Botany 330 Take-Home Midterm Exam 2014

I. Introduction. These essay questions are designed to foster integrative thinking, comprehend the peer-reviewed literature, and express findings in a clear way to a peer audience. The essays are meant to model the kinds of short reports that you might write in a future professional situation. In almost any biology-related field, you are likely to be expected to summarize important information for the rest of your work group in a concise, yet readable way, and to do so by mandated deadlines.

In these essays, you are writing for a reader who is a professional and has earned at least an undergraduate degree in biological science, in other words, a peer. ESSAYS SHOULD NOT BE WRITTEN FOR THE GENERAL PUBLIC. Please use technical language and high-level concepts that you have learned in your previous biology courses! Sample essays written by past students will be posted as examples of correct level.

It is important to have your drafts edited by the instructor before you produce the final product. If you comply with specified deadlines and editorial recommendations, you should be able to earn all or most of the available points for essay exams!

It is not advisable to wait until close to deadlines to start writing! You can benefit your work in this and other courses by starting to work on Botany 330 essays right away and continuing to work steadily toward the midterm due dates.

II. Essential components. Each of your answers is expected to combine relevant material from the lectures and textbook with content from a particular, very recent peer-reviewed article, in approximately equal amounts. The textbook reflects compendia of information that you might rely upon in a future professional situation, the lectures reflect authoritative oral information that you might need to include (like the company president’s recent speech), and the peer-reviewed articles display the latest thinking, techniques, and results in a field. Obtaining information from three reliable sources is a good way to cross-check information and detect information that has become outdated.

So, don’t forget to include all three sources of material (text, lectures, article) in your essays. It is common for people to become so focused on the articles that they forget to incorporate text or lecture information.

When discussing articles, it is very important to include at least an overview of methods used in the study, because without that information, it would be difficult for a peer reader to evaluate the accuracy of the results.

III. Getting started. So that we can get everyone on the right track, everyone must turn in a draft answer to the first question by 5 pm on Sept. 23, 2014. Your drafts
must incorporate/integrate: 1) material from the biogeochemistry lecture of Sept. 9 and the biotic associations lecture on Sept. 11; 2) textbook chapters 2, 3, and 6; and 3) the Graham et al. 2013 paper (Lacustrine *Nostoc* (Nostocales)) and associated microbiome generate a new type of modern clotted microbialite. *This first draft essay is so important that 10 points will be deduced from the total for the midterm exam if this draft is late.*

All drafts and final essays must be 1-3 double-spaced pages long, with 12-point type. Upload drafts to the Botany 330 Learn@UW Dropbox into the file marked "midterm exam drafts". Draft essay 1 will be edited and returned via Botany 100’s Learn@UW dropbox by Sept 30, so that you will know how to proceed with the rest of the exam.

In addition to Q 1, undergraduates must also answer 4 of the questions posed below; graduate students must write about any additional 5. It is a graduate school requirement that in mixed courses, graduate students must perform work not required of undergraduates.

**IV. Additional Deadlines.** Drafts of the other 4-5 essays are due on or before October 10. Ten points will be deducted from the potential 100 points if all 5-6 drafts have not been turned in by midnight on this date.

*Please link all 5-6 of your draft essay files together and incorporate your surname in the filename to reduce odds of misplacing files.* It is common for people to upload essays one at a time or to name them cryptically, in which case grading is delayed by the amount of time needed to gather and rename files. Edits will be returned via Learn@UW by Oct. 17, in time to incorporate suggested modifications into drafts of all essays.

**The final version of all midterm essays is due on October 21.** Ten points will be deducted if any portion of the final version of the midterm exam is late.

The purpose of the deadlines and deduction of points if deadlines are missed is to foreshadow processes that occur in workplaces. There are always deadlines in workplaces and consequences for missing them, so by imposing deadlines we are not being mean, but rather trying to foster work habits that will benefit you later.

*Please link all 5-6 of your final essay files together and incorporate your surname in the filename to reduce odds of misplacing files.*

**V. Resources.** Recent publications pertinent to the questions below are provided in pdf form on the lab computer, which you can download to a flash drive for personal use.

The articles were chosen for currency and relevancy to issues of wide concern. The journals represent the highest-rated & most demanding publication sources.
future, these are among the sources you can trust to provide authoritative and carefully peer-reviewed information.

Before starting to write your essays, please read through the document “Editorial Issues” located on the Botany 100 course website. This action may help you to avoid making common errors in English usage. Because this is a Comm B course, essays will be graded on English expression as well as content. We recommend printing out the document and posting it in your workspace for easy reference.

VI. Ethics and scholarly responsibilities. You must cite the article author(s) appropriately within your essays in this form: (Graham et al. 2013). At the end of each essay provide article author names, date, article title, journal name, volume, & pages. It is not necessary for you to cite lectures or the textbook.

You are not expected to obtain additional information for inclusion in your essays, but if you do, make sure that it has been peer-reviewed and cite it. “Peer-review” means that reviewers who are experts in the field have carefully checked the material before publications. Such reviewers often ask authors to clarify confusing statements, provide additional results, or improve data presentation. Most website material has not been peer-reviewed and is often out of date, so consult instructor before using it.

Collaboration with your peers in the composition of these essays is specifically prohibited, though it is perfectly fine to discuss articles amongst yourselves or with instructors.

It is also prohibited for you to have your essays edited or “polished” in any way by anyone other than current Botany 330 course instructors. Don’t ask friends to help or use professional editing services. The reason for this is to ensure than you will receive the maximum practice in writing and revising, to benefit your future success.

You are not expected to necessarily agree with the conclusions of authors; an alternative opinion can sometimes be justified. Essay content should be professionally unemotional. Personal opinion is fine if it can be justified by peer-reviewed literature. Personal attacks on authors (known as ad hominem attacks) are not acceptable.

1. Discuss the physiological role and ecological importance of carbonate rock formation by cyanobacteria. Explain why cyanobacteria form carbonates and what global impacts these carbonate deposits have had through time. In the process, define the terms “microbialite,” “stromatolite,” “thrombolite,” and “microbiome” and provide some examples of beneficial associations between algae (including cyanobacteria) and non-oxygenic bacteria. Use the article by Graham et al. (2013) “Lacustrine Nostoc (Nostocales) and associated microbiome generate a new type of
modern clotted microbialite” to illustrate how cyanobacteria can form carbonate deposits with a little help from their friends.

2. Define symbiosis and mutualism, then describe at least 3 examples of cyanobacteria that are involved in mutualistic symbioses with plant or fungal partners. Explain what materials are exchanged in each symbiosis. Conclude with a discussion of the Thompson et al. (2012) article “Unicellular cyanobacterium symbiotic with a single-celled eukaryotic alga.”

3. Discuss prospects for using algae to generate hydrogen for use as a fuel. Include the advantages and disadvantages of H-fueling systems. Explain what two major types of algae have been investigated for H-production. Describe some of the barriers that have impeded development of algal H-production systems. Conclude with a discussion of the Baltz et al. (2014) article “Plastidial expression of Type II NAD (P) H Dehydrogenase increases the reducing state of plastoquinones and hydrogen photoproduction rate by the indirect pathway in Chlamydomonas reinhardtii.”

4. Briefly summarize the general benefits of using natural microalgae of various types to produce renewable biofuels, focusing on lipids. Then describe at least three classes of stramenopile algae that are known to produce relatively large amounts of lipids. Explain the value of abundant lipids to these particular algae. Finally, discuss the Moody et al. 1014 article “Global evaluation of biofuel potential from microalgae.” If you choose this question, do not also answer question 5.

5. Briefly summarize the general benefits of using natural microalgae of various types to produce renewable biofuels, focusing on lipids. Then focus on the pros and cons of growing microalgal lipid crops as single species versus mixtures of species. Include in your discussion a consideration of pathogens, predators, and variation in efficiency of light absorption, the latter informed by the Stockenreiter et al. (2013) article “Functional group richness: implications of biodiversity for light use and lipid yield in microalgae.” If you choose this question, do not also answer question 4.

6. Discuss methods used to genetically engineer microalgae for industrial use and potential benefits. Also consider the potential ecological impacts of escape of genetically engineered algae into natural aquatic systems. Conclude with a description of work performed by either Daboussi et al. (2014) “Genome engineering empowers the diatom Phaeodactylum tricornutum for biotechnology” OR Trentacosti et al. (2013) “Metabolic engineering of lipid catabolism increases microalgal lipid accumulation without compromising growth.”

7. Discuss the use of attached algal communities to sequester nutrients and thereby improve water quality in engineered systems. Define the term “periphyton” then describe the types of algae that typically occur in periphyton communities. Discuss the potential use of harvested algal biomass. Conclude with a description of the work done by Adey et al. (2013) “Algal turf scrubber (ATS) floways on the Great
Wicomico River, Chesapeake Bay: Productivity, algal community structure, substrate and chemistry."

8. Briefly discuss some (at least 3) of the techniques that are widely used to classify algae, indicating the positive and negative aspects of using structural characters vs molecular characters, or a combination. Conclude with a synopsis of the Buchheim et al. (2013) article “The blood alga: Phylogeny of Haematococcus (Chlorophyceae) inferred from ribosomal RNA gene sequence data” that explains how and what particular characters were used in this phylogenetic analysis.

9. Provide a brief overview of the ecological importance of the cyanobacteria, listing ways in which the cyanobacteria benefit other organisms and ways in which cyanobacteria are regarded more negatively. Discuss the ecological roles of cyanobacterial toxins and other secondary compounds. Discuss the unusual pathways that cyanobacteria use to make toxins. Use the Engene et al. 2013 article “Five chemically rich species of tropical marine cyanobacteria of the genus Okeania gen. nov. (Oscillatoriales, Cyanoprokaryota)” to provide examples of these concepts. If you answer this question, do not also answer question 10 or 11.

10. Provide a brief overview of the ecological importance of the cyanobacteria, listing ways in which the cyanobacteria benefit other organisms and ways in which cyanobacteria are regarded more negatively. Discuss the ecological roles of cyanobacterial toxins and other secondary compounds. Discuss the unusual pathways that cyanobacteria use to make toxins. Use the Kaasalainen et al. 2012 article “Cyanobacteria produce a high variety of hepatotoxic peptides in lichen symbiosis” to illustrate these concepts. If you answer this question, do not also answer questions 9 or 11.

11. Provide a brief overview of the ecological importance of the cyanobacteria, listing ways in which the cyanobacteria benefit other organisms and ways in which cyanobacteria are regarded more negatively. Explain the hypothetical ecological roles of cyanobacterial toxins and other secondary compounds. Discuss the unusual pathways that cyanobacteria use to make toxins. Use the Vestola et al. (2014) article “Hassallidins, antifungal glycolipopeptides, are widespread among cyanobacteria and are the end-product of a non-ribosomal pathway” to illustrate these concepts.

12. Describe the process of nitrogen fixation, specifying which organisms (not just cyanobacteria) accomplish this process and why it is ecologically significant. Then focus on nitrogen-fixing cyanobacteria and discuss how widespread N-fixation is among cyanobacterial species. Conclude with a discussion of the Bench et al. (2013) article “Whole genome comparison of six Crocosphaera watsonii strains with differing phenotypes,” relating the article to previous discussion.

13. Discuss the occurrence of cyanobacteria in extreme habitats, providing at least three extreme habitat examples. Discuss features of cyanobacteria that allow them to survive in these habitats, and why those adaptations interest astrobiologists.
Conclude with a discussion of habitats in which *Chroococcidiopsis* has been found and describe the work of Cumbers and Rothschild (2014) “Salt tolerance and polyphyly in the cyanobacterium *Chroococcidiopsis* (Pleurocapsales).”

14. Describe the controversy surrounding the number of times that primary plastids originated. Include mention of the separate origin of primary green plastids in the rhizarian *Paulinella* vs green algae and land plants. Assuming that primary plastids of the green lineage arose independently of those of red algae and glaucophytes, which is suggested by some molecular phylogenetic studies, what modern plastid-less eukaryote show structural similarities to green algae and thus might represent a lineage ancestral to green algae and plants? Discuss Kim and Archibald (2013) “Ultrastructure and molecular phylogeny of the cryptomonad *Goniomonas avonlea* sp. nov.”

15. Describe what is known about phylogenetic relationships among the phyla classified in Supergroup Alveolata, then focus on dinoflagellate diversity and phylogeny. Discuss the diversity of plastids in the plastid-bearing dinoflagellates and the sources of these different plastids. Use the Butterfield et al. (2013) article “An analysis of dinoflagellate metabolism using EST data” to discuss differences in the mitochondrial metabolism that occur among alveolates. A brief explanation of ESTs and how such data are acquired will be useful to your peer reader.