

# **Biol 420: Seminar: The Evolution of Sex**

**Spring 2009**

**Wed/Fri 1:00 – 2:15**

**Haworth 3012**

**Professor:** Dr. Justin Blumenstiel

**Office:** 7026 Haworth

**Email:** jblumens@ku.edu

**Phone:** 4-3915

**Office hours:** by appointment

**Prerequisite:** Genetics

## **COURSE GOALS:**

The persistence of sexual reproduction is one of the great mysteries of evolutionary biology. This course aims to provide students a broad overview of current research being performed in this dynamic field. We will start from an overview of sexual reproduction at the molecular and cellular level and build on this foundation to explore a range of topics including sexual selection and parent offspring conflict.

This course alternates between lectures and discussions. On Wednesdays I will introduce a topic and on the following Friday we will discuss a scientific paper related to this topic. This alternating format will provide both a foundation of information about current research as well as insight into current controversies and how studies in the evolution of sex are performed.

## **COURSE OVERVIEW:**

**Lecture on Wednesdays – Articles are provided for suggested reading – usually a review.**

**Discussion on Fridays – A required primary article and occasionally suggested supplemental reading.**

**Discussion Questions – I ask that each student bring two to three printed questions to each discussion.**

**Quizzes – 6 small review quizzes about the material will be periodically administered.**

**Discussion Leading – Toward the end of the semester, groups of three to four will lead the class in discussion about a primary paper.**

**Discussion Paper – Before leading the discussion, groups will submit a one page summary of the paper. This is due one week before discussions.**

**Final Paper – A 5-8 page final paper will be due at the end of the semester.**

## **SCHEDULE OF TOPICS AND READINGS**

**F - Jan. 16** *Course Introduction*

**W - Jan. 21** *Sex is the sharing of genes*

Review: Do Bacteria have sex?, 2001, Rosemary Redfield

**F - Jan. 23** Primary Article: Evolution of Natural Transformation: Testing the DNA repair hypothesis in *Bacillus subtilis* and *Haemophilus influenzae* 1993, Redfield

- W - Jan. 28** *Sexual Reproduction is Meiosis: Molecular Mechanisms*  
**\*\*\*\*Quiz**
- Review: Early Decision: Meiotic crossover interference prior to stable strand exchange and synapsis, 2004, Bishop and Zickler
- F - Jan. 30** Primary Article: The hotspot conversion paradox and the evolution of meiotic recombination, 1997, Boulton, Myers and Redfield
- W - Feb. 4** *Sexual Reproduction is Meiosis: The origin and evolution*
- Review: Whence Meiosis? 2001, Villeneuve and Hillers
- F - Feb. 6** Primary Article: Evidence for karyogamy and exchange of genetic material in the binucleate intestinal parasite *Giardia intestinalis*, 2008, Poxleitner, *et al.*
- Primary Supplemental: Population Genetics Provides Evidence for Recombination in *Giardia*, 2007, Cooper *et al.*
- W - Feb. 11** *Diversity and natural history of sexual reproduction.*  
**\*\*\*\*Quiz**
- Review: The evolution of life cycles with haploid and diploid phases, 1998, Mable and Otto
- F - Feb. 13** Primary Article: The parasexual cycle in *Candida albicans* provides an alternative pathway to meiosis for the formation of recombinant strains, 2008, Forche, *et al.*
- W - Feb. 18** *Why is there sexual reproduction? 1: Harmful mutations*
- Review: Why are sex and recombination so common? 2008, Hadany and Comeron
- F - Feb. 20** Primary Article: Sexual recombination and the power of natural selection, 2001, Rice and Chippindale
- Primary Article Supplement: Come Fly, and Leave the baggage behind, 2001, Lenski
- W - Feb. 25** *Why is there sexual reproduction? 2: Adaptation*  
**\*\*\*\*Discussion Groups Assigned**
- Review: A pluralistic approach to sex and recombination, 1999, West, Lively and Read.
- F - Feb. 27** Primary Article: Parasitism, mutation accumulation and the maintenance of sex, 1994, Howard and Lively
- W - Mar. 4** *Evolution of Gamete Size*  
**\*\*\*\*Quiz**
- Review Article: The uncertain evolution of the sexes, 2001, Randerson and Hurst

- Primary Article: The origin of gamete dimorphisms and the male-female phenomenon, 1972, Parker et al.
- F - Mar. 6** Primary Article: Males evolved from the dominant isogametic mating type, 2006, Nozaki *et al.*
- Primary Article Supplement: Oogamy: inventing the sexes, 2006, Kirk
- Primary Article Supplement: The origin of male gametes, 2007, Charlesworth
- W - Mar. 11** *The Sex Ratio*  
**\*\*\*\*Final Paper Topic Due in Class**
- Review Article: Sex Ratios and Social Evolution, 2006, Queller.
- Review Article: Recent developments in sex ratio studies, 1996, Godfray and Werren
- F - Mar. 13** Primary Article: Adaptive sex allocation by brood reduction in antechinus, 1994, Cockburn
- Primary Article Supplement: Extraordinary Sex Ratios, 1967, Hamilton.
- W - Mar. 18** **Spring Break**
- F - Mar. 20** **Spring Break**
- W - Mar. 25** *Sex Determining Systems*
- Review Article: The evolution of sex ratios and sex-determining systems, 2007, Uller *et al.*
- F - Mar. 27** Primary Article: Sex determination and the evolution of dioecy from monoecy in *Sagittaria latifolia* (Alismataceae), 2003, Dorken and Barret
- W - Apr. 1** *Evolution of Sex Chromosomes*
- Review: The evolution of chromosomal sex determination and dosage compensation. 1996, Charlesworth
- F - Apr. 3** Primary Article: In the platypus a meiotic chain of ten sex chromosomes shares genes with the bird Z and mammal X chromosomes, 2004, Grutzner, et al.
- Primary Article Supplement: Resolution and evolution of the duck-billed platypus karyotype with an X1Y1X2Y2X3Y3X4Y4X5Y5 male sex chromosome constitution, 2004, Rens *et al.*
- W - Apr. 8** *Sexual Selection*  
**\*\*\*\*Quiz**
- Review Article: Unifying and Testing Models of Sexual Selection, 2006, Kokko *et al.*

- F - Apr. 10** *Student Led Discussion 1*
- Primary Article: Female Incitation of Male Competition: A Mechanism in Sexual Selection, 1977, Cox and LaBoeuf
- W - Apr. 15** *Sexual Conflict*
- Review: Evolutionary Conflicts of interest between males and females, 2006, Chapman
- F - Apr. 17** *Student Led Discussion 2*
- Primary Article: Experimental removal of sexual selection reverses intersexual antagonistic coevolution and removes a reproductive load, 1999, Holland and Rice
- W - Apr. 22** *Sex and Genetic Parasites*  
\*\*\*\***Quiz**
- Review: The role of selfish genetic elements in eukaryotic evolution, 2001, Hurst and Werren
- Primary Article: Selfish DNA: A sexually transmitted nuclear parasite, 1982, Hickey
- F - Apr. 24** *Student Led Discussion 3*
- Primary Article: Centromere-Associated Female Meiotic drive entails male fitness costs in Monkey flowers, 2008, Fishman and Saunders
- Supplemental: Competitive Centromeres, 2008, Charlesworth
- W - Apr. 29** *Parental Offspring Conflict*  
\*\*\*\***Quiz**
- Review: Genetic Conflicts in Human Pregnancy, 1993, Haig
- F - May 1** *Student Led Discussion 4*
- Primary Article: Testing the Viviparity-Driven-Conflict Hypothesis: Parent-Offspring Conflict and the Evolution of Reproductive Isolation in a Poeciliid Fish, 2008, Schrader and Travis
- W - May 6** Office Hours/Final Paper Discussion
- F - May 8** Stop Day
- F - May 15** Finals Papers Due at my office by 5 PM

## GRADES

Base Score	<b>70 points</b>
5 of 6 quizzes (20 points each)	<b>100 points</b>
Discussion Participation (15 points/discussion)	<b>210 points</b>
Discussion Questions (5 each for handing in)	<b>70 points</b>
Led Discussion Paper (one week before, in class)	<b>100 points</b>
Led Discussion	<b>100 points</b>
Project Topic (on Time)	<b>50 points</b>
Final Paper	<b>300 points</b>
 Total:	 <b>1000 points</b>

## ASSIGNMENTS AND DUE DATES

**March 11<sup>th</sup>:** Final date for the submission of your project topic. This should include:

- 1) A title
- 2) A short (3-5 sentences) description of your paper topic
- 3) Two primary literature publications highly relevant to the topic (see “RESOURCES” below for approaches to paper topic ideas.)

**May 15<sup>th</sup>:** Final paper is due by 5pm

**Friday, one week before your group led discussion:** Led discussion paper – 1 page.

## FRIDAY DISCUSSIONS

Participation is an important part of the class. It is important to remember that if you have question about the material – don’t be scared to ask! I guarantee others have the same exact question. I will give 5 points for attendance and up to 7 more points for participating at least once. 15 points will be awarded for active participation.

If you are shy and want me to call on you, or want some suggestions for participation, let me know.

## DISCUSSION QUESTIONS

Please print out two or three questions to bring to each Friday discussion. These are to be used by you during the discussions and handed in to me after class. 5 points for handing in.

## LED DISCUSSION PAPER

This paper is an approximate one page overview of the article being discussed by your group. If you want, you can all submit one paper or you can submit papers separately. This will be decided by your group. **It is due one week before your discussion, in class.**

A one page summary should include: 1) background, 2) the question being addressed, 3) the evidence supporting the conclusion, 4) the conclusion and 5) outstanding issues.

## LED DISCUSSION

This will be graded as a group. The goal of the discussion is to explore the topic of the paper as well as make sure the paper is clear to the class. I suggest beginning by providing some background if you feel it is necessary and ask the class several pertinent questions to get the

discussion going. Are there any figures that don't make any sense? What are the outstanding questions? What kind of further experiments would be good to perform?

### **QUIZZES**

Over the course of the semester, there will be 6 quizzes (20 points each) covering material from the previous lectures. Quizzes will be given at the beginning of class, and depending on the length/difficulty of the quiz you will be given 15-30 minutes to complete the quiz. Your final grade will include your top 5 quiz scores; the lowest quiz score will be dropped. If you miss a quiz, for any reason, the missed quiz will count as your lowest score. **There will be no makeup quizzes given.**

### **FINAL PAPER**

The final paper is meant to go into a topic of your interest in greater depth. The topic must be different than the one you presented with your group for discussion. The paper is to be five to eight pages long.

A good format for a final paper is to highlight a debate in the literature and pick four or more *PRIMARY* articles that speak to the debate. For such a paper, the recommended format is:

- 1) An overview of the background
- 2) An overview of the controversy
- 3) A review of the literature, *citing specific experiments and the results*, that speaks to controversy.
- 4) A concluding section which attempts to address conflicts between the interpretation of the experimental data.
- 5) Future directions: what are some further experiments that could be done to address this issue.

Note: A paper that addresses a 'controversy' is not necessary. One could also provide a review of several papers that deals in a particular subject that is non-controversial. These types of topics are less "theoretical" and more related to descriptions of a process. For example, you could do a topic comparing the sex determination pathway of two types of nematodes and discuss the evolutionary implications.

For picking topics, a fantastic place to start is with a review articles. These articles will point you to the primary literature. See **RESOURCES** below for more information. If you want help picking a topic, please arrange to meet with me.

A couple notes:

- 1) Figures are encouraged in order to communicate your ideas (either your own figures or figures modified from the literature with proper citation). Note: figures do not count towards page length.
- 2) A bibliography of all papers referenced must be provided.
- 3) The written assignment must be in your own words. The reason pieces of art or writing can be copyrighted but ideas cannot is that it is hard work to fashion an idea into words or images – and copyright acknowledges that contribution of the creator. The same idea

would be expressed in other words by another person – there is no one way to communicate a thought. So you must take from various authors, process the information, produce something that is clearly your own product, and use citations to give credit to the original source for ideas and data.

**Late papers:** 1 letter grade reduction will be given for each day your paper is late.

## **RESOURCES**

### **Library and Research Resources:**

For specific research questions, you have at your disposal two excellent biology research librarians. Please take advantage of their expertise: Keith Russell, 785-864-8828, [krussell@ku.edu](mailto:krussell@ku.edu) (Ecology and Evolutionary Biology), and Ada Emmett, 785-864-8831, [aemmett@ku.edu](mailto:aemmett@ku.edu) (Molecular Biosciences). General library research resources are available at: <http://www.lib.ku.edu/instruction/research/>

### **Searching for scientific literature:**

- The three search engines most useful to you will most likely be **BIOSIS**, **Web of Science**, and **PubMed**. **NOTE: GOOGLE is not a scientific search engine (but see also Google Scholar. It can be used, but it is not as nice as Web of Science).**
- To access **BIOSIS** or **Web of Science**  
Go to <http://www.lib.ku.edu>  
Link to “Databases: articles and more”  
Choose “W” to find Web of Science  
Choose “B” to find BIOSIS  
Enter search terms
- To access **PubMed** go to <http://www.ncbi.nlm.nih.gov/>, choose “search PubMed” and enter search terms.
- All search engines use boolean criteria [and, or, not etc...] to combine search terms.
- An example of a Web of Science Search for a paper topic idea might be:
  - 1) Connect to Web of Science
  - 2) Choose “General Search”Under “topic” enter “**evolution of ant sperm**” and press “search”  
Many papers are retrieved. One is:  
Jaffe, K. The need for sperm selection may explain why termite colonies have kings and queens, whereas those of ants, wasps and bees have only queens. **THEORY IN BIOSCIENCES**, 2008.  
HMMM, interesting! This paper might make a nice jumping-off point for developing a thesis for your research project. If you want to refine your search to reviews, please see the options on the left. **NOTE:** that in Web of Science you can look at all the papers that were cited in a given paper, as well as all the papers that have cited that paper since its publication (a very valuable tool!).

### **Retrieving scientific papers:**

In web of science you can use the “*KULink*” button to go directly to PDFs of journal articles that interest you. Otherwise:

- 1) determine if KU has access to the journal of interest for the publication year. Go to <http://www.lib.ku.edu/ejournals.shtml> and enter the title “Journal of Experimental Zoology Part B”. Lucky for us, the library has access e-access to this journal from 2003 – present. Click on the link to take you directly to the e-journal, find volume 304B, issue 1, page 86, and download the PDF of the article to your hard drive.
- 2) If KU does not have e-access, the hard copy may be in the stacks. Go to the electronic library catalog at: <http://catalog.lib.ku.edu/cgi-bin/Pwebrecon.cgi?DB=local&PAGE=First> and search for the journal title. Check that the volume and issue numbers match the article you need.
- 3) A great service of the KU library is electronic document retrieval. If the library has the article you need in the stacks, you can have it scanned and retrieve it as a PDF. If the library does not have the article you need you can request an electronic copy. The library will find another library with the article, have it scanned and you will be able to retrieve it as a PDF. These services usually just take a couple of days, and can be found at: <https://illiad.lib.ku.edu/KKU/>

**Endnote:** Endnote is a great software package for managing your references. If you don’t already use Endnote (or RefWorks – I don’t have any experience with RefWorks, so cannot comment on its utility), I highly recommend that you start now. The sooner you learn reference management software the easier your life will be in the future. To install, learn to use and troubleshoot Endnote and RefWorks go to: <http://www.lib.ku.edu/research/writing.shtml>

**The KU Writing Center:** The KU writing center is another great resource at the university. They are there to help you not only with your grammatical problems, but also with the logical structure of your term paper and presentation. Please don’t hesitate to take advantage of this resource.

**Academic Computing Services:** In addition, should you need help with PowerPoint, the Academic Computing Services offers training documents. See <http://www.technology.ku.edu/documentation/index.shtml?powerpoint> for details.