

Herbology: The Science behind Medicinal Plants
BIOD13H3
Instructor: Professor Eliana Gonzales-Vigil

Course description

The study of Medicinal Plants utilizes techniques as diverse as plant tissue culture and metabolic engineering. During this course, students will be expected to integrate knowledge from different disciplines, including biochemistry, genetics, plant physiology and biotechnology to tackle problems with plants of economic importance.

Learning objectives

By the end of this course, students should be able to:

- Identify and describe the most common pathways involved in the biosynthesis of plant medicinal compounds.
- Explain the analytical techniques and methods used to characterize plant specialized metabolites.
- Integrate traditional knowledge on the role of medicinal plants with new evidence provided by biochemistry and genetics.
- Analyze scientific papers and synthesize the information in a research paper.
- Design experiments using genetic and biochemical methods to uncover the biosynthesis and regulation of novel metabolites.
- Identify the value of plant metabolites, not only in traditional and conventional medicine practices, but also in the food industry.

Pre-requisite: BIOC13, no previous plant courses required.

Course delivery

The lectures of this course will be delivered through Zoom in real-time. You are strongly encouraged to be online during lecture hours, as there will be opportunities for discussion and asking questions. However, lectures will be recorded and posted on Quercus. The lab component of the course does require mandatory attendance.

Instructor



Dr. Eliana Gonzales-Vigil
e.gonzalesvigil@utoronto.ca
Can be reached during virtual office hours

TA



Jeff Chen
yitingjeff.chen@mail.utoronto.ca
Can be reached at Discussion board on Quercus

Online resources:



Lectures: Wednesday 1- 3 pm (Live on Zoom, recordings will be posted on Quercus)

<https://utoronto.zoom.us/j/89310608880>

Meeting ID: 893 1060 8880

Passcode: **401083**

Lecture **notes** and **assigned readings** will be posted on Quercus → Modules



Laboratories: Tuesday 10-1 pm SW133, except for the first session. Practicals every other week.

Location	PRA0001	PRA0002
SW313 (Culinaria)	September 14 th	September 21 st
SW133	September 28 th	October 5 th
SW133	October 19 th	October 26 th
SW133	November 2 nd	November 9 th
SW133	November 16 th	November 23 rd
Online	November 30 th	November 30 th



Office hours: Thursday 2-3 pm. Stop by the following Zoom session.

<https://utoronto.zoom.us/j/85276768923>

Meeting ID: 852 7676 8923

Passcode: **523351**

Sign-up for 10 min slots on Quercus → Calendar

Contact information:

- Any important information related to this course will be announced on **Quercus**. Students are expected to check the **announcements** and **discussions** regularly (make sure to check your settings for notifications).
- Questions about the **course content**, should be posted on the **Quercus discussion** board. Other students may benefit from reading questions and answers.
- For questions about **course administration**, send the instructor an **email**.
- For emails, please use **#BIOD13** in the subject line, and include your **full name** in the body of the message. Otherwise, your message might be ignored.
- Typically expect responses within 48 h, but NOT on weekends.

Reading materials:



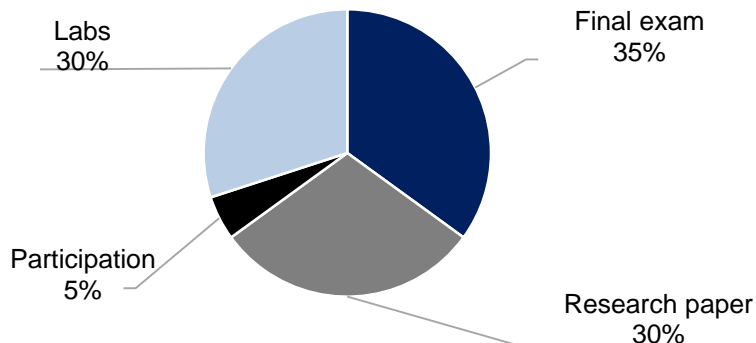
Research articles will be posted on Quercus → Modules. Students are **expected to read them before** the discussion sessions as participation is a component of the evaluation.



There is no required textbook for this course. The following is a list of textbooks available as e-Books from the UofT library that I will consult to design the lectures:

[Plant Secondary Metabolites by Crozier, Clifford, and Ashihara \(Blackwell\)](#)

Grading:



LECTURES (ASSESSED THROUGH FINAL EXAM 35%)

The final exam (3 h) will be case study based with essay-type questions. The final exam will require students to think critically and creatively. Students will be expected to apply their knowledge to explain observations and recommend experimental approaches.

Schedule of the final exam will be arranged by the Registrar's office. Students who miss the final exam must contact the Registrar's Office for appropriate arrangement.

<https://www.utsc.utoronto.ca/registrar/missing-examination>

- Traditional knowledge on medicinal plants
 - Learning from Ayurveda, Traditional Chinese Medicine, First Nations healers, and other traditional health care systems.
- Analytical methods in plant metabolite profiling
 - Phytochemical characterization of plant compounds.
 - Gas and liquid chromatography, mass spectrometry, nuclear magnetic resonance.
- Biosynthetic origin of medicinal compounds
 - Terpenoids, phenylpropanoid-derived, nitrogen-containing and sulphur-containing compounds.
- Uncovering the molecular basis of medicinal compounds
 - Forward and reverse genetics, systems biology approaches (genomics, proteomics, metabolomics).
- Strategies to produce medicinal compounds
 - *in vitro* propagation of plants, cell cultures, engineering of plant biosynthetic pathways in microbes, directed enzyme evolution.
- Guest lectures (to be determined)

RESEARCH PAPER (TOTAL OF 30%)

Being able to collect, read, synthesize and critically evaluate primary literature will be one of the main goals of this course. At the beginning of the semester, students in pairs will be assigned a medicinal plant to work on (students can pick their own plant too but it needs to be approved by the instructor). Students will be responsible for preparing the following:

- Outline and literature search **(5%, DUE OCTOBER 6TH)**
Three weeks after topics are assigned, groups will present an outline of their written report containing the abstract, major sections of the paper and a list of references.
- Written report **(15%, DUE OCTOBER 27TH)**
It will summarize information on the traditional knowledge, the properties of the active compound(s) on human health, as well as the genetics and biochemistry behind its medicinal properties.
The final written report should contain the following sections:
 - 1) Abstract,
 - 2) History of the plant (Where and how it was discovered? By whom? For what purpose?),
 - 3) Medicinal properties (are they backed or refuted by scientific evidence?),
 - 4) Biochemistry and Genetics (What is known about the metabolites? How are they synthesized? What genetic tools are available in the species),
 - 5) Gap in knowledge (What is one of the challenges in the use of this metabolite?).**General guidelines**
The paper should be 10-12 pages in length (excluding references and figures), double-spaced, 12 point font, Times New Roman, 1 inch margins on each side. Do not copy and paste figures or tables from papers or the web without proper citation.
- Oral presentation **(10%, NOVEMBER 10TH, 17TH AND 24TH)**
Communicating knowledge and leading discussions are important skills in all professional environments. For the second half of the course, students in pairs will give a 25 min presentation, followed by a discussion period led by the students themselves. The presentation can be a PowerPoint or a video.
The presentation should emphasize the gap in knowledge identified in the written report and propose experiments to address it (think about this as a thesis or business proposal where you are trying to sell your idea to the audience). You want to show your understanding of the topic and that you have critical skills.

Missed term work: If you miss term work **due to illness** you must self-declare **within 48 hours via Acorn**. Please note it is mandatory for you to **fill in the notes field** within the self-declaration tool on Acorn to specify what term work you are missing and applicable due dates to be considered. For some additional instructions on how to declare illness please review the following resource:

<https://help.acorn.utoronto.ca/blog/ufags/how-do-i-declare-an-absence/>

If you are missing term work for **another reason** including: short-term illness under the care of a Physician or someone affiliated with Health and Wellness, disability reasons, a family death, vehicle accident, essential travel that is not vacation related, or varsity activities must **e-mail the course instructor and Jennifer Campbell** (jac.campbell@utoronto.ca) in advance or within 48 hours of the term work due date. Please note all documentation will be verified for authenticity by Jennifer Campbell and any accommodations (if applicable) will be determined by the course instructor.

Please note that we understand that life happens, and you may miss term work for valid reasons and we will help you navigate through those situations. Please remain in communication with our departmental administration office as well as your course’s teaching team.

*** A late submission penalty of 10% per day will be applied to any late work not justified.**

PARTICIPATION (5%)

Attendance to the students’ presentations is required to obtain 2% in participation. The other 3% will consist of questions to your peers during their presentations and participating in the discussion of papers. Each question is worth 0.5%.

LABORATORY (TOTAL OF 30%, ASSESSED THROUGH 6 LAB REPORTS WORTH 5%)

Study system: <i>Atropa belladonna</i> “Deadly nightshade”	<ul style="list-style-type: none"> • Extraction and analysis of plant volatiles: <ul style="list-style-type: none"> ○ Medicinal plants grown at the UTSC farm ○ Culinaria lab • Growth of plants in sterile conditions: <ul style="list-style-type: none"> ○ Seed sterilization ○ Callus induction • Extraction, separation and identification of alkaloids: <ul style="list-style-type: none"> ○ Metabolite extraction ○ Thin layer chromatography
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At the end of each laboratory activity, you will find a few questions that will guide more in-depth learning of the protocol. Answers to those questions count as the report for the lab. Should be submitted on Quercus one week after the lab session.

Lab Report due	PRA0001	PRA0002
Report #1	September 21 th	September 28 st
Report #2	October 5 th	October 12 th
Report #3	October 26 th	November 2 nd
Report #4	November 9 th	November 16 th
Report #5	November 23 rd	November 30 rd
Quiz	November 30 th	November 30 th

Mental health: As a university student, you may experience a range of health and/or mental health challenges that could result in significant barriers to achieving your personal and academic goals. Please note, the University of Toronto offers a wide range of free and confidential services

that could assist you during these times. The tri-campus [mental health support site](#) offers a series of resources, including in online settings.

AccessAbility: Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the AccessAbility Services Office as soon as possible. AccessAbility Services staff (located in Rm SW302, Science Wing) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations 416-287-7560 or email ability@utsc.utoronto.ca. The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course.

Academic Integrity: All suspected cases of academic dishonesty will be investigated following procedures outlined in the *Code of Behaviour on Academic Matters*. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, please reach out to me. Note that you are expected to seek out additional information on academic integrity from me or from other institutional resources (for example, the [University of Toronto website on Academic Integrity](#)). Normally, students will be required to submit their course essays to the University's plagiarism detection tool for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the tool's reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of this tool are described on the Centre for Teaching Support & Innovation web site (<https://uoft.me/pdt-faq>).

Equity, diversity and inclusion: The University of Toronto is committed to equity, human rights and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. U of T does not condone discrimination or harassment against any persons or communities.

Copyright of course materials: All course materials posted on Quercus (videos, lecture slides, exams) are for the sole use of students registered in this course this year, and **must not be redistributed**. Sharing these materials with anyone outside the course, would be a breach of the terms and conditions.

This course, including your participation, will be recorded on video and will be available to students in the course for viewing remotely and after each session. Course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation and are protected by copyright. Do not download, copy, or share any course or student materials or videos without the explicit permission of the instructor. For questions about the recording and use of videos in which you appear, please contact your instructor.

Online class etiquette:

To successfully engage in this course, you will require a computer with a stable internet connection. A webcam and microphone are recommended as well, but not mandatory.

- Check your Wi-Fi, test your video and audio, and get familiar with the different software (Zoom, Bb Collaborate, Sapling Learning) before the class.

- Pay attention to your video, microphone and screen sharing settings.
- Mute your microphone when someone else is talking.
- Zoom has buttons for raising your hand, responding yes or no, asking the presenter to adjust speed, etc. Use them appropriately.
- Engage and participate in class discussions. Use the chat to ask questions.
- In case of technical difficulties, please be patient.