Biol 691: Fundamental Concepts in Evolution
Syllabus: Section T, 3:30pm- 5:20 pm

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Office: Rm 1215 Exploratory Hall **Office Hours:** Available by appointment on T.

Lecture room: Exploratory Hall 2503
Credit: 3C
Course Description: This course will provide a basic refresher on basic concepts and mechanisms in evolution and of their applications to different fields, from theoretical biology to applied science. Material used in this course includes a textbook in evolution to cover the basics concepts and articles focusing on the history, development and application of these concepts. Additional, supporting reading material will be provided in case students want to learn more about a specific subject.

Learning objectives: Students will familiarize themselves with key concepts in evolution and evolutionary thinking. Students will also get the opportunity of seeing how these concepts can be applied to address different scientific questions and how evolutionary thinking is the basis of many integrative and comparative studies. One of the main goals of this course is to develop and improve communication skills, critical thinking, and the capacity of integrating distinct ideas, theories and mechanisms crucial to understanding and studying evolution.

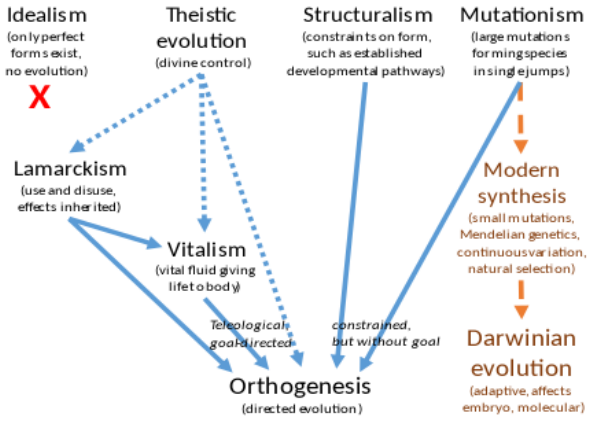
Useful/interesting resources: http://www.pbs.org/wgbh/evolution/

Course Material:
Textbooks:
Herron and Freeman – Evolutionary Analysis (Pearson Publisher)

Additional Resources (not required):
If you have never had a course on evolution before, this textbook may also be helpful (but it is not required):
Stearns and Hoekstra – Evolution, an introduction (Oxford Publisher)

This book on the development and discussion on evolutionary theory at its infancy may also be of interest for some of you

The Eclipse of Darwinism, P. J. Bowler (1992)
Figure from Wikipedia



Articles (pdf will be uploaded to a specific folder in BB): The selected articles have been chosen to stimulate discussion on the topics of each week. Selected articles range from opinions, review, historical papers, must read, and issues with understanding of evolutionary concepts. This list is not comprehensive of all the highly influential papers in evolution – especially as the ones dealing with concepts in population genetics may be math heavy. Article selection may also be changed depending on the background knowledge of the class on each subject.

Week 1

1. D. Reznick, R. Ricklefs (2009) Darwin's bridge between microevolution and macroevolution. Nature 457
2. RC Lewontin (1970) The units of selection. Annual Review of Ecology and Systematics 1-18

Additional facultative reading

3. Philosophy of Biology Book Chapter 4 – Micro and Macroevolution
4. C Darwin (1860) On the origin of species by means of natural selection – Chapter 4

Week 2

5. TR Gregory (2008) Understanding evolutionary trees. Evolution: Education and Outreach 1:121- 137

Additional facultative reading

6. BC Phillips (2012) Teaching Tree Thinking to College Students: It's Not as Easy as You Think

Week 3

7. GH Hardy (1908) Mendelian Proportions in a mixed population. Science 28: 49 – 50

Additional facultative reading

8. P. Schliekelman et al. (2001) Natural selection and resistance to HIV. Nature 411: 545 – 546
9. M Baldwin (1896) A new factor in evolution. The American Naturalist
10. RM Fisher (1958) Polymorphism and Natural Selection. Journal of Ecology 46: 289 – 293
11. HJ Muller (1922) Variation due to change in individual genes. The American Naturalist 56:32-50.

Week 4

12. Dobzhansky, T. & O. Pavlovsky (1957). An experimental study of interaction between genetic drift and natural selection. Evolution 11:311-319

Additional facultative reading

13. S. Wright (1930) The genetical theory of natural selection: a review

Kimura has a lot of really influential papers, but they are heavy on math – which is not a subject loved by everyone in Biology, so I selected some relatively easier papers and historical overview on the neutral theory of molecular evolution

14. Kimura, M. 1968. Evolutionary rate at the molecular level. Nature 217:624-626
15. JL King, TH Jukes (1969) Non-Darwinian evolution.
16. PW Hendrick (1982) Genetic Hitchhiking: A New Factor in Evolution? Bioscience
17. T Ohta, J Gillespie (1996) Development of Neutral and Nearly Neutral Theories. Theoretical Population Biology 49: 128 – 142
18. Eyre-Walker (2006) The genomic rate of adaptive evolution. TREE 21: 569 -575
19. GDD Hurst, JH Werren (2001) The role of selfish genetic elements in eukaryotic evolution. Nature Reviews

Week 5

Special issue in the journal Heredity on Quantitative Genetics – there are various articles that are worth reading in this special edition. I think that starting with the editorial of the special issue and some classical papers is a good way to start on this topic. There are also fundamental papers on this subject but again they are heavy on math, so I have decided to avoid them for this course - https://www.nature.com/collections/rwytkffrrf

20. Walsh (2014) Special issues on advances in quantitative genetics: introduction. Heredity 112: 1 – 3
21. RA Fisher (1930) The genetical theory of natural selection Chapter 1: "The nature of inheritance"

Additional facultative reading

22. Orr & Coyne (1992) The genetics of adaptation: a reassessment. The American Naturalist 140: 725 – 742
23. PR Grant, BR Grant (1995) Predicting microevolutionary responses to directional selection on heritable variation. Evolution 49: 241- 251

Week 6 – Here starts the fun!!!!

24. SJ Gould, ES Vrba (1982) Exaptation – a missing term in the science of form. Paleobiology 8: 4 -15
25. T. Dobzhansky (1973) Nothing makes sense except in the light of evolution. The American Biology Teacher
26. SJ Gould & RC Lewontin (1979) The spandrels of San Marco and the Panglossian paradigm: a critique of the adaptationist programme. Proc. R. Soc. London B 205: 581 – 598

Additional facultative reading

27. Cain (1989) The perfection of animals. Biological Journal of the Linnean Society 3: 36 – 63
28. J Felsenstein (1985) Phylogenies and the comparative method. The American Naturalist 125: 1 – 15
29. E. Mayr (1983) How to carry out the adaptationist programme. The American Naturalist 121: 324 – 334

Week 7:

30. CK Ghalambor et al. (2007) Adaptive versus non-adaptive phenotypic plasticity and the potential for contemporary adaptation in new environments. Functional Ecology 21: 394 – 407.
31. CK Ghalambor et al. (2015) Non-adaptive plasticity potentiates rapid adaptive evolution of gene expression in nature. Nature 525: 372 – 375

Additional facultative reading

32. Replies to Ghalambor et al. 2015 article
33. Nature Comment (2014) Does evolutionary theory need a rethink?

Week 8:

34. RA Fisher (1930) Chapter 6, The genetical theory of natural selection
35. SH Alonzo, MR Servedio (2019) Grey zones of sexual selection: why is finding a modern definition so hard? Proc Royal Soc B 286: 20191325
36. I Skogsmyr, A Lankinen (2002) Sexual selection: an evolutionary force in plants? Biol. Rev. (2002), 77, pp. 537–562
37. WR Rice (1984) Sex Chromosomes and the Evolution of Sexual Dimorphism. Evolution 38: 735-742
38. AV Hedrick, EJ Temeless (1989) The evolution of sexual dimorphism in animals: hypotheses and tests. TREE 4: 136 – 138
39. R Shine (1989) Ecological causes for the evolution of sexual dimorphism: a review of the evidence. The Quarterly Review of Biology 64: 419 – 436

Week 9 and following TBD

Course Logistics:

This course will meet once a week. The course will include a very short lecture at the beginning of every week to introduce the general concept and then paper(s) and book chapters discussion. The goal of this course is to become familiar with many concepts and mechanisms in evolution and be able to discuss about them and connect them with each other.

Short writing assignments are planned for every week. All writing assignments – unless differently specified – must follow the format described below (*writing assignment* section). Writing assignment MUST be sent to me by email at ychiari@gmu.edu at least 24 hours before class begins. All necessary articles for this course will be posted on Blackboard. Announcements will also be posted on Blackboard. Please, check Blackboard regularly. It is also the student's responsibility to check her/his/they email.

Classes will revolve around summarizing the assigned scientific papers/chapters/reading material, in class participation, and the final presentation.

*Weekly writing assignment (**1 page** written in Times New Roman font 12):*

Every student has to:

- prepare a short paragraph of reading reflection on the material (all the material! Try to merge concepts from the different reading material assigned for that week)
- prepare 3 questions (questions must show critical thinking about the subject discussed) on the topic of the week and based on the material to read
- One sentence about something the student did not know or was not so familiar with (or did not know so in depth) before the class

Final topic presentation:

Each student has to select a topic of choice and give a short (max 10 minutes) presentation as a critical reflection on one of the topics discussed in class and based on 2-3 selected papers on the topic (different papers from the ones assigned in class)

Grading:
Final grades will be based on the total points earned for each assignment indicated in the course schedule below. All weekly writing assignments are due by noon on the date on which the assignment is indicated in the schedule. Peer review must be constructive and providing thoughtful comments. Peer reviews containing statements that are not supported by evidence (e.g., clear reference to the writing and to specific section(s)) will not receive the full point credit. Attendance is mandatory. Attendance will be recorded for each class/seminar. Missing more than 1 class will be penalized by removing 5 points for each missed class from final grade. There will be no final exam for this course.

Assessment:	Reading reflections:	20%
	Weekly questions	20%
	In Class Participation:	30%
	Papers selection for final presentation	10%
	Final presentation:	20%

Grades:

96 – 100: A+ 90 – 95: A- 86 – 89: B+ 80 – 85: B
70 – 79: C 60 – 69: D 0 – 59: F

Course Policy:
Students are expected to keep up with the material and submit all the required home work as established. Late work is not accepted in this course. Under special circumstances (sickness, death, family emergency), students may be allowed to send their weekly assignment later. These extenuating circumstances will need to be communicated before class and will need to be documented (e.g., doctor's note for sickness). No other excuses for missed homework will be accepted.
Missed or late work will not be accepted and students will receive a zero for that assignment.

Honor code:
GMU is an Honor Code university; please see the University Catalog for a full description of the code and the honor committee process (https://oai.gmu.edu/mason-honor-code/). The principle of academic integrity is taken very seriously and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, you will perform that task. When you rely on someone else's work in an aspect of the performance of that task, you will give full credit to those people in the proper, accepted form. When doing homework, the work must be yours. It is totally unacceptable to copy the work of another student in this course in any form.

Instructor-Student communication:
I will do my best to respond to emails within 48 hours during the week (Monday-Friday). If you do not receive an answer to your email within 48 hours during week days, please, send me a reminder.

Students with disabilities:
Students with disabilities who need accommodations for this course must be registered with the George Mason University Office of Disability Services (ODS) and inform me about the need for accommodation at the beginning of the semester.

Writing Center:
The staff of the George Mason University Writing Center offers resources and services (e.g., tutoring, workshops, writing guides, handbooks) to support students in their writing assignments.

The Schedule topic is Tentative and may be changed

Date	Topic	Material	Assignments to do before class
Introduction			
Week 1	Micro- and Macro-evolution; pattern of evolution Evolution by natural selection	Chapters 2-3 of Herron/Freeman Articles	Read the book chapters and articles before class Prepare a reading reflection of the class material (articles) including 3 questions/topics for discussion on the subject + one thing that you learned from the chapters/articles that you didn't know (or didn't know so in depth)
Week 2	Phylogeny and phylogenetic tree building	Chapter 4 of Herron/Freeman Articles	Read the article before class Prepare a reading reflection of the class material (article) including 3 questions/topics for discussion on the subject + one thing that you learned from the chapters/articles that you didn't know (or didn't know so in depth)
Mechanisms of Evolutionary Changes			
Week 3	Microevolution: Variation among individuals Mendelian Genetics: Selection and Mutation	Chapters 5-6 of Herron/Freeman Articles	Read the book chapters and article before class Prepare a reading reflection of the class material (articles) including 3 questions/topics for discussion on the subject + one thing that you learned from the chapters/articles that you didn't know (or didn't know so in depth)
Week 4	Mendelian Genetics: Migration, Drift and non random mating Mendelian Genetics: Linkage and Sex Selfish Gene	Chapters 7 – 8 of Herron/Freeman Articles	Read the book chapters and article before class Prepare a reading reflection of the class material (articles) including 3 questions/topics for discussion on the subject + one thing that you learned from the chapters/articles that you didn't know (or didn't know so in depth)
Week 5	Quantitative Genetics	Chapter 9 of Herron/Freeman Articles	Read the book chapters and article before class Prepare a reading reflection of the class material (articles) including 3 questions/topics for discussion on the subject + one thing that you learned from the chapters/articles

			that you didn't know (or didn't know so in depth)
Adaptation			
Week 6	Evolution of form and function – Adaptation or not?	Chapter 10 of Herron/Freeman Articles	Read the book chapters and article before class Prepare a reading reflection of the class material (articles) including 3 questions/topics for discussion on the subject + one thing that you learned from the chapters/articles that you didn't know (or didn't know so in depth)
Week 7	Plasticity: Is plasticity adaptive? Do we need an extended evolutionary synthesis?	Chapters 10 and 15 of Herron/Freeman Articles	Read the book chapters and article before class Prepare a reading reflection of the class material (articles) including 3 questions/topics for discussion on the subject + one thing that you learned from the chapters/articles that you didn't know (or didn't know so in depth)
Week 8	Sexual selection	Chapter 11 of Herron/Freeman Articles	Read the book chapters and article before class Prepare a reading reflection of the class material (articles) including 3 questions/topics for discussion on the subject + one thing that you learned from the chapters/articles that you didn't know (or didn't know so in depth)
Week 9	Speciation	Chapter 16 of Herron/Freeman Articles	Read the book chapters and article before class Prepare a reading reflection of the class material (articles) including 3 questions/topics for discussion on the subject + one thing that you learned from the chapters/articles that you didn't know (or didn't know so in depth)
The origins of Life			
Week 10	Evolution and the fossil record Evo-Devo	Chapter 18 of Herron/Freeman Chapter 19 of Herron/Freeman	Read the book chapters and article before class Prepare a reading reflection of the class material (articles) including 3 questions/topics for discussion on the subject + one thing that you learned from the chapters/articles

			that you didn't know (or didn't know so in depth)
Week 11		TBD	
Week 12		TBD	
Week 13		Presentations	
Week 14		Presentations	