

## BI594 Topics in Biology – Spring 2020 “Sex, sexes, and sexual phenotypes”

Instructor: Prof. Karen Warkentin

Office: BRB Room 500

Email: [kwarken@bu.edu](mailto:kwarken@bu.edu)

Lab website: <http://sites.bu.edu/warkentinlab/>

Office hours: Mon & Wed at <https://karen-warkentin.youcanbook.me/>

Class times: Mon & Wed 4:30–6:15 pm

Location: BRB Room 115

Course credits: 4

**Course Description:** The evolution of sex was a major event in the history of life, facilitating adaptation and the diversification of life, including the evolution and differentiation of sexes and a wide variety of sex-related phenotypes. The biology of sex thus offers opportunities to study fascinating, cutting-edge questions in evolutionary and developmental biology. However, our understanding of the biology of sex and sexes has clearly been affected by human social expectations and biases, changing dramatically with social changes and the incorporation of different perspectives and research questions; this expansion of perspectives is ongoing. The biology of sex thus also serves as an excellent area to critically examine science as a human process. In this course, we will attempt to build a more inclusive understanding of the diversity of sexual biology by examining foundational questions about sex as well as new research that challenges conventional perspectives and is shifting our understanding of sexual variation, in humans and other organisms. One goal is to improve our ability to ask questions and design and evaluate research, considering all the variation. A second goal is to develop ways to use biology to improve inclusion in education. We will also develop resources to make this information more accessible to others. Students will actively participate in finding relevant papers and determining the specific topic coverage through the semester. They will also explore an area of their choice in depth through a research paper, developed in stages with peer and faculty feedback. We will share our work within the class through presentations and discussions. We will share our work outside the class through an online annotated bibliography and Wikipedia editing. Grading weights will be determined in consultation with students when the course begins.

**Prerequisites/background:** This is a 500-level Biology course designed for seniors and graduate students. Participants must possess sufficient biological background in evolution, development, physiology and/or behavior to engage deeply with the material (e.g., a 300+ level course in one or more of those areas). Students must also have a commitment to active participation and a willingness to critically examine assumptions.

**Readings:** Selected primary & review papers & book chapters. Readings will be posted on the course Blackboard Learn site. We may also use a shared course Google Drive, that will be accessible through your BU Google site. **The specific topics covered, time allocation per topics, and papers to read will be determined with input from course participants. See initial Topic List, P. 6.**

**Wikipedia editing – enroll in our class on Wikipedia Education at:**

[https://dashboard.wikiedu.org/courses/Boston\\_University/Sex,\\_sexes,\\_and\\_sexual\\_phenotypes\\_\(Spring\\_2020\)?enroll=xwpnidak](https://dashboard.wikiedu.org/courses/Boston_University/Sex,_sexes,_and_sexual_phenotypes_(Spring_2020)?enroll=xwpnidak)

## Course objectives:

### 1. Build core knowledge of sex-related evolutionary and developmental biology, including

- current understandings
- areas and concepts currently in flux or in debate
- historical changes in sex-related research and their relation to other social changes

### 2. Practice and build skills to

- integrate knowledge across disciplinary areas and approaches
  - improve understanding, identify gaps and discrepancies
  - develop creative approaches to answer questions
- critically examine science as a human process
  - ask questions and design and evaluate research in ways that include all the variation
  - consider ways to acknowledge and minimize impacts of bias, while building knowledge
  - include diverse scientists and human perspectives in science
- communicate science
  - to other scientists, orally and in writing
  - to a broader/lay audience

## Course format, pedagogy, and approach to learning:

We'll meet twice a week, for 1 h 45 min each time. At most meetings our time will be split between two kinds of activities. These will include lectures, discussions, individual presentations with peer feedback, and group work such as concept mapping, critical analyses, etc. ***This is a brand new course, which I (as your professor) and we (as joint participants in this collective learning endeavor) will be developing as the semester progresses.*** As such, your active participation is absolutely essential, both in engaging with the course *content* and to give me feedback on what is/is not working for you, what you want more/less of, etc., in terms of *process*. I cannot promise it will be exactly how you want it to be, or that we can optimize it simultaneously for all participants, but let's do our best to make this what we want it to be. Your open communication will be a key part of that. Assuming this experiment is successful, I will submit a formal proposal for this course to become a regular Biology Department offering.

**Graded Elements:** You will be graded on 5 different kinds of activity.

#### 1. Journal paper presentations

#### 2. Research project, paper & presentation

#### 3. Brief commentaries on readings

#### 4. Wikipedia editing contributions

#### 5. Peer reviews of your colleagues Wikipedia contributions & draft papers

***Note: The set of graded elements, grading breakdown across elements, number of paper presentations, and number of reading commentaries was determined in consultation with students on Jan. 22. For more details, see Grading section, P. 7–8.***

## **Resources and support for success in this course:**

**Meetings with me** (i.e., “office hours” – the most underutilized resource at BU) — You can book meetings Monday or Wednesday though <https://karen-warkentin.youcanbook.me/>. If the times available there don't work for you, email me, talk to me before/after class, or just stop by my office when you're in the building and I'll figure out a time we can meet that works for you. *You'll need to meet with me individually multiple times through the semester to discuss and plan for your presentations, project, and Wikipedia editing work.*

Accommodations for Students with Documented Disabilities — If you are a student with a disability or believe you might have a disability that requires accommodations, please contact the Office for Disability Services (ODS) at (617) 353-3658 or [access@bu.edu](mailto:access@bu.edu) to coordinate any reasonable accommodation requests. ODS is located at 25 Buick Street on the 3rd floor.

## **Community of learning: Course and University policies**

**Mutually respectful learning environment** — This course may challenge participants' assumptions about sex, gender, and sexuality, as well as our prior understanding of the biology of these topics, particularly for areas that are rapidly changing. We will discuss material that may have personal and/or social/political dimensions that different members of the class experience or relate to differently. Diversity of perspective and opinion is expected and welcome in the class. Social science research supports that such diversity improves information processing, complex thinking, problem-solving, creativity, etc., and that interacting respectfully with others unlike ourselves improves the performance of both majority group members and minorities; thus human diversity improves science and other fields. To enable us all to reap the benefits of our intellectual, experiential, and identity diversity, we will commit to mutually respectful discourse.

**Preparation, personal responsibility, and workload** — To get the most out of course meetings, students must (1) come prepared: read the assigned papers thoughtfully and bring your ideas, insights, questions and critiques to discuss with colleagues in class; (2) take responsibility for your own learning: communicate your interests and priorities to help shape our topic coverage and your insights and confusions as we discuss those topics, dig deeply into research for your project; (3) work hard: we will all invest substantial effort into finding and evaluating literature, read a lot, work hard to understand and integrate it, and develop ways to share it with each other and more broadly. I expect that for many class meetings we will all read multiple papers (depending on length), that individuals will read more to find papers to present, and you'll also read for your research project and Wikipedia editing project. This is a 500-level class, so expectations are high, but do tell me if you find the reading level unmanageable.

**Attendance & Absences** — Attendance at all class meetings is expected. It is important both for you to learn the course material and transferable skills as well as for your contributions to our collaborative learning community. In the event that you must miss a class meeting unexpectedly (e.g. illness, family emergency, etc.) please notify me as soon as possible: [kwarken@bu.edu](mailto:kwarken@bu.edu). For anticipated absences (e.g. religious observance, varsity sports) please let me know early in the semester to minimize disruption to our presentation schedule.

**Assignment Completion & Late Work** — Work must be completed and submitted on time. Late work will not be accepted without excellent justification. Drafts submitted late may receive no or minimal feedback (peer and/or professorial); to avoid this submit on time or negotiate any adjustment in advance so your reviewers can plan. Presentation schedules represent an agreement with the entire class and may be highly disruptive to rearrange; please stick to the schedule but if something *truly inevitable* and *unforseeable* happens to disrupt this, communicate as soon as possible.

**Academic Conduct** — All students are expected to understand and follow Boston University’s Academic Conduct Code: <https://www.bu.edu/academics/policies/academic-conduct-code/> To empower identification and self-correction of plagiarism *prior* to submitting written material for grading, students will have access to the **Turnitin.com** plagiarism-detection website. All cases of suspected academic misconduct will be referred to the appropriate Dean’s Office.

**Resources to manage personal and interpersonal challenges** — Challenges to our assumptions can feel uncomfortable, and this stress may be magnified when topics studied are deeply connected to the ways we understand ourselves. Moreover, even individuals intending respectful discourse sometimes say things that unintentionally hurt others. If you are concerned about this in relation to course material or classroom interactions, please talk with me.

For additional support, counselors are always available to students at Behavioral Medicine (617-353-3569, <http://www.bu.edu/shs/behavioral/>) and the Sexual Assault Response and Preventions Center (617-353-SARP, <http://www.bu.edu/sarp/>).

Day	Date	Timeline of Wikipedia Editing & Research Paper assignments
Fri	31-Jan	<a href="#">Wikipedia signup &amp; basic training</a>
Fri	7-Feb	<a href="#">Wikipedia article evaluation</a>
Fri	14-Feb	<a href="#">Possible Wikipedia topics identified, editing rules &amp; advice</a>
Fri	21-Feb	<a href="#">Wikipedia topic finalized, practice adding to an article</a>
Mon	24-Feb	Research project – topic application
Fri	28-Feb	<a href="#">Wikipedia start drafting in sandbox, training on plagiarism &amp; sandbox</a>
Fri	6-Mar	<a href="#">Wikipedia peer reviews on initial drafts due</a>
Fri	20-Mar	<a href="#">Wikipedia response to peer reviews, move out of sandbox</a>
Mon	23-Mar	Research paper draft due for peer review
Wed	1-Apr	Peer reviews of research papers due
Fri	3-Apr	<a href="#">Wikipedia final article &amp; reflection paper due</a>
Fri	17-Apr	Final paper due

**Presentation dates (for journal papers & research project) will vary** – we’ll do 3 rounds of journal paper talks, so everyone does their first talk before we start second talks, etc. **For reading commentaries, please submit them soon after reading papers** – within a week for readings assigned or supplementary for classes. Start submitting commentaries by 24 Feb.

**My approach to this material** – I am broadly interested in developmental and evolutionary diversity and seek to understand the causes and consequences of patterns of phenotypic variation – of which binary differences are just one part. I consider that both oversimplification of more complex variation and overemphasis on sex as an explanatory factor sometimes misleads us. However, the current focus on “sex differences” in biology and medicine is part of a necessary attempt to rectify a historical focus on males, which has led to a disproportionate lack of information on females. An alternative approach to this problem is sometimes to simply focus on females. Moreover, the biology of sex is often presented in (over)simplified ways that reflect and reify social norms and limit opportunities to understand biological diversity. Human social norms also affect the questions biologists ask – and don’t ask – and how research results are interpreted. Thus they affect the current state of our knowledge. The more I learn about sexual and reproductive biology, the more wary I become of (over)generalizations. Some things I was taught – and that I myself taught to prior students – have turned out to be either wrong or simply not general, often in ways that centered (a subset of) mammalian biology as the norm, or that fit societal notions better than do more complex natural patterns. Sometimes my understanding has been altered by new research and publications. Other times the information was already in the literature, but not widely known. I am sure there are things I now think I know that will also turn out to be wrong. In this class, we will examine our changing understanding of sexual and reproductive biology and attempt to develop approaches for working with this material – both in teaching and in research – that are less susceptible to human biases.

**Course content/topics** – The amazing diversity of reproductive and sexual biology has been created by fundamental, general mechanisms of developmental and evolutionary biology, thus offers excellent examples of these processes. We will examine some ‘classic’ questions about sex as well as new work that is shifting our understanding of sexual variation in humans and other organisms. Possibilities include ... How did sex evolve? How did sexes evolve? What defines sexes, biologically, and what about them is and is not binary? What maintains sexual reproduction given the advantages of asexuality and the option of facultative sex? How bad, empirically, are the disadvantages of asexuality? How have the diverse mechanisms of sex determination evolved and how do they work? How is environmental change affecting sexual development? Why and how can individuals of some species change sex, while other species do not, and what else does this change about them? How do sexually differentiated phenotypes evolve and develop? What enables and drives evolutionary patterns of sex role divergence, convergence, and reversal? Why is variation within sexes sometimes unimodal and sometimes bi- or multimodal, and what consequences does that have? How is sexual and reproductive behavior related to sex determination and development? Why do some animals perform same-sex or otherwise non-reproductive sexual behavior and others do not? Why do individuals vary in their partner number & pair-bonding behavior? Etc. ***Clearly, one semester is not sufficient to explore all of these questions in depth. Thus, we decided together how to allocate our time to topics, initially, and may adjust if need be as the course progresses. Topic list adjusted following discussion at first meeting follows.***

## **BI594 – Sex, sexes, & sexual phenotypes –Topic timeline**

*based on prioritization on Jan. 22, subject to possible adjustment as the semester progresses*

### **Foundations – developmental & evolutionary approaches to variation**

27 Jan • Human variation and the complexity of sexual development

29 Jan • Gender/sex and challenges to the gender binary in humans

3 Feb • Phenotypic plasticity, reaction norms, and mechanisms of development & evolution – essentials

5 Feb • Cross-sexual transfer in development and evolution

### **Origins and prevalence of sex, sexes, and sexual reproduction**

10 Feb • Evolution of sex and sexes

12 Feb • Prevalence of sex: maintenance, loss, plastic & obligate sex

### **Sex determination**

18 Feb • Diversity & evolutionary lability of sex determination mechanisms

19 Feb • Hermaphrodites & gonochorists – sexual plasticity, mating & social systems

24 Feb • Sexual development in a changing environment

### **Sex differences & similarities**

26 Feb • Limitations of classic theory (Darwin/Trivers/Bateman) on sex role divergence

2 Mar • Social selection, sexual conflict & cooperation, natural selection on M & F

4 Mar • Mate choice as a process – mechanisms, context dependence, & mutual mate choice

16 Mar • Alternative phenotypes within sexes (*date may change depending on potential guest lecturer*)

18 Mar • Socioneuroendocrinology – toward a richer understanding of mechanisms

### **Cooperative breeding**

23 Mar • Evolution of cooperative breeding & implications of social structure for selection on sexes

25 Mar • Humans are cooperative breeders & this matters for understanding our diversity & potential

### **Diversity of sexual behavior: non-reproductive sex & same-sex sexual behavior**

30 Mar • Non-reproductive sexual behavior in animals: prevalence, context and function

1 Apr • Same-sex sexual behavior in animals: patterns, mechanisms, evolution, implications

6 Apr • Biology of human sexual diversity: approaches, alternatives, critiques

8 Apr • Evolution & mechanisms of monogamy, diversity in pair-bonding/partner numbers

**10 Apr, 12–1 pm CILSE 101: Anne Fausto-Sterling** “*Gender/sex is in the body: How did it get there?*”

13 Apr • Sexual configurations theory: beyond sexual orientation

15 Apr • Improving understanding of sexual diversity – *integrating knowledge to ask better questions*

[20 Apr – Patriot’s day, no classes]

### **Project presentations**

22 Apr • 3 presentations

27 Apr • 3 presentations

29 Apr • Last presentation(s?), wrap-up, course evaluation

## **BI594 – Sex, sexes, & sexual phenotypes – Grading details**

**Graded Elements** – *Based on class discussion on January 22, this is what we agreed.*

**1. Journal paper presentations (30%)** – Find 3 candidate papers, choose one with input from Prof. W., present it in the form of a 10–12 minute “conference talk” with PowerPoint slides, answer questions/engage in discussion about it, receive peers’ & professor’s feedback. *Each student will do this three times over the semester. Grading weight 8, 10, 12% sequentially increasing with practice.*

**Benefits for presenter** – Explore an area of literature, practice finding and evaluating research papers, improve oral & visual presentation skills, build skills in distilling a body of research into a concise format, share something interesting & useful with others.

**Benefits for others** – Exposure to more, and more diverse research than you find and read yourself; practice evaluating presentations helps build your own presentation skills.

**2. Research project (40%)** – In-depth research and writing on a topic of interest, within the scope of the course: i) discuss your interests with Prof. W., ii) submit a short topic application with initial bibliography (5%), iii) research and write a draft paper for review & feedback (5%), iv) provide peer reviews to your colleagues (5%), v) revise and improve your final paper to be submitted for grading (17%), vi) present your work to the class at the end of the semester (8%). Paper format is flexible, pending discussion with Prof. W. to ensure format is suited to topic and available literature – students may choose to write review papers, research proposals, critiques, etc. Talk with me about your ideas! I encourage you to communicate with me and with each other about your projects at any stage of the process – the benefits of collegial input are not restricted to peer review.

**Benefits for researchers/writers** – Explore an area of interest in greater depth than is possible for the whole class, practice and develop your academic research and writing skills, receive feedback to improve your written communication.

**Benefits for others** – Learn about areas that others researched by performing peer reviews and seeing/discussing their final presentations; improve your own writing and analysis by evaluating others; practice engaging collegially in the scientific community.

**3. Commentaries on readings to build an annotated bibliography (10%)** – For a subset of the papers (and book chapters, etc.) that you read for this class, that you would recommend to others, submit a *short* commentary very briefly describing what the paper is about (one or two sentences or bullet points) and explaining why or how it was useful to read, in the context of this course. Include the full citation and (if available) a link to the online abstract at a public website (i.e., something that works without a BU login). If relevant, you may note anything else you think would be informative for potential future readers (e.g. potential caveats?) but keep it short. Commentaries can be on assigned readings, papers you present or consider for presentation, papers you read for your research project, etc., and they can be on both primary and secondary literature. We will compile the commentaries (or edited versions if need be) along with the citations and links to abstracts, into a topically organized, public, online annotated bibliography. *No maximum number of commentary submissions; minimum number 10. You can either email these to me as word files or else compile them in a Google doc that you share with me and add to through the semester.*

*Grading:*

√ = clear, concise, effectively communicates what it needs to, a useful contribution, thanks! (1%)

√+ = wow! super insightful, I'm looking at this paper in a new way (bonus points?)

√- = not quite there yet – unclear, poorly written, missing some key piece of information, or excessively long and rambling (√- commentaries may be edited for resubmission within a week)

**Benefits for commentary writers** – Distilling key information from papers (or other text you read) into a very succinct take-home message and briefly evaluating papers are excellent skills to develop, and could be useful in many contexts. I encourage you to use this as a note-taking practice for your academic reading more broadly; you may find it useful for referring back to materials later on.

**Benefits for others** – Our external goal is to help others who wish to learn about topics addressed in this course to more easily find useful materials. These may include students who don't have access to such a course, other faculty wishing to incorporate elements of material we covered into their courses, etc. There is also an incipient research coordination network forming, of people interested in changing how we teach topics related to sex & gender in undergraduate biology classrooms; this may serve as a resource for them as well.

**4. Wikipedia editing contributions (20%)** – You will learn to edit Wikipedia pages and make a contribution to public knowledge by either creating or editing a Wikipedia page related to course topics. Your Wikipedia work may be on the same subject as your course project or on a different topic related to our course. Note that because the reference requirements for Wikipedia (often requiring multiple reliable *secondary* sources) are different than those for academic work, not all topic areas suitable for academic papers will work for Wikipedia pages. *Training through the Wiki Education platform (3%), peer reviews (3%), reflection paper (4%), actual editing/page creation work (10%). Note that even if other Wikipedia editors change or remove your work, I will still be able to see and grade it.*

**Benefits for editors** – You will learn how the information on Wikipedia gets there, developing an awareness of the community standards, interactions, and processes underlying this important public resource. You will learn about and practice writing for a broad public audience, with a neutral tone; your job on Wikipedia is not to interpret, conclude or convince, but to impartially present factual, well-sourced information. Your work on Wikipedia may have very broad impact, potentially reaching many more readers than your academic work in general, and your regular coursework in particular. See also — <https://wikiedu.org/blog/2017/06/19/what-students-learn-from-contributing-to-wikipedia/>

**Benefits for others** – Wikipedia is the “[largest and most popular general reference work](#)” available on the Web, used by massive numbers of people. It also is incomplete and has acknowledged biases. By improving it, you can help give many others access to information that you care about and think is important.

## BI594 – Sex, sexes, & sexual phenotypes – Topics & readings 2020

Listed below are the core readings we all did (••) + a selected subset of the further readings, as well as the presented papers

### 22 Jan • Introduction, priorities, planning

#### 1. Foundations – Developmental & evolutionary approaches to variation

##### 27 Jan • Human variation and the complexity of sexual development

- Ainsworth C. 2015. Sex redefined: the idea of two sexes is simplistic. *Nature* 518: 288-291
- Fausto-Sterling A. 2015. Concept of multiple sexes is not new. *Nature*
- Montañez A. 2017. Beyond XX and XY [graphic] *Sci Amer*

##### 29 Jan • Gender/sex and challenges to the gender binary in humans; language matters

- Hyde JS, Bigler RS, Joel D, Tate CC, van Anders SM. 2018. The future of sex and gender in psychology: five challenges to the gender binary. *Am Psychol*  
<http://dx.doi.org/10.1037/amp0000307>
  - van Anders S. 2014. Nomenclature and knowledge-culture, or, we don't call semen 'penile mucous'. *Psychology & Sexuality* <http://dx.doi.org/10.1080/19419899.2013.835743>
- Hayssen V, Orr T. 2017. *Reproduction in Mammals: The Female Perspective*, Ch. 1 The female perspective. Johns Hopkins University Press

#### 3 Feb • Phenotypic plasticity, reaction norms, mechanisms of development and evolution – essentials

- Warkentin KM. Notes – Phenotypic plasticity: critical concepts (mostly) condensed from MJ West-Eberhard 2003 *Developmental Plasticity and Evolution*.
- Gilbert SF, Epel D. 2009. *Ecological Developmental Biology*, Ch. 2 How agents in the environment effect molecular changes in development
- Ah-King M, Nylin S. 2010. Sex in an evolutionary perspective: just another reaction norm. *Evol Biol* 37: 234-246
- Fine C, Jordan-Young R, Kaiser A, Rippon G. 2013. Plasticity, plasticity, plasticity ... and the rigid problem of sex. *Trends Cog Sci* <http://dx.doi.org/10.1016/j.tics.2013.08.010>
- Prof. W (example presentation) – Touchon JC.** Reproductive mode plasticity in the treefrog *Dendropsophus ebraccatus* (presented at the 2009 annual meeting of the American Society of Ichthyologists and Herpetologists)

#### 5 Feb • Cross-sexual transfer in development and evolution

- West-Eberhard MJ. 2003. *Developmental Plasticity and Evolution* Ch. 15. Cross-sexual transfer. Oxford University Press
- Majo – Delia J, Bravo-Valencia L, Warkentin KM.** 2017. Patterns of parental care in Neotropical glassfrogs: fieldwork alters hypotheses of sex-role evolution. *J Evol Biol*  
<http://dx.doi.org/10.1111/jeb.13059>

#### 2. Origins and prevalence of sex, sexes, and sexual reproduction

##### 10 Feb • Evolution of sex and sexes (+ Wikipedia: gaps, bias, approaches)

- Gorelick R, Carpinone J, Derraugh LJ. 2017. No universal differences between female and male eukaryotes: anisogamy and asymmetrical female meiosis. *Biol J Linn Soc* 120:1–21

- Fu C, Coelho MA, David-Palma M, Priest SJ, Heitman J. 2019. Genetic and genomic evolution of sexual reproduction: echoes from LECA to the fungal kingdom. *Curr Opin Genet Devel* <https://doi.org/10.1016/j.gde.2019.07.008>
- Heitman J. 2015. Evolution of sexual reproduction: a view from the fungal kingdom supports an evolutionary epoch with sex before sexes. *Fungal Bio Rev* <http://dx.doi.org/10.1016/j.fbr.2015.08.002>
- Lehtonen J, Kokko H. 2011. Two roads to two sexes: unifying gamete competition and gamete limitation in a single model of anisogamy evolution. *Behav Ecol Sociobiol* <http://dx.doi.org/10.1007/s00265-010-1116-8>

### 12 Feb • Prevalence of sex: loss, maintenance, loss, & plasticity

- Lehtonen J, Jennions MD, Kokko H. 2012. The many costs of sex. *Trends Ecol Evol*. <http://dx.doi.org/10.1016/j.tree.2011.09.016>
- Lavanchy G, Strehler M, Llanos Roman MN, Lessard-Therrien M et al. 2016. Habitat heterogeneity favors asexual reproduction in natural populations of grasshoppers. *Evolution* 70: 1780–1790
- Luijckx P, Ho EKH, Gasim M, Chen S, Stanic A, Yanchus C, Kim YS, Agrawal AF. 2017. Higher rates of sex evolve during adaptation to more complex environments. *Proc Natl Acad Sci* 114: 534–539
- Becca – Dudgeon CL, Coulton L, Bone R, Ovenden JR, Thomas S.** 2017. Switch from sexual to parthenogenetic reproduction in a zebra shark. *Sci Reports* <http://dx.doi.org/10.1038/srep40537>

### 3. Sex determination

#### 18 Feb • Diversity & evolutionary lability of sex determination mechanisms

- Bachtrog D, Mank JE, Peichel CL, Kirkpatrick M, Otto SP, et al. 2014. Sex determination: why so many ways of doing it? *PLoS Biology* 12: e1001899
- Capel B. 2017. Vertebrate sex determination: evolutionary plasticity of a fundamental switch. *Nat Rev Genetics* <http://dx.doi.org/10.1038/nrg.2017.60>
- Leon – Whiteley SL, Weisbecker V, Georges A, Gaston Gauthier AR, Whitehead DL, Holleley CE.** 2018. Developmental asynchrony and antagonism of sex determination pathways in a lizard with temperature-induced sex reversal. *Sci Reports* <http://dx.doi.org/10.1038/s41598-018-33170-y>

#### 19–24 Feb • Hermaphrodites, gonochorists, and plasticity in sexual systems; sex in a changing world

- Leonard JL. 2013. Williams’ paradox and the role of phenotypic plasticity in sexual systems. *Integr Comp Biol* <http://dx.doi.org/10.1093/icb/ict08>
- Leonard JL. 2018. *Transitions Between Sexual Systems: Understanding the Mechanisms of, and Pathways Between, Dioecy, Hermaphroditism and Other Sexual Systems*, Ch. 1 The evolution of sexual systems in animals. Springer
- Godwin J, Roberts R. 2018. in Leonard *Transitions Between Sexual Systems*, Ch. 11 Environmental and genetic sex determining mechanisms in fishes (or any other chapter in Leonard)
- Ellis RE. 2017. “The persistence of memory” — hermaphroditism in nematodes. *Mol Repro Devel* <http://dx.doi.org/10.1002/mrd.22668>
- Koene JM. 2017. Sex determination and gender expression: reproductive investment in snails. *Mol Repro Devel* <http://dx.doi.org/10.1002/mrd.22662>
- Tanisha – Ramm SA, Lengerer B, Arbore R, Pjeta R, Wunderer J & al.** 2019. Sex allocation plasticity on a transcriptome scale: socially sensitive gene expression in a simultaneous hermaphrodite. *Molec Ecol* <http://dx.doi.org/10.1111/mec.15077>
- Sex in a changing world PK – Firman RC, Rubenstein DR, Moran JM, Rowe KC, Buzatto BA.** Extreme and variable climatic conditions drive the evolution of sociality in Australian rodents. *Curr Biol* <https://doi.org/10.1016/j.cub.2019.12.012>

#### 4. Sex differences & similarities

##### 26 Feb • Limitations of classic theory (Darwin/Trivers/Bateman) on sex role divergence

- Gowaty PA, Kim Y-K, Anderson WW. 2012. No evidence of sexual selection in a repetition of Bateman's classic study of *Drosophila melanogaster*. *Proc Nat Acad Sci* [www.pnas.org/cgi/doi/10.1073/pnas.12078511109](http://www.pnas.org/cgi/doi/10.1073/pnas.12078511109)
- Tang-Martinez Z. 2016. Rethinking Bateman's principles: challenging persistent myths of sexually reluctant females and promiscuous males. *J Sex Res* <http://dx.doi.org/10.1080/00224499.2016.1150938>
- Fuselier L, Eason PK, Jackson JK, Spaulding S. 2018. Images of objective knowledge construction in sexual selection chapters of evolution textbooks. *Sci & Educ* <https://doi.org/10.1007/s11191-018-9978-7>

##### 2 Mar • Natural, social, and sexual selection on males and females

- Tobias JA, Mongomerie R, Lyon BE. 2012. The evolution of female ornaments and weaponry: social selection, sexual selection and ecological competition. *Phil Trans R Soc B* 367: 2274-2293.
- Clutton-Brock TH, Huchard E. 2013. Social competition and selection in males and females. *Phil Trans R Soc B* <http://dx.doi.org/10.1098/rstb.2013.0074>
- Hare RM, Simmons LW. 2019. Sexual selection and its evolutionary consequences in female animals. *Biol Rev* <http://dx.doi.org/10.1111/brv.12484>
- West-Eberhard MJ. 2014. Darwin's forgotten idea: the social essence of sexual selection. *Neurosci Biobehav Rev* <http://dx.doi.org/10.1016/j.neubiorev.2014.06.015>
- Leon – Willink B, Duryea MC, Svensson EI. 2019. Macroevolutionary origin and adaptive function of a polymorphic female signal involved in sexual conflict. *Amer Nat* <http://dx.doi.org/10.1086/705294>

##### 4 Mar • Mate choice as a process – mechanisms, context dependence, & mutual mate choice

- Rosenthal GG. 2017. *Mate Choice: The Evolution of Sexual Decision Making from Microbes to Humans* Princeton. •• Ch. 1 Mate choice and mating preferences: an overview  
Ch. 8 Mutual mate choice, Ch. 9 Variation in preferences and choices: general considerations  
Ch. 10–12 Variation I–III.
- Becca – Parga JA. 2006. Male mate choice in *Lemur catta*. *Int J Primatol* <http://dx.doi.org/10.1007/s10764-005-9006-z>
- Tanisha – Chaine AS, Lyon BE. 2008. Adaptive plasticity in female mate choice dampens sexual selection on male ornaments in the lark bunting. *Science* <http://dx.doi.org/10.1126/science.1149167>

##### 16 Mar • Alternative phenotypes within sexes (guest lecture: Jay Falk, Cornell & STRI)

- Hunter J. 1870. Account of an extraordinary pheasant. *Phil Trans R Soc* 70: 527–535
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##### 18 Mar • Socioendocrinology – toward a richer understanding of mechanisms

- van Anders S, Goldey KL, Kuo PX. 2011. The steroid/peptide theory of social bonds: integrating testosterone and peptide responses for classifying social behavioral contexts. *Psychoneuroendocrinol* <http://dx.doi.org/10.1016/j.psyneuen.2011.06.001>
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**PK** – Maruska KP, Zhang A, Neboori A, Fernald RD. 2013. Social opportunity causes rapid transcriptional changes in the social behavior network of the brain in an African cichlid fish. *J Neuroendocrinol* <http://dx.doi.org/10.1111/j.1365-2826.2012.02382.x>

## 5. Cooperative breeding

### 23–25 Mar • Evolution of cooperative breeding & its implications – in general and in humans

•• Burkart JM, van Schaik C, Griesser M. 2017. Looking for unity in diversity: human cooperative childcare in comparative perspective. *Proc R Soc B* <http://dx.doi.org/10.1098/rspb.2017.1184>

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•• Blaffer Hrdy, S, 2009. *Mothers and Others: The Evolutionary Origins of Mutual Understanding* Belknap. Ch. 3 Why it takes a village. (Ch. 1 Apes on a plane)

**Leon** – Lin Y-H, Chan S-F, Rubenstein DR, Liu M, Shen S-F. 2019. Resolving the paradox of environmental quality and sociality: the ecological causes and consequences of cooperative breeding in two lineages of birds. *Amer Nat* <http://dx.doi.org/10.1086/704090>

## 6. Diversity of sexual behavior: non-reproductive sex & same-sex sexual behavior

### 30 Mar • Non-reproductive sexual behavior in animals: prevalence, context and function

•• Wolff JO, Macdonald DW. 2004. Promiscuous females protect their offspring. *Trends Ecol Evol* <http://dx.doi.org/10.1016/j.tree.2003.12.009>

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**Majo** – Moscovice LR, Surbeck M, Fruth B, Hohmann G, Jaeggi AV, Deschner T. 2019. The cooperative sex: sexual interactions among female bonobos are linked to increases in oxytocin, proximity and coalitions. *Horm Behav* <https://doi.org/10.1016/j.yhbeh.2019.104581>

### 1 Apr • Same-sex sexual behavior in animals: patterns, mechanisms, evolution, implications

•• Monk JD, Giglio E, Kamath A, Lambert MR, McDonough CE. 2019. An alternative hypothesis for the evolution of same-sex sexual behavior in animals. *Nature Ecol Evol* <https://doi.org/10.1038/s41559-019-1019-7>

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**Becca** – Vasey PL, Duckworth N. 2006. Sexual reward via vulvar, perineal, and anal stimulation: a proximate mechanism for female homosexual mounting in Japanese macaques. *Arch Sex Behav* <http://dx.doi.org/10.1007/s10508-006-9111-x>

**Tanisha** – Young LC, VanderWerf EA. 2014. Adaptive value of same-sex pairing in Laysan albatross. *Proc R Soc B* <http://dx.doi.org/10.1098/rspb.2013.2473>

### **6 Apr • Biology of human sexual diversity: approaches, alternatives, critiques**

- Ganna A, Verweij KJH, Nivard MG, Maier R, Wedow R & al. 2019. Large-scale GWAS reveals insights into the genetic architecture of same-sex sexual behavior. *Science* <http://dx.doi.org/10.1126/science.aat7693>
- Gómez Jiménez FR, Semanya SW, Vasey PL. 2020. Offspring production among the relatives of Istmo Zapotec men and *muxes*. *Arch Sex Behav* <https://doi.org/10.1007/s10508-019-01611-y>

**PK** – Diamond LM. 2016. Sexual fluidity in males and females. *Curr Sex Health Rep* <http://dx.doi.org/10.1007/s11930-016-0092-z>

Diamond LM, Alley J, Dickenson J, Blair KL. 2019. Who counts as sexually fluid? Comparing four different types of sexual fluidity in women. *Arch Sex Behav* <https://doi.org/10.1007/s10508-019-01565-1>

### **8 Apr • Evolution & mechanisms of monogamy, diversity in pair-bonding/partner numbers**

- Huck M, Di Fiore A, Fernandez-Duque E. 2020. Of apples and oranges? The evolution of “monogamy” in non-human primates. *Front Ecol Evol* <http://dx.doi.org/10.3389/fevo.2019.00472>

**Majo** – Vargas-Pinilla P, Babb P, Nunes L, Paré P, Rosa G et al. 2017. Progesterone response element variation in the *OTXR* promoter region and paternal care in new world monkeys. *Behav Genet* <http://dx.doi.org/10.1007/s10519-016-9806-2>

### **13 Apr • Sexual configurations theory: beyond sexual orientation**

- van Anders S. 2015. Beyond sexual orientation: integrating gender/sex and diverse sexualities via sexual configurations theory. *Arch Sex Behav* <http://dx.doi.org/10.1007/s10508-015-0490-8>

### **15 Apr • Embodiment of gender/sex and sexuality: integrating biology & culture**

- Fausto-Sterling A. 2019. Gender/sex, sexual orientation, and identity are in the body: how did they get there? *J Sex Res* <https://doi.org/10.1080/00224499.2019.1581883>

### **Project presentations – 22, 27 April**

**Becca** – Diversity in female mammalian genital anatomy

**Majo** – Natural sex reversal in vertebrates

**Tanisha** – Mate choice copying: evolutionary mechanisms and patterns in guppies, sailfin mollies and black grouse

**PK** – The bidirectional arrow: a review of the relationship between hormones and gendered behavior in humans