

Non-vascular plants  
Biology 4630 (Winter 2018) (2-3)

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**Course description:**

This course reviews and builds on the introduction to Cyanobacteria, algae, mosses and lichens offered in the first year botany course. Classification and basic features of these groups of plants will be covered, with emphasis on recent discoveries made regarding their importance in ecosystems and to humans. Labs will be mainly in the form of projects and centered on the lichen herbarium. Oral and written reports and final oral examination will be the basis for evaluation of the depth of learning.

**Curriculum goals:**

**Expand on first year botany introduction** to non-vascular plants. **Improve** scientific thinking and communication skills (essays, class discussions). **Execute** small independent research projects. Since this is a 4<sup>th</sup> year course, I expect you to draw on experiences from other courses and general knowledge based on books and popular media. You will also be expected to start synthesizing your biology knowledge by formulating valid scientific questions, coupled with ideas on how to approach such questions through the scientific method.

**Evaluation:**

1. Mid-term (multiple choice, March 6)	20%
2. Final (oral, first week of exams)	25%
3. Lichen herbarium curatorial work and documentation (April 16 <sup>th</sup> )	25%
4. Essay (due last day of classes)	20%
6. Class participation	10%

The mid-term and final will be based on formal lectures outlined below. In the oral final, you will also be expected to discuss your experience regarding the essays and projects. You will draw a primary and supplementary questions “from a hat” and asked to talk about the topic, and answer questions related to your questions and course work.

**Algae** - main group life cycles and taxonomy - (blue green), green, red, brown, Diatoms  
nitrogen fixation  
fresh water sponges  
response to phosphorus-eutrophication in fresh water and iron in marine systems  
as food / medicine  
source of oil - fossil/modern

**Mosses, liverworts, hornworts** - life cycles, taxonomy  
freezing tolerance  
human uses - sphagnum, other?

**Lichens** - types, taxonomy

pollution sensitivity  
chemistry - dyes, food, medicines  
biogeography - latitudinal vs. altitudinal distribution  
new discovery of yeasts as partners - how was this missed/discovered?

There will be one introductory “lab” on micro/macro photography of algae. This will not be graded, but will permit you to take subsequent independent approach to your own work on the lichens.

Lichen curatorial work and documentation project

Part A – Database and collection organization.

Digital photography is adding a new dimension to collecting living organisms, many of which are becoming rare, and ideally should not be collected if number of individuals in a population is below certain threshold. I am following this tenet with the lichen *Lobaria pulmonaria*, and only “collect” field digital images, in order to ultimately develop a digital map of its occurrence in our region (modern cameras also collect GPS coordinates of where the images were taken). You will be helping with the entry of old LU lichen collection information, based on the physical specimens. This is to learn the basic and classical way of organizing collections, which can now be easily shared electronically with other researchers and organizations.

You will be given one tray of lichen specimen packets, to enter the individual records into a spreadsheet which is nearly 80% completed. Follow the format of the existing records, in other words:

1. Stick as closely as possible to the information available on each of the packets
2. You don't always have to spell out full words - you may shorten directions to abbreviations such as NNW, or the word lake to L or river to R. You may omit punctuation or ignore foreign characters in names. However, keep in mind that researchers elsewhere may not be able to understand TB for Thunder Bay – hence geographical names have to be given fully
3. Dates should be give in the unusual American format of MM-DD-YEAR, because the international North American database is done in this format
4. If information is missing, don't worry, leave the field blank. This will happen with some of the entries for “source” herbarium. I have been leaving Kingston (Queen's U) and Alberta (government, U of C) blank, because it is not clear where these collections currently reside (I believe the Alberta collections are now at the provincial museum in Edmonton).
5. When the data entry is completed, open a new Excel spreadsheet and copy ONLY YOUR section into it, name with your NAME and TRAY number and submit to me

Part B. Digital photography documentation of lichen specimens.

These images will be eventually included in the database, as well as used in a publicly accessible web pages.

You will be working with expensive digital equipment, always under my supervision. NEVER try to change lenses yourself, and be VERY careful placing or removing lens cap, so that you DO NOT TOUCH THE LENS! Be careful with all the cables, I managed to nearly pull the camera out of my hand when I forgot to detach it from the cable(s).

#### Project:

Document as best as you can at least THREE specimens from my Dog Lake road field trip. Arrange for mutually agreeable times to spend time in the lab with me. As a foundation for this project, the field images I took have been placed into OneDrive Cloud site into folders labeled DogLSpot1, 2, 3, etc. Each corresponding to a box or a bag of lichen material collected, sometimes given a more descriptive extension, if more substrates were used to collect from (bark, branch, rock, etc.).

Various temporary image storage locations will exist as you progress, depending on the tool used to generate the picture (camera, stack-shot device, or microscope). One of the bigger challenges (for me at least) is keeping the file storage locations organized and sensibly named and labeled. As a backup, I suggest you copy the more important files to your own computer.

Working with me, start by taking flash shots at f22 (At Macro magnifications using the 24-80mm zoom lens) for the greatest depth of focus. Then move to the keys to start identifying some the more important features of the lichen and photographing them at 1x or 5x magnification (using the specialized manual focus lens). If the identification key requires thallus or ascus sectioning, spore measurements or chemical reactions, move to the microscope camera to document these.

#### ESSAY TOPICS:

Wild populations of caribou (*Tarandus* sp.) in North America are suffering a gradual decline. Various causes for this have been proposed and a fair amount of effort has been put into “managing” caribou in Alaska and Canada. In boreal Eurasia “reindeer” are managed as livestock and even more information is available. Lichens constitute about 50% and 70% of caribou diet in summer and winter, respectively, suggesting a link may exist between lichen biology and their top consumer.

- (1) Has lichen distribution and forage availability changed in boreal North America over the last 100 years? A lot of data are available on this – synthesize into a concise “story” and suggest (with justification) where future work should focus.
- (2) What is the nutritional value of lichen to caribou/reindeer? Most work concentrates on protein (nitrogen) content of forage. Lichens are unique in that fungal cell wall contains nitrogen in the cell wall chitin. Microbes in the caribou digestive tract may be able to convert this nitrogen into nutritionally useable forms of N. Investigate what the literature has to say and outline experiments which would have to be performed to resolve this question.
- (3) Prion disease (i.e. transmissible spongiform encephalopathy, chronic wasting disease, Jacob-Creutzfeldt disease in humans) have been observed in *Tarandus* species. Lichens

have been shown to contain substances inhibiting prion propagation. Survey and summarize literature on this topic, and correlate with (potential) link to caribou decline.

In addition to basic grammar and sentence structure, essay evaluation will focus on the breadth and quality of information you were able to find a survey critically. You are expected to organize the obtained information into a concise (condensed) form presented in a logical structure. YOUR own interpretation (with justifications) of the surveyed information is expected.