

Syllabus
BIOL 4506 – Cactus Biology – Fall 2020

Professor: Root Gorelick
TA: Alec Medd

Tuesday 2:35 pm

CONTACT INFORMATION

E-mail – Use CU-Learn e-mail, otherwise your e-mails may get tagged as ‘junk’.
Phone – I do NOT have access to a phone during the pandemic, so please don’t phone me.

NOTE: Your e-mails must be formal, polite, and proofread in order to guarantee a response from me. I reserve the right to ignore e-mails that are filled with spelling and grammatical errors. Use the automatic spelling and grammar checker, possibly cutting-and-pasting from a word processor. I reserve the right to ignore e-mails that address me only by my first name or otherwise appear overly colloquial. You are here to learn, which includes learning how to effectively communicate with those who evaluate your work.

PREREQUISITE: BIOL 2002 (Plant Form & Function)

COURSE OBJECTIVES

- Learn for the joy of it, with no obvious practical takeaways.
- Understand how much diversity exists, even in a narrow evolutionary slice of the world.
- Appreciate the importance of exceptions in biological theory.
- Detect when biologists are (usually unknowingly) telling adaptationist just-so-stories.
- Think, speak, and write for yourself, saying what you actually believe, questioning authority and eschewing conformity.
- Combine ecology, evolution, systematics, developmental biology, morphology, anatomy, physiology, geography, genetics, and anthropology to study a small taxon.
- Tackle questions for which nobody yet knows the answers and discern when questions are unanswerable.

CAVEATS

I reserve the right to alter this syllabus at any time, but promise to only do so for good cause. If I get hit by a bus or something akin to that, whoever takes over teaching the course also reserves the right to alter the syllabus when they step in. Other than during a pandemic – which itself seems like an extraordinary situation – the only time I previously altered a syllabus during middle of the term was due to a labour strike and consequent loss of a few weeks of labs in BIOL 2002.

OPTIONAL TEXTBOOK

If you are looking for an optional textbook to supplement the course material, I highly recommend the following superb book, which is easy to find both new and used copies for sale online. Given that it was first published 34 years ago, it is unfortunately no longer in print.

The Cactus Primer by Arthur C. Gibson and Park S. Nobel (1986) Harvard University Press.

MY PHILOSOPHY

You should know up front that I am a bit of an anarchist. There exists several classes in biology that foster group work, but this is NOT one of those. Instead, I want to hear your own personal voice. That seems more inclusive, more diverse, and a way for you to develop your own voice and persona. The practical side to that, though, is that if two or more of you seem to mimic one another in written work, be it assignments or the questions each week, I reserve the right to send this to the associate dean for adjudication as a putative plagiarism case. So please remember in this class NOT to be collaborative. I would much prefer to hear as many different opinions as we have students and even for your opinions – if well-grounded – to differ from mine.

ACADEMIC INTEGRITY

Carleton University's Senate defines plagiarism as "presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one's own." This can include:

- reproducing or paraphrasing portions of someone else's published or unpublished material, regardless of the source, and presenting these as one's own without proper citation or reference to the original source;
- submitting a take-home examination, essay, laboratory report or other assignment written, in whole or in part, by someone else;
- using ideas or direct, verbatim quotations, or paraphrased material, concepts, or ideas without appropriate acknowledgment in any academic assignment;
- using another's data or research findings;
- failing to acknowledge sources through the use of proper citations when using another's works and/or failing to use quotation marks;
- handing in substantially the same piece of work for academic credit more than once without prior written permission of the course instructor in which the submission occurs.

Plagiarism is a serious offence that cannot be resolved directly by the course instructor. The Associate Dean of Science will conduct a rigorous investigation, including an interview with the student, if I suspect a piece of work has been plagiarized. Currently, minimum penalties for any violation of Carleton's *Policy on Academic Integrity* are:

- First offence (for anybody other than 1st year students): F in the course
- Second offence: One-year suspension from program
- Third offence: Expulsion from the university

More-severe penalties will be applied in cases of egregious offences, e.g. bribing a faculty member or TA for a better grade would be grounds for suspension from the university.

COURSE COPYRIGHT

My lectures and course materials, including all powerpoint slides, videos, handouts, and similar materials, are protected by copyright. I am the exclusive owner of copyright and intellectual property of all course materials. You may take notes and make copies of course materials for your own educational use. You may NOT allow yourself or others to reproduce or distribute my course materials publicly for commercial purposes without my express written consent.

ONLINE DETAILS

I will post on CU-Learn (with the dreadful acronym ‘CUL’, albeit better than the acronym for its soon-to-be replacement, Bright-Space, which is being called “BS”) pre-recorded lectures as powerpoint recordings with my voice over the slides.

There will be two important times each week: (1) tuesdays at 2:35 pm when we will all convene for discussions in which you will earn participation points and (2) fridays at 11:55 pm which will be the deadline for submitting assignments regarding the past tuesdays’ topics plus submitting questions regarding the following tuesdays’ topics.

Weekly discussions, which include your verbal participation, will be conducted using Zoom (<https://zoom.us/j/94965600622>). These online Zoom discussions will start punctually at 2:35 pm each tuesday, are scheduled for two-hours, but will usually last for an hour-and-a-half.

You will submit weekly written ASSIGNMENTS regarding the previous week’s topic and readings via CU-Learn on or before 11:55 pm each friday night. I will deduct 10% per day for late assignments, with the penalty applied starting at 11:56 pm each friday. Assignments will be posted under the “Assignments” tab in CU-Learn.

Weekly written QUESTIONS regarding the coming week’s reading will also be due no later than 11:55 pm each friday night. Post your questions using the CU-Learn tab labeled “Questions on readings – due each friday at 11:55 pm” using the “Forum” tool. Make these questions that you want to know the answer to and questions for which I have not provided the answers in the pre-recorded lectures. I will NOT allow late submission of written questions. You will only be allowed to see copies of your colleagues’ questions after you submit your questions. Therefore, I encourage you to also look back at all the responses before class on tuesdays.

The assignments and questions that you turn in must be your own work in your own words. If two or more people have effectively the same answers, I will send your papers to the dean for adjudication of possible plagiarism. Transcription of somebody else’s written or spoken words without quotation marks or without citation to the original source constitutes plagiarism. Failure to include quotation marks (or other distinguishing marks) and a full citation constitutes a *prima facie* violation of the university’s academic integrity policy, which will be immediately referred to the dean for adjudication. If two or more students submit qualitatively similar questions or similar assignments each week, I will also refer these to the dean. Copying of someone else’s words but then substituting half of the words therein also constitutes a *prima facie* case of plagiarism. See the *Guardian*’s hilarious article about “sinister buttocks” ([here](#)) for what this might entail, and note that this still would be sent to the dean as a presumptive case of plagiarism.

GRADING

12 Assignments: due each friday after the scheduled class (only 10 highest scores will count)

12 Questions: due each friday before the scheduled class (only 10 highest scores will count)

12 Participation marks: weekly (only 10 highest scores will count)

There are a maximum of 50 points you can earn for the term.

ASSIGNMENTS will count for 60% of your final course mark (maximum 3 points per week).

Written QUESTIONS will count for 20% of your final course mark (maximum 1 point per week).

PARTICIPATION will count for 20% of your final course mark (maximum 1 per week).

Your first weekly questions will be due at 11:55 pm on Friday 11 September 2020, i.e. **before** our first class. Your last weekly assignment will be due at 11:55 pm on Friday 11 December 2020, which is the last of classes for the university. There will be no final exam nor term paper.

Participation will be based on your responses during the synchronous portion of the class starting at 2:35 pm on tuesdays. We will use talking circles for much of this, where we will go in order speaking. I will sometimes announce ahead of time whether you will speak in alphabetic or reverse alphabetic order, either alphabetized by first or last name. Sometimes I will randomize the speaking order. While your speaking order will be controlled, you are free at any time to chime in at any time using the “chat” function on Zoom.

All course marks will be posted on CU-Learn, allowing you to monitor your marks as the course proceeds. Please understand that as the course instructor, I only advise the department chair and dean about what final mark you will receive for the course. The dean makes the final decision on marks. Therefore, there is a chance, albeit a small chance, that the marks you calculate from CU-Learn may be different from the final course mark that you ultimately see from the registrar’s office. I also will NOT post your marks for the final week of class until after the dean and the registrar release final course marks to you.

With one exception described below, you will NOT be allowed to make up any assignments, written questions, or participation marks. I effectively drop the lowest marks in order to account for an occasional absence. Those lowest marks could be zeroes. Plus, it is far less likely that any of us will have to miss class this term because of traveling, especially since you can connect to the internet from almost anywhere. I encourage you to hand in assignments and questions early because there are no make-ups of anything and because the 11:55 pm deadlines are hard and fast. The only way I will extend those deadlines is if there is a CU-Learn outage just before midnight. Therefore, I strongly encourage you to submit your weekly assignments and questions early.

The one exception alluded to above is that you will have the option of submitting an “un-essay” on or before tuesday 1 December, worth a maximum of 5 points to be used in lieu of any single week’s 5 points of assignment-questions-participation. This is NOT extra credit, but must replace a week’s worth of your scores, which could have been scores of zero. This substitution must be for one week of scores, e.g. cannot be divvied up to replace five separate participation marks. An “un-essay” is a creative work of art related to the course material, such as a painting, sculptor, video, poetry, song, etc. Talk with me about various options. You also must be willing to share this “un-essay” with the rest of the class. The reason an “un-essay” is due on 1 December is to provide adequate time to integrate such things into the last day of class on 8 December.

REQUESTS FOR ACADEMIC ACCOMMODATIONS

You may need special arrangements to meet your academic obligations during the term because of disability, pregnancy or religious obligations. Please review the course outline promptly and write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. See the Department of Equity and Inclusive Communities' website to view the policies and to obtain more detailed information on academic accommodation at <https://carleton.ca/equity/>.

For Students with Disabilities:

The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your *Letter of Accommodation* at the beginning of the term, and no later than two weeks before the first scheduled assignment. **Requests made after this deadline will be reviewed on a case-by-case basis.** After requesting accommodation from PMC, please talk with me to ensure accommodation arrangements are made.

For Religious Obligations:

Students requesting academic accommodation on the basis of religious obligation should make a formal, written request to me for alternate dates and/or means of satisfying academic requirements. Such requests should be made during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist, but no later than two weeks before the compulsory event. Accommodation is to be worked out directly and on an individual basis. I will make accommodations in a way that avoids academic disadvantage to the student. For more details, see the Carleton Department of Equity and Inclusive Communities "Student Guide".

Students who have questions or want to confirm accommodation eligibility of a religious event or practice may refer to the Department of Equity and Inclusive Communities' website for a list of holy days and Carleton's Academic Accommodation policies, or may contact an Equity Services Advisor in the Department of Equity and Inclusive Communities for assistance.

For Pregnancy:

Pregnant students requiring academic accommodations are encouraged to contact an Equity Advisor in the Department of Equity and Inclusive Communities to complete a *letter of accommodation*. During the first two weeks of class or as soon as possible after the need for accommodation is known to exist, the student must write to me with any requests for academic accommodation.

FAVOURITE CACTUS HABITATS

I will post several optional lectures. These will NOT be used in grading and will not explicitly help with the weekly written questions, assignments, or participation...except to say that these optional lectures on my favourite cactus habitats will give you greater appreciation for cactus diversity. My hope is to post online optional lectures regarding the following half-dozen places:

- Anthony Gap, New Mexico (and barely into Texas) and nearby Achenbach Canyon, US
- Big Bend, Texas, US
- Cataviña boulder fields, Baja California, Mexico
- Grão Mogul, Minas Gerais, Brazil
- Morro do Chapéu, Bahia, Brazil
- my winter-hardy cactus garden in Ontario

FOUR KEYS TO SUCCESS IN CLASS

Read Mike Dorf's brilliant and still timely 23 August 2010 *FindLaw* column ([here](#)).

Although written about law school, Mike Dorf's article is applicable to any university course.

[<http://writ.lp.findlaw.com/dorf/20100823.html>]

SCIENCE STUDENT SUCCESS CENTER

The "Science Student Success Centre" offers help to all science students, from helping to secure summer jobs, to improving chances at getting accepted to medical school, to helping learn how to improve grades in Carleton science classes. Events include orientation workshops, mini-conferences, science-related events, and one-on-one mentoring.

Voice: 613- 520-2600 ext 3111

Email: sssc@carleton.ca

URL: www.carleton.ca/sssc

APPEALS

If you wish to appeal any grade, please do so via an e-mail to both the professor and TA via the CU-Learn e-mail function and submit this written appeal within one week of us posting the mark. Your e-mail should politely explain in detail how and/or why you think we erred. We will **not** discuss grades on Zoom because it is not a secure platform. By contrast, CU-Learn and Carleton e-mail are considered secure.

SCHEDULE, TOPICS, AND READINGS

Each week we will read and discuss two or three papers on a given topic. Before the weekly discussion, you will have (1) read the papers for that week, (2) watch the pre-recorded lecture on the topic, (3) submitted online one question on the previous Friday evening for each of the two designated papers that week – if there are three papers, the syllabus specifies which ones you are assigned to draft questions on, (4) be prepared to discuss that week's papers and pre-recorded lecture, and (5) submitted online an assignment each Friday evening related to the previous week's topic and papers. Below, you will find the list of topics and papers to be read.

Download the assigned readings early because some of them are somewhat difficult to find on the Carleton Library website. For example, the first week's reading can be found at *Scholars Portal Journals* and my website (<https://rootgorelick.com/21-2/publications-by-topic/cacti-and-succulents/>). The 2002 paper by Hugo Cota-Sánchez is only available from his personal website. Most other papers are available via the links on *Web of Science*.

What is a cactus? What are cacti related to?

15 September

- Nyffeler R, Eggli U, Ogburn M, Edwards EJ (2008) Variations on a theme: repeated evolution of succulent life forms in the Portulacineae (Caryophyllales). *Haseltonia* 14: 26-36.
- Leuenberger BE (2008) *Pereskia*, *Maihuenia*, and *Blossfeldia*: Taxonomic history, updates, and notes. *Haseltonia* 14: 54-93.
- Gorelick R (2009) Odd Opuntias: *Quiabentia* and *Brasiliopuntia*. *Cactus and Succulent Journal* (2009) 81: 162. [no need for written questions on this very short paper]

22 September

- Hernández-Hernández T, Hernández HM, De-Nova JA, Puente R, Eguiarte LE, Magallón S (2011) Phylogenetic relationships and evolution of growth form in Cactaceae (Caryophyllales, Eudicotyledoneae). *American Journal of Botany* 98: 44-61.
- Mauseth JD (2017) An introduction to cactus areoles (part 1 **and** part 2). *Cactus and Succulent Journal* 89: 128-134, 219-229.
- Gorelick R (2011) *Ariocarpus fissuratus* and other cacti at the Dog Canyon trailhead, Big Bend. *Cactus and Succulent Journal* 83: 146-149. [no need for written questions on this paper]

Adaptation to deserts

29 September

- Altesor A, Silva C, Ezcurra E (1994) Allometric neoteny and the evolution of succulence in cacti. *Botanical Journal of the Linnean Society* 114: 283-292.
- Mauseth JD (2006) Wood in the cactus subfamily Opuntioideae has extremely diverse structure. *Bradleya* 24: 93-106.

6 October

- Mauseth JD (2006) Structure-function relationships in highly modified shoots of Cactaceae. *Annals of Botany* 98: 901-926.
- Barthlott W, Porembski S (1996) Ecology and morphology of *Blossfeldia liliputana* (Cactaceae): a poikilohydric and almost astomate succulent. *Botanica Acta* 109: 161-166.

Canadian Cacti

13 October

- Cota-Sánchez JH (2002) Taxonomy, distribution, rarity status and uses of Canadian cacti. *Haseltonia* 9: 17-25. [download this from the author's website at Univ. of Saskatchewan]
- Gorelick R (2015) Northern range limit of *Opuntia fragilis* and the Cactaceae is 56°N, not 58°N. *Madroño* 62: 115-123.

20 October

- Gorelick R, Drezner TD, Hancock K (2015) Freeze-tolerance of cacti (Cactaceae) in Ottawa, Ontario, Canada. *Madroño* 62: 32-44.
- Frego KA, Staniforth RJ (1985) Factors determining the distribution of *Opuntia fragilis* in the boreal forest of southeastern Manitoba. *Canadian Journal of Botany – Revue canadienne de botanique* 63: 2377-2382.
- Gorelick R (2017) *Opuntia fragilis* in the San Juan Islands. *Cactus and Succulent Journal* 89: 197-200. [no need for written questions on this paper]

Reproductive structures and strategies

3 November

- Martorell C, Vega E, Ezcurra E (2006) Morphological consequences of the trade-off between growth and reproduction in a columnar cactus (*Lophocereus schottii*). *Plant Ecology* 183: 125-131.
- Gorelick R (2016) Subdermal woody thorns with secondary growth may support shoots of senita, *Lophocereus schottii* (Cactaceae). *Haseltonia* 22: 18-21.

10 November

- de Almeida OJG, de Souza LA, Paoli AAS, Davis AR, Cota-Sánchez JH (2018) Pericarp development in fruit of epiphytic cacti: implications for fruit classification and macro-morphology in the Cactaceae. *Botany* 96: 621-635.
- Gomes VGN, Quirino ZGM, Machado IC (2014) Pollination and seed dispersal of *Melocactus ernestii* Vaupel subsp. *ernestii* (Cactaceae) by lizards: an example of double mutualism. *Plant Biology* 16: 315-322.

17 November [pick whichever 2 of these 3 papers you want to write questions about]

- Gorelick R (2016) What is a cephalium? *Bradleya* 34: 100-124.
- Zavala-Hurtado JA, Vite F, Ezcurra E (1998) Stem tilting and pseudocephalium orientation in *Cephalocereus columma-trajani* (Cactaceae): a functional interpretation. *Ecology* 79: 340-348.
- Gorelick R, Machado M (2012) Axillary branching of lateral cephalia of *Coleocephalocereus* (Cactaceae). *Haseltonia* 17: 35-41.

Ecology – 24 November

- Drezner TD, Garrity CM (2003) Saguaro distribution under nurse plants in Arizona's Sonoran Desert: directional and microclimate influences. *Professional Geographer* 55: 505-512.
- Bennett JP, Bomar CR, Harrington CA (2003) Lichens promote flowering of *Opuntia fragilis* in west-central Wisconsin. *American Midland Naturalist* 150: 221-230.
- Bowers JE, Webb RH, Rondeau RJ (1995) Longevity, recruitment and mortality of desert plants in Grand Canyon, Arizona, USA. *Journal of Vegetation Science* 6: 551-564. [no need for written questions on this paper]

Evolution/Genetics – 1 December

- Gorelick R (2009) Evolution of cacti is largely driven by genetic drift, not selection. *Bradleya* 27: 41-52.
- Sanderson MJ, Copetti D, Burquez A, Bustamante E, Charboneau JLM, Eguiarte LE, Kumar S, Lee HO, Lee J, McMahon M, Steele K, Wing R, Yang T-J, Zwickl D, Wojciechowski MF (2015) Exceptional reduction of the plastid genome of saguaro cactus (*Carnegiea gigantea*): Loss of the *ndh* gene suite and inverted repeat. *American Journal of Botany* 102: 1115-1127.

Culture – 8 December

- Dyck E, Bradford T (2012) Peyote on the Prairies: religion, scientists, and Native-newcomer relations in western Canada. *Journal of Canadian Studies – Revue d'études canadiennes* 46: 28-52.
- Griffith MP (2004) The origins of an important cactus crop, *Opuntia ficus-indica* (Cactaceae): new molecular evidence. *American Journal of Botany* 91: 1915-1921.