Course Outline for
BIOL 4203/5510 – Evolution of Sex

Instructor: Felipe Dargent, PhD

Class time and location: Tue/Thu 2:35 – 3:55 pm; Canal Building 2400

Term/Year: Winter 2020

Contact Information and Office Hours
e-mail – Use the CULearn e-mail (your e-mails may get lost in my other e-mail accounts)
Office Hours –Tuesday and Thursday 1:00 – 2:15 pm (or by appointment)
Office - Carleton: TBA / U Ottawa: CAREG (20 Marie Curie Pvt) 112

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Course description
The evolution of sex, including meiosis, syngamy, sex determination, sex chromosomes, and gender from organismal, genetic, and developmental perspectives; the origin, maintenance, function, and ubiquity of sex.

Pre-requisites
Introductory Genetics (BIOL 2104) or Fundamentals of Genetics (BIOL 2107).

Learning outcomes
After completing this course you should be able to:
LO 1. Explain general concepts related to the evolution of sex and its consequences.
LO 2. Extrapolate concepts and case studies to novel examples to predict the potential outcomes of ecological/evolutionary interactions and processes.
LO 3. Appraise the adequacy of arguments and empirical or theoretical tests related to the evolution of sex and its consequences.
LO 4. Develop novel questions and tests related to the evolution and ecology of sex.
LO 5. Develop an appreciation of the immense diversity of ways in which sex does, and does not, shape individual behavior.

Class structure
This will be a seminar course on the evolution of eukaryotic sex and its consequences. I expect you to thoroughly read the articles assigned for each class and to participate in class discussions. You are not only responsible for making an effort to understand the readings but should also have a list of comments and questions prepared for the discussion.

Classes will generally follow a four-section structure. First, I will provide an overview of key ideas related to the topic of each class. Second, a student will introduce a paper related to the class topic and provide ideas to motivate the following discussion. Third, you will break into small groups to compare your views, critique, and dissect the paper for class discussion. Finally,

we will converge as a full class again to summarize the most salient points that were debated and review any concepts that remain unclear.

Course materials

There is no course textbook, this course draws extensively from the primary literature. Required readings provide examples of perspectives, experimental assessments and theoretical approaches to central questions on the origin, evolution and consequences of sex. Required readings will be posted on CULearn. Suggested readings provide context for class discussions and give an overview of the key topics that we will cover.

Formal assessment scheme for undergraduate students

Component	**Weight**	**Date**	**Max. Length**
Participation	20%	All classes	Not applicable
Presentation	10%	To be determined	15 minutes
Assignments	15% (5% each, best 3 of 4)	Jan. 28th, Feb. 06th, Feb. 25, Mar. 10th	1 page each
Proposal	15%	February 13th	1.5 pages
Final assignment	40%	April 07th	10 pages

Participation –Your participation in class discussions plays a dual role, it facilitates your learning of the course material and it develops your ability to evaluate and critique science. I expect you to engage in polite discussion with your peers and to provide evidence and/or well reasoned arguments for your views.
-Please read carefully the "Participation evaluation rubric" document in the "Rubrics" folder in CULearn.

Presentation – Once during the semester you and a partner will deliver a 15 minutes talk aimed at presenting and evaluating a paper related to the class discussion topic. This presentation should outline and briefly explain the main theory being addressed by the paper, summarize the specific goals of the authors and the approaches they used to meet those goals, briefly explain the methodology, highlight any results you deem salient, and provide ideas you think should guide your peers' discussion of that day's article.
-Please read carefully the "Presentation guidelines" and "Presentation evaluation rubric" posted in the "Rubrics" folder in CULearn.

Choosing a presentation date: Look at the class schedule below and find a topic (date) you would like to present on, and then have a quick look at the assigned paper for that day to confirm this topic interests you. Go to the forum option "Student presentations" on CULearn ("Week 2") and post the date of the class, your name and your partner's name. Priority will be given on a first-come, first-served basis (if you have not made a choice by Thursday 14th January I will assign you a date for your presentation). Next, carefully look at the primary literature and choose an experimental or theoretical paper relevant to that topic of the class. To give yourself enough time to find another paper if I find your selection inadequate, no later than a week before your

presentation is due, send me and your T.A. a link to the paper you have chosen and a one sentence argument for why do you think this paper is a valuable contribution.

Assignments –There will be four short writing assignments aimed at developing your scientific literacy and preparing you for the final assignment. Through these assignments, as well as the class discussions, you will identify key components of scientific papers related to the evolution of sex and its consequences, dissect the methodology and results, and critique the conclusions to which the authors arrive. Assignments will have a maximum length of 1 page.

Preliminary Proposal – This preliminary research proposal provides both you and me an opportunity to evaluate whether you are on good track for the final assignment. You will be asked to identify a key question related to the evolution of sex, synthesize the state-of-the-knowledge regarding the particular field you will research, state why this questions matters, outline a clear hypothesis and predictions and outline the methods you would use to address your question. The page limit is 1.5 pages (not including references).
-Please read carefully the "Proposal evaluation rubric" posted in the "Rubrics" folder in CULearn.

Final assignment –The final assignment has two parts: (1) a two-page research proposal in which you develop an experimental, observational or theoretical approach to address one fundamental question pertaining any topic you choose related to the course (15% of your total grade); and (2) a seven-page mini-review in which you provide an assessment and synthesis of the subject area being addressed in your research proposal (25% of your total grade). Your review paper should follow the standard structure of a review/opinion paper (see Trends in Ecology and Evolution for examples of review/opinion papers). References are not included in the page count, and you can include one original figure (e.g. predicted outcomes) that will not be considered in the page limit.

Further details, specific to each assignment, will be provided via CULearn and in class. All written assignments should be in done in Times New Roman size 12 font, in A4 paper, 2.54cm margins and 1.5 line spacing.

All written assignments should be uploaded via CULearn before the start of the class on the date they are due in.

Formal assessment scheme for graduate students

Component	**Weight**	**Date**	**Max. length**
Participation	25%	All classes	Not applicable
Presentation	20%	To be determined	30 minutes
Paper outline	5%	March 07th	1-2 pages
Final paper	50%	April 07th	As needed

Participation –I expect graduate students to be engaged and participate enthusiastically in the discussions. They should be prepared to answer questions regarding the papers being discussed and should facilitate/guide their group discussions.

Presentation –I will assign you one class where you will be in charge of a 30 minutes lecture relevant to the topic of the class (see Class schedule). Once we have determined which class you will be in charge of, we should meet one week in advance to review your slides, and make sure that no important subjects are left out.

Final paper –Your final paper can be a review/opinion, meta-analysis or theoretical paper. Depending on which of these options you choose I will give you specific guidelines. You should aim to hand-in a paper that you would potentially submit for publication at a discipline-specific journal.

Course policies

Late submissions –There is a 10% per day penalty for late submissions. An assignment handed in on the due date but after the start of the class has already lost 10% of the maximum attainable grade.

Academic integrity –The University is committed to ensuring fairness and consistency in the completion of all evaluations. As part of this commitment, students are required to follow proper procedures. A student who commits a violation of this policy on an any assignment, or obtains or produces an answer or unfair advantage by deceit, fraud, or trickery, or by an act contrary to the rules of the assignment are subject to the sanction under this Policy.

All written work that you submit must be in your own words and with appropriate citations when referring to someone else's ideas. 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 direct violation of the university's academic integrity policy, which will be immediately referred to the dean for adjudication.

e-mail policy –Use your CULearn e-mail to contact me. This protects your privacy and allows me to identify you as one of my students. I will reply to your e-mail within two business days.

Class schedule and provisional readings

Class	Date	Subject	Suggested Readings	Required Readings
Week 1 Meiosis process and origin				
1	Tue., Jan. 07	Overview A historical perspective	Meirmans 2009 In: Lost Sex; Ch2	
2	Thu., Jan. 09	Definitions and evolution of meiosis	Mirzaghaderi & Horandl 2016 *PRSB* Cleveland 1947 *Science*	Cunningham et al. 2017 *Biol Lett*
Week 2 Costs and benefits of sex				
3	Tue., Jan. 14	Costs	Lehtonen et al. 2011 TREE	Stelzer 2011 *Am Nat*
4	Thu., Jan. 16	Benefits		McDonald et al. 2016 *Nature*
Week 3 Sex determination				
5	Tue., Jan. 21	Diversity and mechanisms	Bachtrog et al. 2014	Pen et al. 2010 *Nature*
6	Thu., Jan. 23	Epigenetic sex differentiation	Beukeboom & Perrin 2014 Ch2	Warner & Shine 2008 *Nature*
Week 4 Haplontic and diplontic cycles – and in between				
7	Tue., Jan. 28†	Haplontic and diplontic cycles an overview	Beukeboom & Perrin 2014 Ch2	Gerstein et al. 2010 *JEB*
8	Thu., Jan. 30	Mating types and sexes		Perrin 2012 *Evolution*
Week 5 Anisogamy				
9	Tue., Feb. 04	Evolution of anisogamy	Cox 2011Ch1 in: Evolution of anisogamy - Cambridge UP	Lehtonen & Kokko 2009 *Beh Ecol Sociobio*
10	Thu., Feb. 06†	Sex roles		Scharer et al. 2012 *TREE* AND Ah-King 2013 *TREE* (Comment) AND Kokko et al. 2013 *TREE* (Reply)
Week 6 Sexual conflict				
11	Tue., Feb. 11	Types of sexual conflict	Parker 2006 Phil trans, Chapman et al 2003 TREE, Bonduriansky & Chenoweth 2009 TREE	Plesnar et al. 2014 *Evolution*

12	Thu., Feb. 13†	Guest Lecture - CHRIS ANGELL		TBA
Week 7				
	Winter Break – Feb 17-21			
Week 8 Sexual selection and mate choice				
13	Tue., Feb. 25†	Mechanisms	Servedio & Boughman 2017 Ann Rev Ecol Evol Syst; Mann & Seehausen 2011 Ecol Lett	Eizaguirre et al. 2009 *Mol Ecol*
14	Thu., Feb. 27	Guest Lecture - LI YUN		Yun et al. 2018 *PNAS*
Week 9 Asexuality?				
15	Tue., Mar. 03	Gynogenesis	Lehtonen et al. 2013 TREE	Choleva et al. 2008 *Phil trans*
16	Thu., Mar. 05	Androgenesis	Schwander & Oldroyd 2016 Phil Trans	Hedtke et al. 2011 *PNAS*
Week 10 Sex and infection				
17	Tue., Mar. 10†	Red-Queen and co-evolution	Lively 2010 J. Heredity	Morran et al 2011 *Science*
18	Thu., Mar. 12	STDs, sex manipulators, infection and sexual selection	Engelstadter & Hurst 2009 Ann Rev Ecol Evol Syst	Joye & Kawecki 2019 ~~Jiggins et al. 2000 *PRSB*~~
Week 11 Same sex sexuality				
19	Tue., Mar. 17	Same-sex sexual behaviour	Bailey & Zuk 2009 TREE;	Hoskins et al. 2015 *PRSB*
20	Thu., Mar. 19	Alternative sexual behaviours		Hird 2006 *Aus Fem Studies*
Week 12 The limits of inference				
21	Tue., Mar. 24	Science, pseudoscience, science denial	Pigliucci & Boudry 2013 Philosophy of pseudoscience – Ch2, 7, 11, 12	Hansson 2017 *Studies His Phil Sci*
22	Thu., Mar. 26	Evolutionary arguments, human sexuality and behavior	Zuk 2013 Paleofantasy Ch7	Puts 2016 *Curr Op Psych*
Week 13 Overview				
23	Tue., Mar. 31	Linking sex to ecological patterns		Neiman et al. 2018
24	Thu., Apr. 02	Final Assignment Workshop		
Week 14 Review				

25	Tue., Apr. 07†	Review		

†Assignment due

Note: For full bibliographic details see the course "Reference list" in CULearn.

Request for academic accommodation

Academic Accommodation

You may need special arrangements to meet your academic obligations during the term. Please review the course outline as soon as possible and write to me with any requests for accommodation during the first two weeks of class or as soon as possible as the need for accommodation is known to exist. For an accommodation request the processes are as follows:

Pregnancy obligation: 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. For more details visit the Department of Equity Services website: http://www.carleton.ca/equity/

Religious obligation: 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. For more details visit the Department of Equity Services website: http://www.carleton.ca/equity/

Academic Accommodations 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 in-class scheduled test or exam requiring accommodation (if applicable). **Requests made within two weeks will be reviewed on a case-by-case basis.** After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website (www.carleton.ca/pmc) for the deadline to request accommodations for the formally-scheduled exam (if applicable).

You can visit the Department of Equity Services website to view the policies and to obtain more detailed information on academic accommodation at http://www.carleton.ca/equity/

Academic support

The Centre for Student Academic Support (CSAS) is a centralized collection of learning support services designed to help students achieve their goals and improve their learning both inside and outside the classroom. CSAS offers academic assistance with course content, academic writing and skills development. Visit CSAS on the 4th floor of MacOdrum Library or online at: carleton.ca/csas.