

PlantS: Life on Edge

BIOC37H



Course Manual

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, hot deserts, inundation, winters, or arctic and alpine environments. Also, students will learn how trees manage to hold two world records, those of being the oldest and largest living organisms on earth. Lastly, case studies will showcase the fact that behavior, a term historically reserved for animals, also applies to plants; plants can sense the identity of their neighbors (above and below ground), plants have elaborate interactions within and across species and even are engaged in prolonged offspring care. 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 four indoor labs, investigating the diversity and function of flowers, leaves, and roots, and experience how plants disperse their seeds on an outdoor hike (rain or shine). In the labs that form an important and mandatory part of the course, (1) students will be required to closely observe and draw plant adaptations in a lab journal (subject to inspection worth part of the final grade); (2) to contribute to a class data set investigating the reproductive strategies of two particular plant species which will form the basis of a written assignment, and (3) hand in quizzes worth part of the final grade covering lab specimens. Because the course heavily relies on course material covered in BIOA01/2H and BIOB31H, students will be expected to brush up on selected topics before particular lectures in preparatory quizzes, worth a portion of the final grade.

Learning outcomes

1. Understand the effect of different limiting environmental conditions and how plants cope with them.
2. Understand 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. Understand 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.

Instructor

Ivana Stehlik

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Office hours: TBA

Lectures and other course material

Lectures will be posted in a dedicated BIOC37H class folder on dropbox, typically 24 hours before class, so you will either need to create a new (and free) dropbox account or you can use your pre-existing dropbox. In order to create your personal 2 GB dropbox account, please follow instructions online found under

<https://www.dropbox.com/pricing>

by choosing the FREE option. Once you own a dropbox account, you will be able to follow the invitation sent to you by the instructor through email to join the dropbox class folder in the first week of classes. This invitation will be sent to your official university email account, so it is vital that you check your email inbox as soon as the course starts (no lecture material will be posted on Blackboard or intranet, so it is in your own interest to get access to all course materials through dropbox ASAP). Lectures will be posted typically the evening before class.

Marks breakdown

| | |
|---|-----|
| Paper on reproductive strategy data set | 20% |
| Writing of long-answer exam question | 10% |
| 3 prep quizzes, worth 2% each | 6% |
| 2 lab quiz worth 1% each | 2% |
| 2 each-one-teach-ones | 4% |
| Midterm | 25% |
| Cumulative final exam | 33% |

Times and location

Course lecture time and place: Tue & Thu 3-4 PM

Lab time and place: Wed, 11 – 2, SW242

Note I: Alternate weeks for the two lab groups (group 1 & 2), if more than 24 students are enrolled

Note II: Stay in your allocated lab group, as lab space is limited. If you have a conflict, talk to Ivana Stehlik

Course schedule/Important dates

| Date | Lecture | Activity |
|-------------------------------|---|--|
| Sep. 6/8 | 1/2 | Course introduction; Pollination I |
| Sep. 7 | Lab 1 | Reproductive strategy lab; group 1 |
| Sep. 13, 11:59 PM | Preparatory quiz 1 on flower morphology on course website on Blackboard | |
| Sep. 13/15 | 3/4 | Pollination II |
| Sep. 14 | Lab 1 | Reproductive strategy lab; group 2 |
| Sep. 20/22 | 5/6 | Seed dispersal syndromes |
| Sep. 21 | Lab 2 | Seed dispersal hike outdoors (rain or shine: come prepared); groups 1 & 2 |
| Sep. 27, 11:59 PM | Preparatory quiz 2 on root morphology on course website on Blackboard | |
| Sep. 27/29 | 7/8 | Survival under low-nutrient conditions: mycorrhiza and rhizobium |
| Sep. 28 | Lab 3 | Root lab (rain or shine: come prepared); group 1 |
| Oct 4, 11:59 PM | Preparatory quiz 3 on nutrient uptake in roots on course website on Blackboard | |
| Oct. 4/6 | 9/10 | Survival under low-nutrient conditions: cluster roots, carnivory, parasitism |
| Oct. 5 | Lab 3 | Root lab (rain or shine: come prepared); group 2 |
| Oct. 11-15 | Reading week | |
| Oct. 18/20 | 11/12 | Survival under dry conditions I |
| Oct. 25/27 | 13/14 | Survival under dry conditions II |
| Nov. 1/3 | 15/16 | Surviving an overabundance of water |
| Nov. 2 | Lab 4 | Leaf lab; group 1 |
| Nov. 8/10 | 17/18 | Survival in the winter |
| Nov. 9 | Lab 4 | Leaf lab; group 2 |
| Nov. 13, 11:59 PM | Submission of paper on plant reproduction | |
| Nov. 15/17 | 19/20 | Arctic/alpine survival |
| Nov. 22/24 | 21/22 | Plant behavior I |
| Nov. 27, 11:59 PM | Submission of long-answer exam question | |
| Nov. 29, Dec. 1 | 23/Q & A | Plant behavior II/ Q & A |
| Dec. TBA (exam period) | Final exam (lectures 1-24) | |

Attendance policy in labs and quizzes

Each lab will contain a quiz which will be handed out at the end of the lab. Unless you attend the lab, you will not be able to submit the quiz (worth 2% each). Only students who contribute to putting together the class data set forming the basis for the reproductive strategy paper will be allowed to write the paper.

If you miss any of these events due to illness or other causes beyond your control, submit, within one week of the missed event, a written request for special consideration to the instructor explaining the reason for missing the event, and attaching appropriate documentation, such as the official University of Toronto medical certificate (www.utoronto.ca/health/form/medcert.pdf).

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.

Missed exams

Students who miss an exam for reasons entirely beyond their control may, within one week of the missed test, submit a written request for special consideration to the instructor explaining the reason for missing the test, and attaching appropriate documentation, such as the official University of Toronto medical certificate (www.utoronto.ca/health/form/medcert.pdf).

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

Students will be asked to submit their papers to **Turnitin.com** 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 Turnitin.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 at (416) 287-7560 or using 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.

2. Lab Project

1. Methodology

1.1. General rule

Follow the detailed instructions communicated to you during labs by the instructor.

1.2. Specific lab instructions and data submission to TA

- (1) Using a ruler, measure in mm the largest length (*Glechoma hederacea*; fused corolla) of a given flower. Keep track of this information in your lab journal.
- (2) Identify whether a measured flower is a female (code: 1; for a unisexual flower) or a hermaphrodite (code: 2; for a bisexual flower) and keep track of this information along with the flower measurement.
- (3) Repeat for all your allocated flowers.
- (4) Enter your data into an excel table using the exact table layout as below (Table 1).
- (5) Submit your correctly formatted data table to the TA by the end of the day of your lab (deadline: 11:59 PM). There will be a penalty of 5% applied to the mark of your paper if your table is formatted differently (and hence the TA will have to manually rework your table in order to create the large class data table) and an additional penalty of 5% if you fail to meet the data submission deadline.

Table 1. Organization of the data table. For the identification of gender, use 1 for females and 2 for hermaphrodites.

| Student name | Largest width/length in mm | Gender |
|--------------|----------------------------|--------|
| Jane | 38 | 1 |
| Jane | 43 | 2 |
| Jane | 39 | 2 |
| Jane | 38 | 2 |
| Jane | 22 | 1 |
| Jane | 24 | 1 |

- (6) The TA will create the class data sets. These data sets will be uploaded to the dropbox course folder for you to download (availability: after Oct 19th).

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

Between Oct 19th and the deadline of the paper submission Nov 16th, you will have to, using your own time management, run the statistical analysis on the two class data sets, produce appropriate figures (one per species), understand and do research on why the two genders have different flower sizes (the same reasoning will apply for both species), 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...

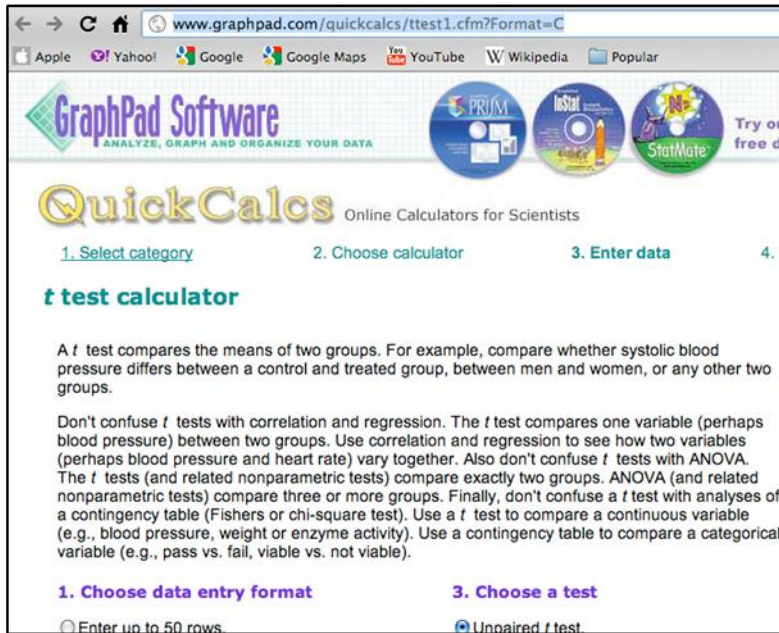
1.4. Data analysis

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, also 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.

1. Choose data entry format

- Enter up to 50 rows.
- Enter or paste up to 2000 rows.
- Enter mean, SEM and N.
- Enter mean, SD and N.

Caution: Changing format will erase your data.

2. Enter data

[Help me arrange the data.](#)

Label:

Values:

| | |
|----|----|
| 24 | 19 |
| 38 | 13 |
| 22 | 39 |
| 19 | 68 |
| 13 | 65 |
| 39 | 11 |
| 68 | 39 |
| 65 | 38 |
| 11 | 21 |
| 39 | 29 |
| 38 | 10 |
| 21 | 68 |
| 29 | 65 |
| 10 | 11 |
| 68 | 39 |
| 65 | 34 |
| 11 | 19 |
| 39 | 38 |
| 34 | 38 |
| 19 | 22 |
| 38 | 19 |

Enter one value per row.

3. Choose a test

- Unpaired t test.
- Welch's unpaired t test (used rarely).
- Paired t test.

[Help me decide.](#)

4. View the results

2. 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 without 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.

2.2. 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.

3. GENERAL GRADING SCHEME FOR REPORTS

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

3.1. 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.

3.2. 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.

3.3. 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

3.4. 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.

3.5. 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

4. WRITING ASSIGNMENT: EXAM QUESTION & ANSWER

4.1. Purpose

The purpose of this assignment is to encourage you to think about course material in a critical way. You will be expected to determine the key points underlying a given block of course material, and then use logic and creativity to design a good question to assess understanding of these points. Finally, you will have to outline a complete answer key for marking your question.

4.2. Overview

This assignment will be completed in a group of 3 or 4 and your group will hand in a single assignment. For this assignment, you must create a written-answer question suitable for an exam along with an answer key for your question, based on assigned material covered in lectures and readings in this course. You may select your own group, or be assigned to a group. Group registration will be at the beginning of lab 2 (September 15). Your topic will also be assigned at this time.

4.3. Due date

November 23, 11:59 PM. No extensions will be granted. Late assignments receive a penalty of 5% per day.

4.4. Evaluation

This assignment is worth 10% of your final mark. Your mark will depend on our assessment of the quality and clarity of your question and answer, and the extent to which it tests understanding of concepts, rather than just straight recall of details (marking rubric see below).

4.5. Equal work-load assessment

To get a mark for this assignment, **each member of your group must hand in a confidential assessment of work-load sharing** in which they briefly outline whether work was shared equally by all group members (this can be hand-written). You must put your full name, student#, and group# on these assessments, which **only** Ivana Stehlik will review. Ivana Stehlik will keep these reports confidential, they will not be read by anyone else, and will be destroyed after final marks are submitted. If everything was fine, then you need only write: 'equal work by all group members'. If you feel that someone in your group did not do their fair share, you should outline the problem, along with the name of this group member. If there is consensus within a group that one member did not do a fair share of the work, then a penalty may be applied to that individual's mark. **Your work-load assessment must be handed in at the same time as the question & answer assignment.**

4.6. Format Guidelines

1. Your question should result in an answer worth approximately 15- 20 marks. Your answer key must clearly indicate which points would receive marks, and the total mark-value of the question.
2. You may construct multi-part questions as long as the parts are related to each other. You may include figures or tables for interpretation questions if you wish.
3. You may refer to real organisms, places, data, or situations, or you may invent hypothetical ones for your question. For example, you may choose to write a question about *Fakus nonsensicus*, a fish that has been recently introduced to Lake Nowhere.
4. This assignment should be between 1 and 1.5 pages long plus one additional page for any figures or tables you may use. Minimum font size is 11pts, and minimum line spacing is 1.5 lines.
5. Your answer key must be clear and understandable, but can be written in point form.
6. The best questions/answers will test understanding of material, rather than straight recall of memorized facts.

4.7. Handing in your assignment

1. Each individual must hand in their own confidential work-load assessment as an email attachment.
2. Each group must also submit ONE digital copy of their assignment via Turnitin.com by the due date).

4.8. Marking scheme (max total 30 pts)

Tests understanding (5 pts max)

- Requires application of concepts to novel data or examples and/or explanation of concepts
- Minimizes straight recall

Integration of topic (5 pts)

- Better: questions focus on narrow topic cover different levels
- Worse

Question & answer are correct (5 pts max)

- Accurate representation of course material and other published data in the subject area

Question would reasonably lead to answer given (5 pts max)

- Interpretation of question is clear
- Informed person in this course would be likely to give answers on key after first exposure to the question

Clarity and quality (5 pts max)

- Grammar, vocabulary and structure contribute to ease of reading and interpretation
- Citations given where needed
- Question is at the right level for this course

Answer has clear and appropriate mark distribution (2.5 pts max)

- Item of more importance or requiring more explanation have higher marks assigned to them than less important or straight recall answers
- Items of similar difficulty have similar mark value.

Creativity (2.5 pts max)

Incorrect length: - 2 to -5 if too long