BOT*3310 Plant Growth and Development

Winter 2024
Section(s): 01

Department of Molecular and Cellular Biology
Credit Weight: 0.50
Version 1.00 - December 21, 2023

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1 Course Details

1.1 Calendar Description

In this course the unique function and structure of plants is explored in relation to their growth, survival and adaptation to the environment. The control of growth and development by environmental and hormonal signals is explained through lectures and "hands-on" laboratories.

Pre-Requisites: BIOL*1090, (BIOL*1070 or BIOL*1080)

1.2 Course Description

This course explores the basic foundations of plant growth and development. Emphasis will be on unique aspects of plants, ranging from the single cell to the whole organism, and integration of events at the cellular level with whole plant development. Topics include basic plant structure and morphology, developmental physiology, growth regulators, hormones and signaling, photomorphogenesis, vegetative and reproductive development, cellular and sub-cellular components and their connection to plant form, and plant/environment interactions. Molecular and genetic mechanisms underlying plant physiology will be a central theme of this course. The laboratory component will offer students hands-on experience in the modern methods of plant analysis using the model plant *Arabidopsis thaliana*.

1.3 Timetable

Lectures and Laboratories:

- **Lectures: Monday, Wednesday and Friday from 12:30 - 1:20 pm** in **THRN 1307** (Albert A. Thornbrough Building).
- Lectures start on **January 8, 2024**.
- Lecture notes will be provided via Courselink.
- **Laboratories**: **Mondays and Tuesdays from 2:30 - 5:20 pm in SSC 3304.**
- The first labs will be on **January 8-9**.

1.4 Final Exam

FINAL EXAM: April 13th, 2024, 08:30 - 10:30 am (Location TBD).

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2 Instructional Support

2.1 Instructional Support Team

Instructor: Yang Xu
Email: yangxu@uoguelph.ca
Telephone: +1-519-824-4120 x54788
Office: SSC 4453
Office Hours: Please contact me directly via email to schedule an appointment.

Dr. Yang Xu is an Assistant Professor in the Department of Molecular and Cellular Biology. Dr. Xu received her Ph.D. degree in Plant Science from the University of Alberta with a research focus on plant lipid biotechnology. She worked as a Postdoctoral Fellow in microalgal lipid biotechnology at the University of Alberta and later as a Postdoctoral Research Associate in plant lipid biochemistry at Michigan State University. Her research laboratory focuses on studying lipid metabolism in plants and microalgae and developing biotechnology strategies to produce designer oils for food, fuel and renewable materials.

Lab Co-ordinator: Chris Meyer
Email: cmeyer02@uoguelph.ca
Telephone: +1-519-824-4120 x53955
Office: SSC 3507

Dr. Chris Meyer obtained B.Sc. and Ph.D. degrees in Plant Biology from the University of Waterloo. He has contributed to research and teaching in the plant sciences at the Universities of Waterloo, Wilfrid Laurier and Brock. Dr. Meyer continues to explore new approaches in plant science education at Guelph. As the Lab Coordinator, he manages all aspects of the teaching laboratory. See the Lab Manual for further details.

2.2 Teaching Assistants

Victoria Butler

Alyssa Clews

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3 Learning Resources

A basic understanding of Genetics, Molecular Biology and Biochemistry is required for understanding important aspects of this course.

3.1 Required Resources

Information supplied during lectures (Readings)

Sources of information and accessory information, for example scientific papers, web site URLs or videos, or links to those, will be posted on CourseLink.

3.2 Recommended Resources

Plant Physiology and Development (Textbook)

Plant Physiology and Development (Textbook)

HIGHLY recommended textbook for this course: "**Plant Physiology and Development**, **6th edition (2015) or 7th edition (2023) by L. Taiz, E. Zeiger, I.M. Møller and A. Murphy".** Available in the bookstore and on reserve in the library.

Principle of Genetics (Textbook)

The book "Principles of Genetics", by Snustad and Simmons (any edition) provides good background information on genetics and molecular biology. The genetics components from the textbook for BIOL*1090 course also can be useful.

Biology of Plants (Textbook)

"Biology of Plants" 8th edition (2013) by R.F. Evert and S.E. Eichhorn, is recommended for students who like to read a bit simpler text than Taiz et al to prepare themselves. This book is used, and therefore on reserve, for BOT2100.

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4 Learning Outcomes

4.1 Course Learning Outcomes

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

1. Understand structure and function of tissue and organs of higher plants.
2. Demonstrate knowledge of plant growth regulating substances and their roles in plant development.
3. Decipher molecular signal transduction pathways based on genetic makeup.
4. Understand the role of environmental interactions in plant growth.
5. Design experimental protocols to identify mutant phenotypes.
6. Collaborate effectively with fellow students in performing lab experiments.
7. Carry out lab experiments with minimal supervision.

8. Interpret data and findings in the context of primary scientific literature.
9. Design a scientific poster describing qualitative and quantitative data.
10. Explain data on poster to colleagues and defend conclusions.

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5 Teaching and Learning Activities

5.1 Lab

Topics:

DETAILED INFORMATION WILL BE PROVIDED IN THE LABORATORY MANUAL FOR WINTER 2024

See CourseLink

- Week 1: Jan 8-9
  Introduction
- Week 2: Jan 15-16
  Start growing *Arabidopsis* plants in soil (Series #1) and media plates (Series #2)
- Week 3: Jan 22-23
  Observe *Arabidopsis* plants
  Tutorials on image processing, graphing and statistics
- Week 4: Jan 29-30
  Observe *Arabidopsis* plants
  Conduct seed plating for Series #3
- Week 5: Feb 5-6
  Observe *Arabidopsis* plants
  Details on reading scientific articles and writing lab reports
- Week 6: Feb 12-13
  Observe *Arabidopsis* plants
  Tutorials on ePlant and BLAST
- WINTER BREAK: February 19-23
- Week 7: Feb 26-27
  Observe *Arabidopsis* plants
  Conduct seed plating for Series #4
- Week 8: Mar 4-5
  Observe *Arabidopsis* plants

Details on poster presentations
- Week 9: Mar 11-12
  Observe *Arabidopsis* plants
  Last chance to start new plating series
- Week 10: Mar 18-19
  Observe *Arabidopsis* plants
- Week 11: Mar 25-26
  Last chance to observe *Arabidopsis* plants
  Prepare and print posters
- Week 12: Apr 1-2
  Poster presentation sessions

5.2 Lecture Schedule

- Week 1: Jan 8 - Jan 12: Lectures 1 - 3
  Course overview
  Introduction to *Arabidopsis,* features of plants
  Embryogenesis, SAM development and maintenance
- Week 2: Jan 15 - 19: Lectures 4 - 6
  Methods used to identify genes involved in plant development
  Mutants, transformation, reporter constructs, *in situ* hybridization
  Molecular circuits of meristem development, feedback loops in SAM
  Leaf initiation, patterning and phyllotaxy
- Week 3: Jan 22 - 26: Lectures 7 - 9
  Cell fate determination
  Lateral roots, lineage vs position, chimeras
  Leaf development
- Week 4: Jan 29 - Feb 2: Lectures 10 - 12
  Differential growth and cell patterning, epidermal cell functions
  Trichome and root hair
  Guard cells, stomata and water/gas exchange
- Week 5: Feb 5 - 9: Lectures 13 - 15
  Water movement
  Photosynthesis, carbon fixation
  Photo-assimilate transport

- Week 6: Feb 12 - 16: Lecture 16
  REVIEW
- **MIDTERM EXAM Friday February 16, 2024 (IN CLASS)**
- WINTER BREAK: February 19 - 23, 2024
- Week 7: Feb 26 - Mar 1: Lectures 17 - 19
  Light signaling, phytochrome
  Circadian clock, bule light signaling
- Week 8: Mar 4 - 8: Lectures 20 - 22
  UV light signaling
  Auxin, gravitropism
- Week 9: Mar 11 - 15: Lectures 23 - 25
  Auxin, apical dominance
  Gibberellic acid, seed germination
- Week 10: Mar 18 - 22: Lectures 26 - 28
  Cytokinin, meristem function
  Ethylene, ripening & senescence
- Week 11: Mar 25 - 29: Lectures 29 - 30
  Abscisic acid, stress response
  Other phytohormone and signaling mechanisms
- Week 12: Apr 1 - 5: Lectures 31 - 32
  Flowering, the floral transition and floral induction
  OVERVIEW
- **FINAL EXAM: April 13th, 2024, 08:30 - 10:30 am; Location TBD**

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6 Assessments

6.1 Marking Schemes & Distributions

Midterm Exam (25%)

Fri, Feb 16, 12:30 PM - 1:30 PM, In Class.

Learning Outcomes: 1, 2, 3, 4, 8

Lab Reports (20%)

Two independently written reports worth 20% in total. See the lab manual for more information.

Learning Outcomes: 1, 2, 3, 4, 5, 6, 7, 8

Student Poster Presentations (20%)

To be presented in person during the final lab period.

Learning Outcomes: 1, 2, 3, 4, 8, 9, 10

Final Exam (35%)

Sat, Apr 13, 08:30 AM - 10:30 AM, location TBD.

Name	Scheme A (%)
Midterm Exam	25
Lab Reports	20
Poster presentation	20
Final Exam	35
Total	100

6.2 Assessment Details

Midterm Exam (25%)
Learning Outcome: 1, 2, 3, 4, 8

Final Exam (35%)
Learning Outcome: 1, 2, 3, 4, 8

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7 Department of Molecular and Cellular Biology Statements

7.1 Academic Advisors

If you are concerned about any aspect of your academic program:

- Make an appointment with a program counsellor in your degree program. B.Sc. Academic Advising or Program Counsellors

7.2 Academic Support

If you are struggling to succeed academically:

- Learning Commons: There are numerous academic resources offered by the Learning Commons including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills. You can also set up individualized appointments with a learning specialist. http://www.learningcommons.uoguelph.ca/
- Science Commons: Located in the library, the Science Commons provides support for physics, mathematic/statistics, and chemistry. Details on their hours of operations can be found at: http://www.lib.uoguelph.ca/get-assistance/studying/chemistry-physics-help and http://www.lib.uoguelph.ca/get-assistance/studying/math-stats-help

7.3 Wellness

If you are struggling with personal or health issues:

- Counselling services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance. https://www.uoguelph.ca/counselling/
- Student Health Services is located on campus and is available to provide medical attention. https://www.uoguelph.ca/studenthealthservices/clinic
- For support related to stress and anxiety, besides Health Services and Counselling Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations. http://www.selfregulationskills.ca/

7.4 Personal information

Personal information is collected under the authority of the University of Guelph Act (1964), and in accordance with Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) http://www.e-laws.gov.on.ca/index.html. This information is used by University officials in order to carry out their authorized academic and administrative responsibilities and also to establish a relationship for alumni and development purposes.

For more information regarding the Collection, Use and Disclosure of Personal Information policies please see the Undergraduate Calendar. (https://www.uoguelph.ca/registrar/calendars/undergraduate/current/intro/index.shtml)

7.5 Course Offering Information Disclaimer

Please note that course delivery format (face-to-face vs online) is subject to change up to the first-class day depending on requirements placed on the University and its employees by public health bodies, and local, provincial and federal governments. Any changes to course

format prior to the first class will be posted on WebAdvisor/Student Planning as they become available.

8 University Statements

8.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

8.2 When You Cannot Meet a Course Requirement

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. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Graduate Calendar - Grounds for Academic Consideration
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions
https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml

8.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Graduate Calendar - Registration Changes
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml

Associate Diploma Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml

8.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be

asked to resubmit work at any time.

8.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

For Guelph students, information can be found on the SAS website
https://www.uoguelph.ca/sas

For Ridgetown students, information can be found on the Ridgetown SAS website
https://www.ridgetownc.com/services/accessibilityservices.cfm

8.6 Academic Integrity

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 encourages academic integrity. 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.

Undergraduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Graduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

8.7 Recording of Materials

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

8.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars
https://www.uoguelph.ca/academics/calendars

8.9 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).
