UNIVERSITY OF SASKATCHEWAN

COURSE SYLLABUS

COURSE TITLE:	*Grasses and Grasslands*		
COURSE CODE:	Biol. 424 - CRN: 20036	**TERM:**	02
COURSE CREDITS:	3	**DELIVERY:**	Lecture and Lab
CLASS SECTION: **CLASS LOCATION:** **CLASS TIME:** **WEBSITE:**	1 Room 4C77, Ag. Bldg. Tuesday & Thursday 8:30-9:50 am Accessible via Blackboard on PAWS	**START DATE:** **LAB LOCATION:** **LAB TIME:**	Jan. 5 Room 4C77, Ag. Bldg. Monday 1:30-5:30 pm

Course Description

- A study of the morphology, systematics, phylogeny, biogeography, synecology and autoecology of grasses and other graminoid species, including ecology and management of grasslands.
- Laboratory emphasis is on the structure and taxonomy of grasses and grass-like plants and recognition of representative species of Saskatchewan.

Prerequisites

- BIOL 121 and 222 (formerly 202 or 205); or permission of the instructor.

Learning Outcomes

By the completion of this course, students will be expected to:

1) Understand grass phylogeny and evolution,
2) Recognize and identify grass and grass-like species using dichotomous keys or distinctive morphological traits,
3) Describe grasses, grassland structure and function and understand classification of grasslands,
4) Discuss key concepts of grassland ecology at population, community and ecosystem levels,
5) Demonstrate knowledge of grassland ecology in the context of conservation and management.

Information on literal descriptors for grading at the University of Saskatchewan can be found at: http://students.usask.ca/current/academics/grades/grading-system.php.

More information on the Academic Courses Policy on course delivery, examinations and assessment of student learning can be found at: http://www.usask.ca/university_secretary/council/academiccourses.php.

The University of Saskatchewan Learning Charter is intended to define aspirations about the learning experience that the University aims to provide, and the roles to be played in realizing these aspirations by students, instructors and the institution. A copy of the Learning Charter can be found at: http://www.usask.ca/university_secretary/LearningCharter.pdf.

Course Overview

- In this course students are introduced to grass morphology, physiology, and an overview of its phylogeny and evolution. In addition, the morpho-physiological adaptations, reproductive strategies, and evolution of grasses are investigated along with an exploration of relevant ecological concepts at the population, community and ecosystem levels. We consider key ecosystem processes that shape grassland environments and discuss current issues of grassland conservation and management.
- This course provides a global perspective of grasses and grassland ecology with emphasis on the temperate grasslands of North America.

Class Schedule

Date	Topic	Readings
Jan. 5.	Course introduction	
Jan. 7	Grass morphology	Judd et al. 2016, pp. 312-317
Jan. 11	Lab 1 –Grass morphology, leaf and Kranz anatomy	
Jan. 12	Chromosome evolution in grasses	Hilu, 2004. *Austrl. J. Bot.* 52: 13-22
Jan. 14	Grass leaf anatomy, photosynthetic pathways & adaptations	Kellogg 2001; Edwards et al. 2010
Jan. 18	Lab 2 – Basal lineages of grasses	
Jan. 19	Grass Systematic (Phylogeny) – I	GPWG. 2001. *Ann. Mis. Bot. Gard.* 8: 373-457.
Jan. 21	Grass Systematic (Phylogeny) – II	
Jan. 25	Lab 3 – BEP Clade –Pooideae I (Bromeae, Aveneae & Tritriceae)	
Jan. 26	Reproductive biology in grasses	Soderstrom et al. Ch. 12
Jan. 28	Grasslands of the world	
Feb. 1	Lab 4 –Pooideae II – Other rep. genera of Pooideae	
Feb. 2	North American grasslands	TBD
Feb. 4	Grassland ecosystem – Guest Lecture – R. Vera	TBD
Feb. 8	Lab 5 – PACCAD Clade- Aristidioideae	
Feb. 9	Rare and invasive grasses	
Feb. 11	**Midterm 1 - through Feb. 4**	**TBD**
Feb. 15-19	**Reading Week – No Class**	
Feb. 22	Lab 6 - Panicoideae	
Feb. 23	Guest lecture	TBD
Feb. 25	Guest lecture	TBD
Feb. 29	Lab 7 –Chloridioideae & Centothecoideae	
March 1	Jacey – Range Plants & Grassland Ecosystem - Grazing	TBD
March 3	Jacey - Grassland Ecology - Goods and Services	TBD
March 7	Lab 8 – Arundinoideae and Danthonioideae	
March 8	Jacey - Grassland Restoration	
March 10	**Midterm 2 – through March 8**	
March 14	Lab 9 - Cyperaceae and Juncaceae I	
March 15	Jacey - Grassland Conservation	TBD
March 17	Jacey - Grassland Management & Assessment	TBD
March 21	Lab 10 – Cyperaceae and Juncaceae II	
March 22	Guest lecture – Dr. Eric Lamb	TBD
March 24	Guest lecture	TBD
March 28	Lab 11 - review	
March 29	Economic uses and ethnobotany of grasses	TBD
March 31	Grass domestication I - Corn	TBD
April 4	**Lab 12 – Lab final practicum**	
April 5	Grass domestication II - Wheat	TBD
April 7	Review	

Instructor Information

Dr. Hugo Cota-Sánchez, Professor and Curator

Contact Information

Office: Room 141, Biology Building. ***Tel.*** 966-4405
Email: hugo.cota@usask.ca

Office Hours

TR 10:30 am -1:00 pm, Biol. 141

Instructor Profile

Hugo was born in Mexico. He has a B.Sc. in Biology from the Escuela Nacional de Ciencias Biológicas, M.Sc. in Botany from the Claremont Graduate University, and a Ph.D. in botany from Iowa State University. He was a postdoctoral fellow and research associate at the Missouri Botanic Garden (1998-2000) while simultaneously supervising the DNA sequencing and plant molecular systematics labs at the University of Missouri-St. Louis.

At present, he is a full professor in the Department of Biology and herbarium curator at the University of Saskatchewan, Canada. He has been the recipient of four Teaching Excellence awards. He has taken several administrative roles, including membership in the Cactaceae Specialist Group for the World Conservation Union (1996-), board of directors for the Flora of Saskatchewan Association (2007-), and board of directors for the Canadian Botanical Association (2004-2007).

Hugo speaks English, French, Portuguese and Spanish and frequently travels to Mexico and other parts of Central and South America to conduct collaborative fieldwork. His research interests within the cactus family are: 1) systematics and phylogeny, and 2) reproductive biology, with emphasis in the biology and evolution of viviparity. In his role as curator of the W.P. Fraser Herbarium he conducts floristic, taxonomic, and biodiversity studies dealing with carnivorous plants and other native species of Saskatchewan. His lab and herbarium research programs are funded by national, provincial and international agencies.

Laboratory Instructor

Jacey Bell
Room University of Saskatchewan
email: jacey.bell@usask.ca

Jacey Bell completed her B.Sc. (Hon.) in Biology at the University of Saskatchewan in 2010 and has over 7 years of experience working with plants including positions as a summer research assistant at the Crop Development Centre, and as a botanist at an environmental consulting company. She has gained teaching experience through the Let's Talk Science outreach program and has completed courses in the College of Education. Jacey has worked for the University of Saskatchewan as a teaching assistant for several terms since 2008 and has previously assisted with teaching Biol. 120 labs and tutorials, and Biol. 222 and 424 labs.

Resources

Required:

Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. and M.J. Donohue. 2016. Poaceae. In: *Plant Systematics: A Phylogenetic Approach*, 4nd Ed., Sinauer Assoc., Inc., pp. 312-317.

Leighton, A. 2012. *Sedges (*Carex*) of Saskatchewan.* Flora of Saskatchewan, fascicle 3. Flora of Saskatchewan Association, Nature Saskatchewan, Regina, SK.

Leighton, A. and V.H. Harms. 2014. *The Grasses of Saskatchewan,* fascicle 4. Flora of Saskatchewan Association, Nature Saskatchewan, Regina, SK.

Readings/Textbooks – (Recommended)

Bayliss, J., Helyar, A., Lee, J.T. and Thompson, S. 2003. A multi-criteria targeting approach to neutral grassland conservation. *Journal of Environmental Management* 67(2): 145-160.

Bennetzen, J.L. 2007. Patterns in grass genome evolution. *Current Opinion in Plant Biology* 10(2): 176-181.

Bremer, K. 2002. Gondwanan evolution of the grass alliance of families (Poales). *Evolution* 56(7): 1374-1387.

Briske, D.D. 1991. Developmental morphology and physiology of grasses. *Grazing management: an ecological perspective. Timber Press, Portland, OR*, pp.85-108.

Brown, K.J., Clark, J.S., Grimm, E.C., Donovan, J.J., Mueller, P.G., Hansen, B.C.S. and Stefanova, I. 2005. Fire cycles in North American interior grasslands and their relation to prairie drought. *Proceedings of the National Academy of Sciences of the United States of America* 102(25): 8865-8870.

Clark, L.G. and R.W. Pohl. 1996. *Agnes Chase's First Book of Grasses: The Structure of Grasses Explained for Beginners*, 4th. Ed.

Clark, L.G., Zhang, W. and Wendel, J.F. 1995. A phylogeny of the grass family (Poaceae) based on *ndh*F sequence data. *Systematic Botany* 20: 436-460.

Coupland, R.T. 1961. A reconsideration of grassland classification in the Northern Great Plains of North America. *Journal of Ecology* xxx: 135-167.

Devos, K.M. 2010. Grass genome organization and evolution. *Current Opinion in Plant Biology* 13(2): 139-145.

Donlan, J. 2005. Re-wilding North America. *Nature*: 436(7053): 913-914.

Edwards, E.J. and S.A. Smith. 2010. Phylogenetic analyses reveal the shady history of C_4 grasses. *Proceedings of the National Academy of Sciences* 107(6): 2532-2537.

Edwards, E.J., Osborne, C.P., Strömberg, C.A. and Smith, S.A., 2010. The origins of C_4 grasslands: integrating evolutionary and ecosystem science. *Science* 328(5978): 587-591. doi: 10.1126/science.1177216.

Estep, M.C. et al. 2014. Allopolyploidy, diversification, and the Miocene grassland expansion. *Proc. Natl. Acad. Sci.* 11 (42): 15149-15154.

Fuhlendorf, S.D., Harrell, W.C., Engle, D.M., Hamilton, R.G., Davis, C.A. and Leslie Jr, D.M. 2006. Should heterogeneity be the basis for conservation? Grassland bird response to fire and grazing. *Ecological Applications* 16(5): 1706-1716.

Gibson, D.J. 2009. *Grasses and Grassland Ecology*. Oxford University Press, New York, USA. 305 pp.

Giuliani, A.L., Kelly, E.F. and Knapp, A.K. 2014.Geographic variation in growth and phenology of two dominant central US grasses: consequences for climate change *J. Plant Ecol.* 211-221. p.rtt036.

Grass Phylogeny Working Group. 2001. Phylogeny and Subfamilial Classification of the Grasses (Poaceae). *Annals of the Missouri Botanical Garden* 88(3): 373-457.

Grass Phylogeny Working Group II. 2012, New grass phylogeny resolves deep evolutionary relationships and discovers C_4 origins. *New Phytologist* 193: 304-312. doi:10.1111/j.1469-8137.2011.03972.x

Gould, F.W. and R.B. Shaw. 1983. *Grass Systematics,* 2nd Ed. Texas A&M University Press.

Harrington, H.D. 1977. *How to Identify Grasses and Grasslike Plants.* Swallow Press, USA. 154 pp.

Hobbs, R.J. and Huenneke, L.F., 1996. Disturbance, diversity, and invasion: implications for conservation. In *Ecosystem Management* (pp. 164-180). Springer New York.

Hilu, K.W. 2004. Phylogenetics and chromosomal evolution in the Poaceae (grasses). *Australian Journal of Botany* 52: 13-22.

Hilu, K.W.,2007. A century of progress in grass systematics. *Kew Bulletin* 1: 355-373.

Jacobs, S.W. 2000. *Grasses: systematics and evolution*. CSIRO Publishing.
Kellogg, E.A. 2001. Evolutionary history of the grasses. *Plant physiology* 125(3): 1198-1205.
Knapp, A.K., Blair, J.M., Briggs, J.M., Collins, S.L., Hartnett, D.C., Johnson, L.C. and Towne, E.G. 1999. The keystone role of bison in North American tallgrass prairie. *BioScience*, 49(1): 39-50.
Lambert, A.M., Dudley, T.L. and Saltonstall, K. 2010. Ecology and impacts of the large-statured invasive grasses *Arundo donax* and *Phragmites australis* in North America. *Invasive Plant Science & Management* 3(4): 489-494.
Levy, A.A. and Feldman, M. 2002. The impact of polyploidy on grass genome evolution. *Plant Physiology* 130(4): 1587-1593.
Lynch, D.H., Cohen, R.D.H., Fredeen, A., Patterson, G. and Martin, R.C. 2005. Management of Canadian prairie region grazed grasslands: Soil C sequestration, livestock productivity and profitability. *Canadian Journal of Soil Science* 85(2): 183-192.
Osborne, C.P. 2008. Atmosphere, ecology and evolution: what drove the Miocene expansion of C_4 grasslands? *Journal of Ecology* 96(1): 35-45.
Seastedt, T.R. and Pyšek, P. 2011. Mechanisms of plant invasions of North American and European grasslands. *Annual Review of Ecology, Evolution, and Systematics* 42(1): 133.
Samson, F. and Knopf, F. 1994. Prairie conservation in North America. *BioScience* 1: 418-421.
Simpson, M.G. 2010. Poaceae. In: *Plant Systematics.* 2nd Ed., Elsevier Acad. Press. Amsterdam. pp. 249-258.
Soderstrom, T.R., Hilu, K.W., Campbell, C.S., and Barworth, M.E. (Eds.). 1986. *Grass Systematics and Evolution*. Smithsonia Institute Press.
Stebbins, G.L. 1975. The role of polyploid complexes in the evolution of North American grasslands. *Taxon* 1: 91-106.
Strömberg, C.A. 2011. Evolution of grasses and grassland ecosystems. *Annual Review of Earth and Planetary Sciences* 39: 517-544.
t Mannetje, L., 2006. Grasslands of the world. *Grass and Forage Science* 61(2): 200-201.
Thomson, D. 2005. Measuring the effects of invasive species on the demography of a rare endemic plant. *Biological Invasions* 7: 615-624.
Thorpe, J., Wolfe, S.A. and Houston, B. 2008. Potential impacts of climate change on grazing capacity of native grasslands in the Canadian prairies. *Canadian Journal of Soil Science* 88(4): 595-609.
Vegetti, A.C. and Anton, A.M. 2000. The grass inflorescence. *Grasses: Systematics and evolution*, pp. 29-31.
Watson, L. and Dallwitz, M.J., 1992. *The grass genera of the world*. CAB international.
Willms, W., Adams, B. and McKenzie, R. 2011. Overview: anthropogenic changes of Canadian grasslands. *Arthropods of Canadian Grasslands 2*: 1-22.

Textbooks are available from the University of Saskatchewan Bookstore: www.usask.ca/consumer_services/bookstore/textbooks AND the U of S Sciences library.

Online Resources

Grass Phylogeny Working Group: http://www.virtualherbarium.org/grass/gpwg/
Overview of the Angiosperm Phylogeny Group, and phylogenetic schemes of Monocots, Poales and Poaceae visit: http://www.mobot.org/MOBOT/Research/APweb/welcome.html
Festuca of North America: http://delta-intkey.com/festuca/index.htm
Grass Genera of the World: http://delta-intkey.com/grass/index.htm

Supplementary Resources

- Laboratory handouts will be provided on a weekly basis by the instructor.
- Links to online resources will be provided for reading assignments.

Grading Scheme

REQUIRED EXAMINATION, COURSE WORK, AND GRADING SYSTEM

INPUT	% OF GRADE	IMPORTANT DATES
Theory Mid-term I	15%	February 11
Mid-term II	15%	March 10
Lab quizzes	10%	Every week
Laboratory Final	25%	April 4
Comprehensive Theory Final Exam	35%	April ???

Criteria that must be met to pass

Students must complete all the assignments indicated above. Students who DO NOT complete one or more assignments will receive an "INC" (incomplete) grade

Evaluation Components

See above
MIDTERM 1 and 2 will be written and scheduled during class time (90 min).

All exams will be cumulative, *i.e.*, cover all material studied from the first day of class until the date of the exam. We will, however, emphasize material covered since the last exam. There will also be approximately 5-8 laboratory quizzes (15 minutes each), worth 10% of your final grade.

LABORATORY FINAL – Will last four hours and will be held the last lab of the term. It includes the proper identification of preserved specimens as well as the determination of several subfamilies and genera of the grass family. Taxonomic keys and botanical glossaries will be provided.

Mid-term and final exams:
There will be two mid-term exams. The mid-term and final exams will test material covered in lecture and any of the assigned readings. The exams will include a combination of fill-in-the-blank, short answer questions and essay questions. Material covered from the start of the course up to the date of the exam is eligible to be included on an exam.

Missed exams / Make-up policy:
You must take examinations during their scheduled periods. Make-up tests will be allowed only if there are extenuating circumstances, in which case the test will be given orally. If there is a medical problem that causes a student to miss an exam, the student must contact the instructor *within 3 days* of the exam to provide documentation of the illness and make arrangements for a make-up exam. Failure to do so will result in a zero grade for the exam.

Note that **Laboratory sessions** are very important because that is where you will learn and reinforce a great deal of information about material discussed in lecture.

Attendance Expectations and Participation
Note that: class attendance, participation and overall performance in lecture and lab will also be considered in your final grade.

ABOUT THE LAB

Philosophy – A significant part of the learning experience in this course is in the laboratory portion. This is where we will discuss and debate various ideas, as well as examine fresh materials (flowers!) that will generally not be available to students who miss the lab.

Remember that this is an ***integrative course*** and that lecture and laboratory sessions make up the entire content of this course. Hence, the exams will include material from both components.

There will be no make-up lab sessions!

Integrity Defined (from the Office of the University Secretary)

The University of Saskatchewan is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Student Conduct & Appeals section of the University Secretary Website and avoid any behavior that could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

All students should read and be familiar with the Regulations on Academic Student Misconduct (http://www.usask.ca/university_secretary/honesty/StudentAcademicMisconduct.pdf) as well as the Standard of Student Conduct in Non-Academic Matters and Procedures for Resolution of Complaints and Appeals (http://www.usask.ca/university_secretary/honesty/StudentNon-AcademicMisconduct2012.pdf)

For more information on what academic integrity means for students see the Student Conduct & Appeals section of the University Secretary Website at:
http://www.usask.ca/university_secretary/pdf/dishonesty_info_sheet.pdf

Examinations with Disability Services for Students (DSS)

Students who have disabilities (learning, medical, physical, or mental health) are strongly encouraged to register with Disability Services for Students (DSS) if they have not already done so. Students who suspect they may have disabilities should contact DSS for advice and referrals. In order to access DSS programs and supports, students must follow DSS policy and procedures. For more information, check http://www.students. usask.ca/disability/, or contact DSS at 966-7273 or dss@usask.ca.

Students registered with DSS may request alternative arrangements for mid-term and final examination. Students must arrange such accommodations through DSS by the stated deadlines. Instructors shall provide the examinations for students who are being accommodated by the deadlines established by DSS.