1. Course syllabus

Course description

The goal of this course is to understand how plants have evolved life history strategies and adapted organs to maximize survival, growth, and reproduction as sedentary organisms and to face various limiting environmental conditions such as nutrient shortage, drought, inundation, winters, or arctic and alpine environments. Students will learn how plants have evolved to grow as trees and thus to engage in secondary growth and produce wood. Lastly, case studies will showcase the fact that behavior, a term historically reserved for animals, also applies to plants. While students will develop a detailed understanding of vascular plant anatomy, including their organs, tissue types, and cells, the study of plant anatomy will always be used as a vehicle to appreciate the amazing range of evolutionary adaptations in vascular plants. Students will study plant adaptations in three labs, investigating the diversity and function of flowers, roots (outdoors in person, rain or shine), and experience how plants disperse their seeds on an outdoor hike (outdoors in person, rain or shine). In the labs that form an important and mandatory part of the course.

Labs

In the first lab (on flower form and function), students will measure the size of flowers and contribute to a class data set investigating the reproductive strategies of one particular plant species, ground ivy or creeping Charlie (*Glechoma hederacea*). This lab happens online on an individual student basis. The resulting joint data set will form the basis of a written assignment. For second lab, the seed dispersal lab, students will engage in a hands-on outdoors quest and collect seeds and fruits in the green space on the UTSC campus and beyond. Connected to this lab, students can voluntarily put together a seed collection (maximum bonus of 4% above and beyond 100%, collecting seeds covering different dispersal categories in their home neighborhoods). For the third lab, the root lab, instead of the prof doing the bulk of talking, YOU will teach your class mates, while on a live and outdoor walk in the Highland Creek valley. In particular, I will assign each one of you a small teachable unit, which I call an 'Each-one-teach-one' (EOTO). Each EOTO consists of a short text, which I would like you to 'teach' in your own words to the class and without using a script. The two outdoor labs (seeds and roots) are accompanied by quizzes (handed in at the end of the lab) worth part of the final grade.

Learning outcomes

1. Explain the effect of different limiting environmental conditions and how plants cope with them.
2. Explain how plants have evolved the staggering range of present global plant morphologies using the relatively simple modular construction of their bodies into roots, shoots, and leaves.
3. Explain how plants as sessile organisms are manipulating their biotic and abiotic environment for their own interests.
4. Appreciate that all plants are products of natural selection and that interpretation of plant anatomy can only make sense in light of evolution.
5. Relate the structure of particular types of cells, tissues, and organs to their functions in particular environments.

Marks breakdown

Online lecture-based practice questions	12%
Paper on reproductive strategy data set	21%
Quizzes on the seed and root labs (1% each)	2%
Each-one-teach-one on roots (or online backup assignment)	5%

(Voluntary) seed collection	4%
Midterm	27%
Cumulative final exam	33%

Instructor

Ivana Stehlik; Phone: 416-287-7422; Email: ivana.stehlik@utoronto.ca
Virtual office hours: Thu, 3 PM or by appointment

Times and location

Course lecture time: Tue & Thu 3-4 PM
Lab time: Wed, 11 – 2

Flipped classroom approach

Work through the prerecorded lecture material on your own. A course approach using a flipped classroom consists of prerecorded lectures which you are expected to work through on a weekly basis (procrastination is the death of any high cGPA…). To keep you on track, connected to the course contents, and to help you figure out whether you understand the course content, the weekly lectures are accompanied by weekly practice quizzes, where each slide is covered by at least one quiz question. The times in which in-person live lecturing would have occurred in the pre-covid era are now dedicated to live online problem solving (drop-in for difficult course content; Q and A on hard quiz questions), led by the professor, but heavily depending on your input. To help you problem-solve as you review course material, a course buddy system (online learning pods) will help you to jointly solve lecture issues or jointly identify concepts which would benefit from professorial help in the live drop-ins.

Virtual peer-based online learning pods (course buddy system). The course instructor will allocate students into groups of 4-5 members each. These groups are meant to informally and without professorial oversight problem-solve any course content which you might struggle with. In particular, when working through and reviewing the lectures for solving the weekly quizzes, some slides or concepts might be more difficult than others: ask your pod buddies for help! Build your own reliable small community of study peers! This will also help you jointly identify what questions to bring to the weekly Tuesday live drop-ins for difficult course content.

Drop-in for difficult course content. Each Tuesday, 3 - 4 pm, I will be available live to interactively tackle your questions about difficult course content. Bring any lecture-related question, whether your own or a question which came up in your peer-based learning pod. I will pull up any lecture slide and scribble away on the virtual white-board to review concepts! This session will be recorded but will greatly benefit from your live attendance and input, because if no one asks a question, there will be nothing to do…

Live Q and A sessions on hard lecture-based practice quizzes. Each Thursday, 3 - 4 pm, I will be available live online to interactively review the hardest questions from the most recent batch of practice quizzes. These are questions which were answered correctly by a maximum of 70% of the class. This Q and A

review will be recorded for those of you who cannot attend live, however, this session will greatly benefit from YOUR LIVE attendance!

Are you struggling to keep up with assignments and the course in general? I am here to help! Please contact me before things get out of hand! We will work together to find solutions and accommodations.

Penalty for late submission

There will be a penalty of 5% per day for assignments received late. Weekend days count as individual days. Unless there are extenuating circumstances (e.g. medical reasons with an official University of Toronto medical certificate), a mark of zero will be applied to assignments submitted one week late or more. Heavy workloads or malfunctioning computer equipment are not legitimate reasons for late submission. If you know ahead of time that you have a legitimate reason why you cannot hand in an assignment, let the course instructor know two weeks before the due date.

Date	Lectures uploaded
Sep. 7	Lecture 1: Course introduction; Pollination I
Sep. 9	Lecture 2: Pollination II
Sep. 14	Lecture 3: Pollination III
Sep. 16	Lecture 4: Pollination IV
Sep. 21	Lecture 5: Seed dispersal syndromes I
Sep. 22	Lecture 6: Seed dispersal syndromes II
Sep. 28	Lecture 7: Survival under low-nutrient conditions I
Sep. 30	Lecture 8: Survival under low-nutrient conditions II
Oct. 5	Lecture 9: Survival under low-nutrient conditions III
Oct. 7	Lecture 10: Survival under low-nutrient conditions IV
Oct. 19	Lecture 11: Survival under dry conditions I
Oct. 21	Lecture 12: Survival under dry conditions II
Oct. 26	Lecture 13: Survival under dry conditions III
Oct. 28	Lecture 14: Survival under dry conditions IV
Nov. 2	Lecture 15: Surviving an overabundance of water I
Nov. 4	Lecture 16: Surviving an overabundance of water II
Nov. 9	Lecture 17: Survival in the winter I
Nov. 11	Lecture 18: Survival in the winter II
Nov. 16	Lecture 19: Arctic and alpine survival I
Nov. 18	Lecture 20: Arctic and alpine survival II
Nov. 23	Lecture 21: Trees
Nov. 25	Lecture 22: Plant behavior I
Nov. 30	Lecture 23: Plant behavior II
Dec. 2	Lecture 24: Plant behavior III

Date	Activities
Sep. 7	Introduction to BIOC37
Sep. 8	Intro to Lab 1 Reproductive strategy lab (11 am - 1 pm; recorded): -introduction to project -how-to-do lab instructions -how to write a good paper Submit flower measurements to TA (by 11.59 pm; individual student work)
Sep. 13	**Practice questions 1**
Sep. 14	Office hours on hard lecture concepts (lecs 1/2)
Sep. 15	Seed dispersal lab group 1
Sep. 15	**Practice questions 2**
Sep. 16	**Q and A review (quizzes 1, 2)**
Sep. 18	Submit flower measurement data
Sep. 20	**Practice questions 3**
Sep. 21	Office hours on hard lecture concepts (lecs 3/4)
Sep. 22	Seed dispersal lab group 2
Sep. 22	**Practice questions 4**
Sep. 23	**Q and A review (quizzes 3, 4)**
Sep. 27	**Practice questions 5**
Sep. 28	Office hours on hard lecture concepts (lecs 5/6)
Sep. 29	Root lab group 1
Sep. 29	**Practice questions 6**
Sep. 30	**Q and A review (quizzes 5, 6)**
Oct. 3	**Submission of voluntary seed collection**
Oct. 4	**Practice questions 7**
Oct. 5	Office hours on hard lecture concepts (lecs 7/8)
Oct. 6	Root lab group 2
Oct. 6	**Practice questions 8**
Oct. 7	**Q and A review (quizzes 7, 8)**
Oct. 9-15	**Reading Week**
Oct. 17	**Submission of the written report on the reproductive strategy of *Glechoma hederacea***
Oct. 18	**Practice questions 9**
Oct. 19	Office hours on hard lecture concepts (lecs 9/10)
Oct. 20	**Practice questions 10, integration 7-10**
Oct. 21	**Q and A review (quizzes 9, 10, integration 7-10)**
Oct. 25	**Practice questions 11**
Oct. 26	Office hours on hard lecture concepts (lecs 11/12)
Oct. 27	**Practice questions 12**
Oct. 28	**Q and A review (quizzes 11, 12)**
Nov. 1	**Practice questions 13**
Nov. 2	Pre-exam office hours review (lectures 1-12)
Nov. 3	**Midterm exam: lectures 1-12**
Nov. 3	**Practice questions 14**
Nov. 8	**Practice questions 15**
Nov. 9	Office hours on hard lecture concepts (lecs 13/14)
Nov. 11	**Q and A review (quizzes 13-15)**
Nov. 15	**Practice questions 16**
Nov. 16	Office hours on hard lecture concepts (lecs 15/16)
Nov. 17	**Practice questions 17**
Nov. 18	**Q and A review (quizzes 16, 17)**
Nov. 22	**Practice questions 18**
Nov. 23	Office hours on hard lecture concepts (lecs 17/18)
Nov. 24	**Practice questions 19**
Nov. 25	**Q and A review (quizzes 18, 19)**
Nov. 29	**Practice questions 20**
Nov. 30	Office hours on hard lecture concepts (lecs 19/20)
Dec. 1	**Practice questions 21**
Dec. 2	**Q and A review (quizzes 20, 21)**
Dec. 6	**Practice questions 22**
Dev. 7	Office hours on hard lecture concepts (lecs 21/22)
Dec. 8	**Practice questions 23 and 24**
Dec. 9	**Q and A review (quizzes 23, 24)**

TBA	Pre-exam office hours review (lectures 1-24)
Dec. TBA (exam period): Final exam (cumulative; lectures 1-24)	

Missed term work policy

If you miss term work (including term tests) 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/ufaqs/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 admin office as well as your course's teaching team.

Academic integrity policy

According to Section B of the University of Toronto's *Code of Behaviour on Academic Matters*, it is an offence for students to:

- use someone else's ideas or words in their own work without acknowledging that those ideas/words are not their own with a citation and quotation marks, i.e. to commit plagiarism.
- include false, misleading or concocted citations in their work.
- obtain unauthorized assistance on any assignment.
- provide unauthorized assistance to another student. This includes showing another student completed work.
- submit their own work for credit in more than one course without the permission of the instructor
- falsify or alter any documentation required by the University. This includes, but is not limited to, doctor's notes.
- use or possess an unauthorized aid in any test or exam.

Violation of the Code of Behaviour on Academic Matters will force the instructor to provide a written report of the matter to the Chair/DeanProvost's and a penalty according to the U of T's guidelines on sanctions will be put into place.

Submission of reports to Turnitin embedded in Quercus

Students will be asked to submit their papers to turnitin as implemented on Quercus 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 Turitin.com reference database, where they will be used solely for

the purpose of detecting plagiarism. The terms that apply to the University's use of the Turnitin.com service are described on the Turnitin.com web site:
(http://www.utoronto.ca/ota/turnitin/ConditionsofUse.html)
Turnitin.com is most effective when it is used by all students; however, if and when students object to its use on principle, the course offers a reasonable offline alternative. The student will then be asked to meet with the course instructor to outline and discuss the report before its final submission to demonstrate the process of creating the report according to the academic integrity policy.

Communication policy

Students are required to regularly and often check their university email to receive announcements relating to the course. To inquire about course-related issues, students are strongly encouraged to solely use their university email, as hotmail or other email providers are spam-filtered on a regular basis. It is the responsibility of the student to make sure his or her email reaches the instructor.

The instructor will not answer any questions related to material discussed in class or during the labs by email (unless it is a clear yes-no answer), but the student is encouraged to ask these questions during official office hours or to schedule a meeting outside office hours by email.

Accessibility

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 the course instructor and/or the AccessAbility Services Office as soon as possible. Enquiries are confidential. The UTSC AccessAbility Services staff (located in S302) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations (416) 287-7560 or ability@utsc.utoronto.ca.

Readings

There is no required reading and no course book, because no single book covers adequately all course topics. The course heavily relies on sources from the primary literature. In case of conceptual problems, students are encouraged to do their own online research, consult the primary sources referred to on the slides or get help from the instructor before or after class or during office hours.

Practice questions

Each of the 24 lectures is associated with a practice quiz containing an average of approximately 40 questions, targeting each slide with actual contents. These questions have two main aims: (1) provide you with the motivation to stay on top of the lectures and (2) help you practice the course material.

In order to earn a maximum of 12% towards your final grade, you need to answer *correctly* each question *within one week of the lecture*. In particular, for a Tuesday lecture, you have until the Monday at 11.59 pm after the Tuesday class. You only get *one try* to solve each question, but there is no time limit and you can leave open your quiz as long as you want (even several days), as long as you don't close the quiz or click the submit button at the end of the quiz.

After the end of the time-period for taking the quizzes for credit, all quizzes will open up again and you can take the quizzes to practice for midterm and final exams. In these for-practice quizzes, you can take

the quizzes as many times as you want. Upon completing a for-practice quiz, you will be able to see the correct solutions for each question.

As you might know from previous courses you took with me, taking these quizzes is a lot of work (but with a big return). I understand that in crunch time, you might not have the energy or time to work these quizzes every week. I am thus giving each of you two weeks' worth of jokers. In other words, for full points, you only need to solve 10 weeks' worth of quizzes and still get the possible max of 12%. But you can also do the full complement of all quizzes (the full 12 weeks) in which case I will only count the best 10 weeks' towards your possible max of 12%.

I will analyze each quiz and identify the questions which were solved poorly (less than 70% correct answer rate). These will be the questions I will discuss in the weekly live Q and A sessions. This Q and A review will be recorded for those of you who cannot attend live, however, this session will greatly benefit from YOUR LIVE attendance! Please drop in and ask whatever course-related questions you might have and/or participate in a joint problem-solving! Students who in 2020 regularly participated in this interactive and relaxed forum felt more connected to the group overall and the course material, were better able to keep up with assignments, did better on the exams, and generally had more fun in the course! Participating also fostered a group feeling, where we got to know each other (among students and students and prof).

Project on reproductive strategy in *Glechoma hederacea* (Creeping Charlie)

Methodology

General information

In a first step and in an online virtual meeting, I will give all of you background information on what this project is about. This will allow you to understand why you will do all following steps, including providing you with the backbone of the paper you are expected to write.

Each student's individual contribution will result in a joint class data set. This class data set forms the basis for a statistical analysis (done by each individual student on their own). The result of this in turn provides the basis for a write-up of a scientific paper worth 12% of your final grade. If you do not contribute to the class data set or miss the deadline to do this without a declaration of the reason for it, you do not get to write the paper assignment and hence forfeit a max of 12%.

This project would normally happen in a supervised lab setting, where your TA would give you instructions on what to do. You would also have access to a dissecting scope, a ruler, tweezers, and plant material which has been collected five months before the lab in May (when the plant flowers) and fixed in 70% alcohol. Using the dissecting scope and a 4-10 times magnification, you would learn how to tell the two genders apart (hermaphroditic and female flowers). Without a dissecting scope, this is very hard to do. Despite this difficulty, I decided to keep the project (for the quality of its data, its intellectual/scientific value and fit to the lecture material), but obviously I had to adapt/simplify it for you to be able to do at home. In this version of the lab, I have determined the gender of the flowers for you. In female flowers, there is only a stigma or style visible, but not anthers (Fig. 1), while in hermaphroditic flowers, both stigma/style and anthers are visible (Fig. 1). Hermaphroditic Glechoma flowers have two sets of anthers, two are hidden away inside the flower corolla and two are just jutting out beyond the flower when ripe (Fig. 1). But unfortunately, it is impossible to see that reliably in a picture...

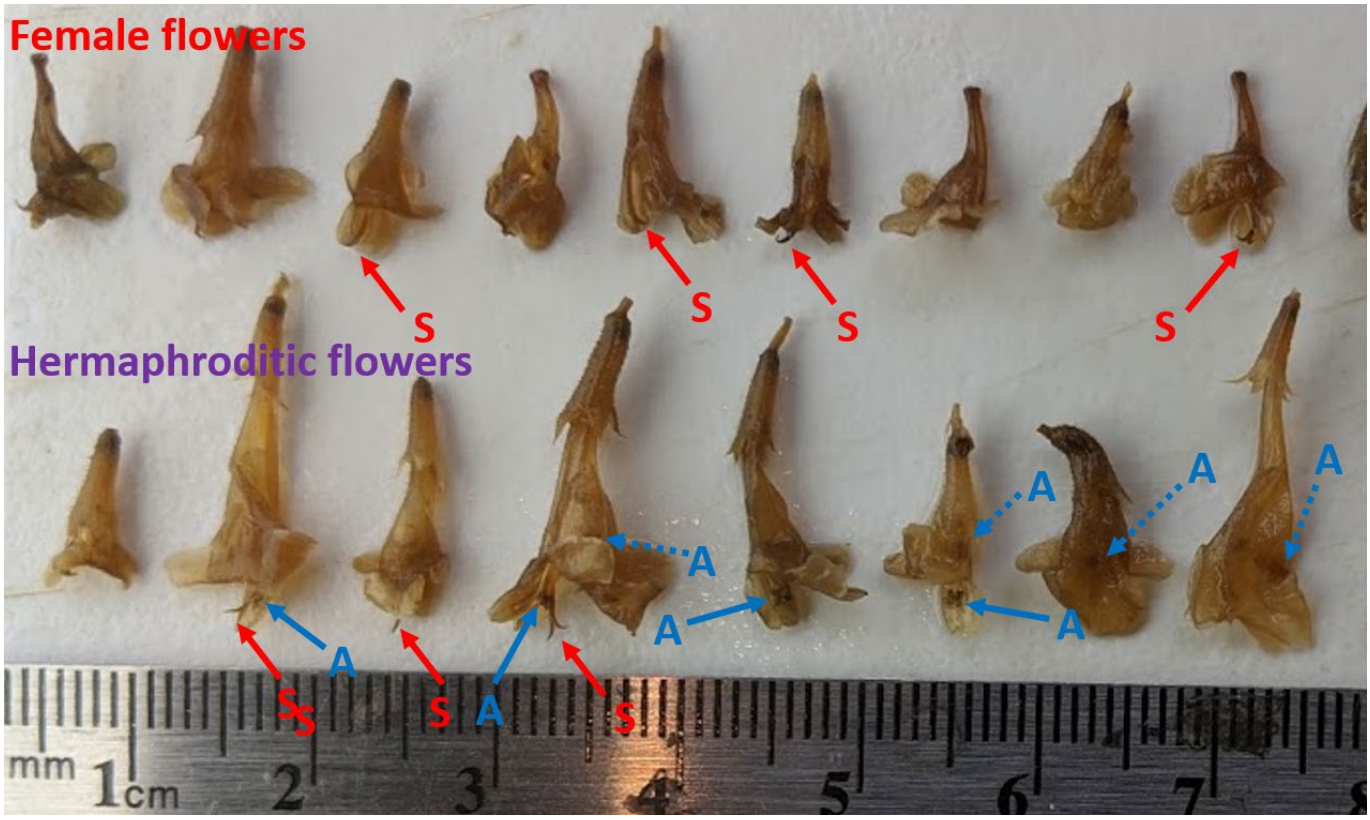

Fig. 1. Example of female and hermaphroditic flowers in *Glechoma hederacea*. Female flowers are lined up at the top and only have female reproductive organs (S), while hermaphroditic flowers at the bottom and contain both female and male flower parts. S stands for stigma (female flower part) and A stands for anther (male flower part). The dotted blue line indicated the anthers which are hidden inside the corolla and which hence are not visible (or only visible sometimes as a dark dot from outside, at least in these flowers fixed in alcohol).

Specific instructions to do the lab in an at-home setting and data submission to TA

(1) You will get access to your own file with pictures of *Glechoma* flowers (each student will get their personal file with a selection of hermaphroditic and female flowers. The flowers have been fixed in alcohol and hence have lost their natural color (blue) and appear brown and somewhat transparent. The photo with the flowers also contains a ruler, so that you know what the relative magnification through your screen is. This will allow you to assess the true length of each flower.

(2) **In your picture, the hermaphroditic flowers are just adjacent to the ruler, while the female flowers are away from the ruler.**

(3) On your screen and using your own ruler, measure the longest length of each flower in mm (red lines in photo; Fig. 2). Keep track of this information, along with the gender of each measured flower.

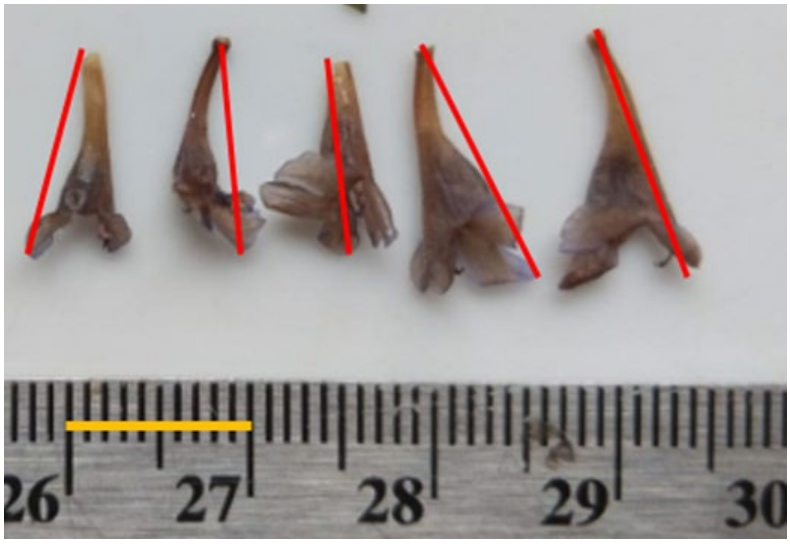

Fig. 2. How to measure the longest length of *Glechoma hederacea* flowers (red line) and how to assess how your computer device might have distorted the magnification (orange line).

(4) Measure how long, on your screen, 10 mm are as shown on the ruler in the picture to adjust for screen size or magnification (orange line). This will allow you to figure out the correction you need to adjust for the true size of the flower. For example: the flower on your screen appears to be 50 mm long, as measured with our own home ruler. In addition, 10 mm on the ruler in the picture appears to be 25 mm long (as measured with your own ruler). The true length of your flower is thus
50 mm [your measured length on the screen] * (10/25 [conversion factor]) = 20 mm [true flower length].

(5) Identify the true length of all flowers in your allotted picture (using the same conversion factor). Along with the flower gender, enter this information into an excel spreadsheet using the table template shown below (Table 1). In a first column, enter the last four digits of your student ID. In a second column, enter the gender of each flower (H: hermaphroditic and F: female flower), and in column 3 enter the TRUE length of the flower (step 4).

(6) Make sure to complete these measurements on the required day (TBA) by midnight. Don't be late… (see 'General information' above). Once your table is assembled, submit it to your TA (TBA) before midnight.

(7) The TA will create the class data set. This data set will be uploaded to our Quercus course folder for you to download (availability: TBA).

Table 1. Please use exactly this layout of the table to submit to your TA, otherwise the TA will have to format everything manually.

Last 4 digits of student ID	Flower gender	True max. flower length [mm]
1234	F	8.0
1234	F	9.5
1234	F	11.7
1234	H	15.3
1234	H	15.8
…		

Steps between your download of the class data set and the submission of your paper

You will have to, using your own time management, run the statistical analysis on the class data set, produce the appropriate figure (Fig. 3), understand and do research on why the two genders have different flower sizes, read enough scientific papers to cite in your paper (see detailed instructions below) and write and submit your paper to turnitin (see detailed instructions below). I would hence strongly recommend that you not leave all the work until the last few days before the paper submission…

Data analysis

Run a T-test comparing the average size of flowers of the two genders. From the analysis, retrieve the mean flower size per gender including standard errors. Use these in your figure of your report. You can either run a T-test with whatever statistical program you are already used to or you can use a free online program, using the following step-by-step instructions.

(1) In your web browser, go to the URL:
http://www.graphpad.com/quickcalcs/ttest1.cfm?Format=C
Read the website thoroughly, and consider what boxes should be selected given the data set.

(2) Choose data entry format: How many rows of data do we have? More than 50, therefore choose the option, "Enter or paste up to 2000 rows."
(3) Enter data:
What labels should you choose? You are comparing between the size of female and hermaphrodite flowers, so use 1 for female and 2 for hermaphrodites as labels. What values do we enter? You can simply copy the rows into the "Values" section of "2. Enter data" from the excel spreadsheet.

(3) Choose a test: What test should you choose? Click on "Help me decide" to determine the test to be used for this analysis. (Hint: use the "Unpaired t test")

(4) View the results: Select "Calculate now". Your analysis is immediately calculated and returned to you on the next page. Make sure to include in your text and figure the standard error (named SEM on the website) and sample sizes. Take the two means and standard errors per species and create two figures in excel.

Figure needed in the report

Create a figure using the following (fake) example (Fig. 3). In particular, you need the average flower lengths and their standard errors. Please note that the standard error for female and hermaphrodite flowers is not the same. You will also have to change the standard excel output to resemble a graph type more commonly used in scientific publications (Fig. 3).

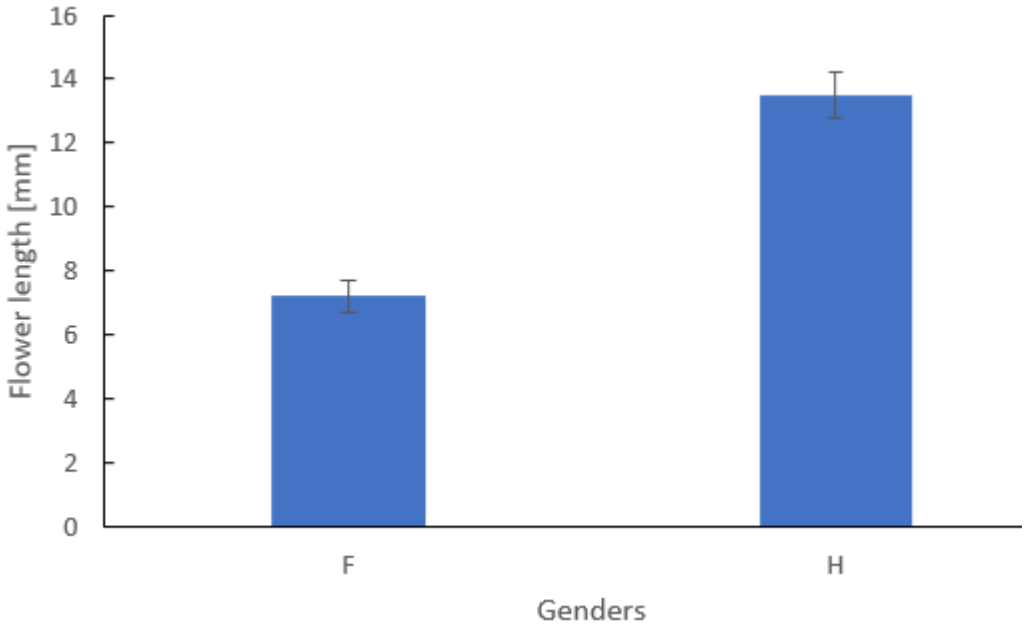

Fig. 3. Overview what type of figure is expected from you in your paper for this project. Note that this figure is based on fake data and you will have to create the figure based on the data provided in the excel file created by the whole class together, assembled by the TA and made accessible to you TBA. After making a standard bar graph, make sure to add the labels of axes. If you do not know how to do this, google for help online ('how to add labels of axes in excel'). Add solid and black lines to the x and y axes. Remove the ugly and unnecessary background lines in the chart by clicking on them and deleting them. Most importantly, add individual error bars. Note that flower lengths of female (F) and hermaphroditic (H) flowers will have differently sized error bars! If you do not know how to do that, watch the 1-min youtube tutorial: https://www.youtube.com/watch?v=OGutc_l0JjE. Add major tick marks to the inside of the Y axis.

WRITING INSTRUCTIONS

The length of the text (references, figures and tables excluded) should be **1200 – 1500** and consist of the following parts

Title
Abstract: maximum of 200 words
Key words: 6
Introduction: approx. maximum of 300
Methods: approx. maximum of 200 words
Results: approx. maximum of 200 words
Discussion: approx. maximum of 600 words
References (do not count toward word count of a report)

Title. Concise title potentially containing the main finding of your study.

Abstract. The abstract should explain to the general reader why the research was done and why the results should be viewed as important. It should be able to stand alone; the reader should not have to get any information from the main paper in order to understand the abstract. The abstract should provide a brief summary of the research, including the purpose, methods, results, and major conclusions. Do not include literature citations in the abstract. Avoid long lists of common methods or lengthy explanations of what you set out to accomplish. The primary purpose of an abstract is to allow readers to determine quickly and easily the content and results of a paper. The following breakdown works well: purpose of the study (1-2 sentences), outline of the methods (1-2 sentences), results (1-2 sentences), conclusion (no introduction to this section, no discussion/guesses, no citations).

Key words. List 6 key words. Words from the title of the article may be included in the key words. Each key word should be useful as an entry point for a literature search if your report were to be published.

Introduction. A brief Introduction describing the paper's significance should be intelligible to a general reader. The Introduction should state the reason for doing the research, the nature of the questions or hypotheses under consideration, and essential background. The introduction is the place where you can show the reader how knowledgeable you are with a given field, without being too lengthy. Close the introduction with your main hypothesis/question(s).

Methods. The Methods section should provide sufficient information to allow someone to repeat your work. A clear description of your experimental design, sampling procedures, and statistical procedures is especially important.

Results. Results generally should be stated concisely and <u>without</u> interpretation. Present your data using figures and tables; guide your reader through them.

Discussion. The discussion section should explain the significance of the results. Distinguish factual results from speculation and interpretation. Avoid excessive review. Structure your discussion as follows. 1. First paragraph - restate your major findings concisely and then relate to the literature. 2. Discuss the problems that might have been present to influence your findings. 3. Compare your findings with those of others; examine why differences occurred and why this may have been so.

References. Use the correct format (also see the formatting of the literature in the course manual). You should search for and read related studies beyond those cited in the overview on a lab and your report should list at least 12 references.

Formatting your report, writing tips

Use the formatting style of the journal of “Ecology.” It might seem tedious to you to have to follow the many rules the journal prescribes, but adhering to one style makes a paper more organized, increases readability and bad formatting typically is a sign that the contents are also of sub-par quality.

Formatting of species names. When mentioning a species in English, also provide the Latin name, at least the first time. Latin names have to be in italics and the first time a Latin name is mentioned, the genus name (first part of the official binary name) has to be spelled out, later on it can be abbreviated,

such as in the following example: “Common milkweed, *Asclepias syriaca*, is a hermaphroditic perennial common to Southern Ontario. The leaves of *A. syriaca* are toxic to cattle.”

Formatting of references. In the body of the text, references to papers by one or two authors in the text should be in full, e.g. Liang and Stehlik (2009) show *blablabla*. Or: *Blablabla* (Liang and Stehlik 2009). If the number of authors exceeds two, they should always be abbreviated; e.g. Campitelli et al. (2008) show *blablabla*. Or: *Blablabla* (Campitelli et al. 2008). If providing more than one reference in brackets, the order should be chronological with the oldest first and the younger ones later. In the case of two studies from the same year, the order should be alphabetical. E.g. Blablabla (Zuk 1963; Korpelainen 1998; Stehlik and Barrett 2005, 2006; Stehlik et al. 2008).”

All references cited (and read by you!) in the main text should be included in “Literature cited.” References should be in alphabetical order and their formatting should follow the format exemplified below.

Citing articles in scientific journals:
Michaels., D. R., Jr., and V. Smirnov. 1999. Postglacial sea levels on the western Canadian continental shelf: revisiting Cope's rule. Marine Geology 125:1654-1669.

Citing whole books:
Carlson, L. D., and M. Schmidt, eds. 1999. Global climatic change in the new millennium. 2nd ed. Vol. 1. The coming deluge. Oxford Univ. Press, Oxford, U.K.

Citing individual articles/chapters in books (if the individual chapters have different authors than the book):
White, P.S. and S. T. A. Pickett. 1985. Natural disturbance and patch dynamics: An introduction. Pp. 3-13 *in* S. T. A. Pickett and P. S. White, eds. The Ecology of Natural Disturbance and Patch Dynamics. Academic Press, San Diego, California, USA.

Citing a webpage (avoid as much as possible, cite a paper or book instead):
IUCN, Conservation International, and NatureServe. 2004. Global amphibian assessment. Available at www.globalamphibians.org. Accessed October 15, 2004.

Formatting of tables. Tables (if present) should NOT be inserted in your text, but follow, one table per page, after your Literature cited. Give a brief description what the table is about (table caption) and introduce the parameters stated in the table in a text inserted above the table (see examples in all project descriptions). The description should be self-explanatory, thus the reader should not be forced to read the main body of text in order to understand the message of a table. Each column and row in the table should be labeled (with units if necessary). If mentioning a species name, provide the spelled out Latin name (in italics). In the table, round numbers to two meaningful digits.

Formatting of figures. The design of a figure should clearly convey a major result, thus scale your data appropriately. Label all axes with sufficiently large font and meaningful labels. Keep it simple; do not use unnecessary elements such as 3D diagrams if not absolutely necessary as based on the data structure. Similarly as tables, figures should NOT be inserted in your text, but follow, one figure per page, after your tables. Give a brief description what the table is about (figure caption) and introduce the parameters stated in the figure in a text inserted below the figure (see examples above). The description

of the figure should be self-explanatory, thus the reader should not be forced to read the main body of text in order to understand the message of a figure. Also, each axis in a plot should be labeled (with units) and each bar in a bar chart should be labeled. If mentioning a species name, provide the spelled out Latin name (in italics).

References to tables and figures in the text. In your text, refer to figures as follows: 'In the spring, temperatures are higher than in the winter (Fig. 1).' Or: Figure 1 shows that temperatures are higher in the spring than in the winter. In your text, refer to tables as follows: 'In the spring, temperatures are higher than in the winter (Table 1)'. Or: Table 1 shows that temperatures are higher in the spring than in the winter.

Formatting of statistical references. In the text, the results of a statistical test should be cited in parentheses, in support of a specific statement. Example: Xylem tension at the top of trees was significantly higher (25 bars) than at the bottom (20 bars) of the tree ($P < 0.05$). When mentioning the result of a statistical test, always provide the P value, R^2 or χ^2 were applicable, mean values, sample sizes and standard errors or confidence intervals. Format your text according to the following example. "There was a significant difference in the frequency of flowering between low and high elevation sites, with greater bias among low than high elevation populations (average flowering frequency: low elevation = 0.93, SE = 0.01; high elevation = 0.78, SE = 0.02; $\chi^2 = 35.04$, $P < 0.0001$; df = 1)."

Miscellaneous. Avoid quotations - paraphrase your sources instead while making sure you are not plagiarizing.

GENERAL GRADING RUBRIC FOR GLECHOMA PAPER

When writing the report, you should also consider the criteria and grading scheme that will used to evaluate your report.

Information content (30%)

This portion of the grade reflects whether or not you have presented and adequately discussed all of the relevant information. This includes background information on the topic being addressed, as well as the information you have gathered (or should have gathered). Specifically, do not forget to include all relevant statistical result parameters, statistical and other tables, data figures and the written explanation of the results. Also make sure you have cited the adequate number of required articles.

27-30: All of the relevant information was included and discussed adequately.
24-26: One of the pieces of information was not included or discussed adequately.
20-23: One of the most important pieces of information was not included or discussed adequately.
15-20: Two or more of the most important pieces of information were not included or discussed adequately.
<15: Little of the important information was included or discussed.

Interpretation and persuasiveness (30%)

This portion of your grade reflects whether or not you interpreted the information correctly and provided persuasive arguments to support your interpretation. Specifically, does your reasoning make sense on its own and also in the light of the published literature, with which you compare your results?

27-30: All of the relevant information was interpreted correctly, and the arguments were very persuasive.
24-26: Most of the information was interpreted correctly, and the arguments were persuasive.
20-23: One of the important pieces of information was not interpreted correctly, or some of the arguments were not persuasive.
15-20: Two or more important pieces of information were not interpreted correctly, and some of the arguments were not persuasive
<15: Little of the information was interpreted correctly, and few of the arguments were persuasive.

Clarity of writing (20%)
This portion of the grade reflects whether or not you wrote your sentences and paragraphs clearly. In particular, do you avoid overly long sentences? Are your paragraphs succinct and mostly dealing with one major line of reasoning each? Do your paragraphs preferably start with an introductory sentence and end with a strong summarizing statement? Do you use scientific terms correctly?

19-20: Very clear
16-18: Mostly clear
14-15: Several unclear sentences
10-13: Many unclear sentences
<10: Few clear sentences

Formatting (10%)
This portion of the grade reflects whether or not you formatted your report well. This includes the overall structure, the references, and the figures and tables (see instructions above).

9-10: The entire report was formatted correctly, and looked very professional.
8-9: The report was formatted correctly, and looked fairly tidy.
7-8: There were a few formatting errors, or one of the relevant questions was not posed in the introduction.
5-7: There were several formatting errors, or several of the relevant questions were not posed in the introduction.
<5: There were many formatting errors, or few of the relevant questions were posed in the introduction.

Spelling, grammar and punctuation (10%)
This portion of the grade reflects whether or not you used correct spelling, grammar and punctuation.

9-10: There were no errors in spelling, grammar, or punctuation
8-9: There were a few minor errors
7-8: There were several minor errors, or a few major errors
5-7: There were several major and minor errors
<5: There were many errors

Voluntary seed collection

After taking the seed dispersal lab, I would like you to go out on your own and into three basic types of natural habitats, as much as possible where you live: oldfield meadows (unruly, colorful high and/or dense meadows), forests and disturbed sites (gravel backyard for example) and collect seeds of wild plants. For this assignment, you are invited to categorize the seeds of wild plants into their dispersal syndromes, resulting in your own seed or fruit collection. It might be helpful for you to go to the closest 'good' (least disturbed) forest in your neighborhood (such as the in the Rouge Urban National Park or in the Highland creek system), to some uncut meadow or old-field (where there are plenty of asters and goldenrods) and some waste sites with gravel. If you go to all three such locations and train your eye for seeds, you should have no problem to ace this assignment.

In class and in the outdoor seed dispersal lab, we will look at eight seed dispersal syndromes: 1: anemochory; 2: ballistochory; 3: splash-seed dispersal; 4: no seed dispersal adaptation; 5: exozoochory; 6: endozoochory; 7: barochory; 8: myrmecochory.

Not all of these dispersal categories are present in the fall or found reliably even if present. In particular, myrmecochorous seeds are only present in the spring (in spring ephemerals in the forest). In addition, it will be very hard for you to find splash-seed dispersed seeds, because these species are so rare and you need to know exactly what species to look for and where they grow. The situation is similar for ballistochorous species. This leaves five syndromes for you to cover.

You will need a total of 40 plant species, covering trees, shrubs and herbs. Skip grasses, but you can include vines. You are required to collect a different number of species per seed dispersal category; more in common categories, fewer in rarer categories. Here is how many different species you need to cover per category:

1: anemochory: 10 ***(must include 3-7 woody and 3-7 non-woody plant species)***
4: no seed dispersal adaptation: 10
5: exozoochory: 5
6: endozoochory: 10
7: barochory: 5

Here is how you should submit your collection: assemble your outdoor loot *by dispersal category* on a white background and take a photo of it. You will thus submit five pictures, one per seed dispersal category. Go for high resolution and as close-up as possible. Maximize light levels. Please also add your student ID onto the table along with your samples (see figure 1 for an example of photos: exozoochorous seeds).

Fig. 1. An example of exozoochorous seeds. Do not forget to add your U of T ID card into the picture. Go for maximum light, high resolution and a close-up.

Root lab

For the root lab, instead of me doing the bulk of talking, YOU will teach your classmates, with the help from me. In particular, I will assign each one of you a small teachable unit which I call an 'Each-one-teach-one' (EOTO). Each EOTO consists of a short text, which I would like you to 'teach' in your own words and without any notes. If you are interested to learn more about your topic, feel free to do that, but do not go beyond what I am providing you in the particular EOTO text, because otherwise the info will be too long and you will lose the attention of your classmates... Some EOTOs are simpler than others (none of them are really hard) and I am assigning them randomly...

For this lab, we will go on a walk in the Highland Creek valley and at appropriate locations and species, I will prompt you to teach your short unit. This material will also be covered in the midterm and final exams, thus it is your responsibility to teach your classmates well... There will also be a brief quiz at the end of the root walk worth a maximum 2%, thus don't snooze while your classmates are talking.

You will get the maximum of 5% if you speak without the help of any notes, you don't get lost and cover what is needed (not less and not more), you will get 2.5% for an intermediate performance and 1% for a poor performance.

If at all possible, I encourage you to come to the walk in person. It will be so much more fun that to stare some more at a screen… If you cannot join the live outdoor lab, you can watch a video of our hike and submit the quiz questions online. Instead of teaching your EOTO live outdoors, you will have to do a backup assignment (TBA) which should take approximately as much time as an average commute to UTSC (to come to the root lab), to do the walk (minus the time of the video recording which you are still expected to watch) and the time you would have spent learning your EOTO by heart, for an approximate total of 3.5 hours.

I will notify you which EOTO you will have to do (TBA).

After the end of the root walk, I will make all texts of the EOTOs available online, as the content is testable.