this semester great leniency and consideration will be given to due dates, **however** *an email requesting extension is a* ***must***.

**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](http://tinyurl.com/UoG-misconduct) 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 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 to review (PowerPoints and Youtube videos by week and subject)**

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| January 11th – 15th  | 1: Introduction to Insecticide Science and Toxicology |
| 2: The Basics: Insect Physiological Systems |
| 3: The Basics: How Insects Die |
| January 18th – 22nd | 4: The Biological Context: Botanical and Fungal Defensive Compounds |
| 5: Insect Defences: Behavioural and Physiological Mechanisms  |
| 6: Metabolic Detoxification: Introduction  |
| January 25th – 29th  | 7: Metabolic Detoxification: Mechanisms and Synergists |
| 8: Respiratory Toxins I: Cellular Respiration |
| 9: Respiratory Toxins II: METIs |
| February 1st – 5th  | 10: Respiratory Toxins III: Uncouplers and ATP Synthesis Inhibitors |
| 11: Insect Nervous System I: Resting Potentials |
| 12: Insect Nervous System II: Action Potential Generation |
| February 8th – 12th  | 13: The Voltage-gated Ion Channels |
| 14: Organochlorines I: DDT-like Compounds & Review 1 |
| 15: Organochlorines I: DDT-like Compounds & Review 1 |
| February 15-19 WINTER BREAK |  |  |  | A short history of DDT: Is DDT a “bad” pesticide? |
| February 22nd – 26th  | 16: Pyrethroids I: Origins, Activity and Structure |
| 17: Pyrethroids II: Target Site, Mode of Action and Resistance |
| 18: Other Sodium Channel Modulators: Veratrotoxins, Indoxacarb, Semicarbazones, N-Alkylamides |
| March 1st – 5th  | 19: Insect Nervous System III: Excitatory Neurotransmission, The Acetylcholine Receptor and the Botanical Nicotinoids |
| 20: Neonicotinoids and Sulfoxaflor & Review 2 |
| 21: Other Acetylcholine Receptor Toxins: Cartap, Spinosyns, Muscarine, Atropine  |
| March 8th – 12th  | 22: Acetylcholinesterase |
| 23: Organophosphorus Insecticides  |
| 24: Carbamates and Triazamate |
| March 15th – 19th  | 25: nsect Nervous System IV: Inhibitory Neurotransmission |
| 26: Targeting the GABA Receptor: Organochlorines II and Fiproles |
| 27: Targeting the Glutamate Receptor: Avermectins and Milbemycins |
| March 22nd – 26th  | 28: Insect Muscles and Ryanodine Receptors: Novel Targets |
| 29: Synthetic Diamide Ryanoids |
| 30: The Arthropod Exoskeleton |
| March 29th – April 2nd  | 31: Disrupting Moulting: Chitin Synthesis, Lipid Synthesis, Sclerotization |
| 32: Ecdysteroids and Related Growth Regulators |
| 33: Metamorphosis |
| April 5th – 9th  | 34: Juvenile Hormone Mimics and Antagonists |
| 35: Resistance Management: A synthesis & Final Review |
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