Department of Biological Sciences, Binghamton University
Biol 351: Mechanisms of Evolution
Spring 2017 Syllabus

Lecture- Tuesdays and Thursdays 11:40-1:05 in SL 212

Discussion Sections – M- 4:50-5:40; W - 4:40-5:50; R- 5:50-6:50 in SW 331

Instructor Information

Professor:Dr. Tom Powell
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Office Hours: Tuesday 2:00-4:00, Wednesday 10:30-12:00, or by appointment

TA: Haley Arnold
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Office: Science III G86 (in the basement next to the computer POD).
Office Hours: Fridays 2:30-3:30

Text Book: Jon Herron and Scott Freeman 2014 *Evolutionary Analysis* 5th ed. Pearson.
Other required material: Calculator

Course information

Course description- Evolution is simply the change of allele frequencies in populations, but the process that drives these changes serves as the unifying framework for all of modern biology. The field of evolutionary biology involves taking relatively simple premises and understanding how they play out in marvelously complex ways in nature. As Darwin wrote in *On the Origin of Species* "…from so simple a beginning endless forms most beautiful have been, and are being, evolved." Evolution was the engine that built not only all of life's diversity in form (producing the millions of species inhabiting the earth) but also life's diversity in function. Evolution is the process that builds and shapes biochemical pathways, genome structure, physiological regulatory mechanisms, and the virulence of pathogens. Thus, the subject isn't just about patterns in the fossil record or esoteric adaptations in animals, and it certainly isn't just about human origins. Rather, the subject is concerned with providing a comprehensive and dynamic view of the living world.

The course can essentially be divided into three parts. After a brief historical overview, we will first deal with the basic nuts and bolts of evolutionary biology – how gene frequencies change in populations and how these genetic changes relate to phenotypes. Then, we'll explore a number of ways that these basic mechanisms play out in nature. Finally, we'll finish the semester by zooming out to look at some of the patterns of biodiversity that these processes have driven over the history of life.

Learning objectives- On the successful completion of Biol351, students will be able to:

1) Describe the four evolutionary forces underlying evolutionary change and predict the effects of their interaction in biological systems.
2) Use simple mathematical models to quantify the action of the four evolutionary forces.
3) Describe the necessary conditions for natural selection and analyze biological systems from this perspective.
4) Apply an understanding of the transmission of complex traits in populations to human phenotypes.
5) Use examples to demonstrate the importance of evolution as an active, on-going process in the world around us.
6) Describe the processes underlying the formation of new species and compare and contrast different modes of speciation.
7) Discuss the combined roles of stochasticity and determinism in macroevolutionary processes.

Along with these *proximate* goals (those related directly to the curriculum at hand), I also intend for this course to help students progress towards some important *ultimate* goals of science education, including 1) an understanding of how biologists use the scientific process in practice, 2) becoming comfortable with reading the primary scientific literature, and 3) developing an understanding of the integrative nature of modern biological sciences.

Communication policy- I want to be as accessible as possible to students. However, this is a very large class. I really wish that I could make myself available to work hands-on with each student on every topic in the course throughout the semester, but that simply isn't feasible with this number of students. In lieu of being able to meeting with each of you outside of class on a regular basis, I'm going to propose a multi-pronged strategy for getting you the help that you need to succeed in this class. I urge each of you to take advantage of all of the options available to you. **1) Ask questions in class** – There are over 115 of you in here, so you if don't understand something, you can be assured that you're not the only one! Don't be shy; your classmates will actually appreciate it. **2) Work with your peers** – Again, there are a lot of you here, so just as other people will undoubtedly have the same questions, some of you will also have the answers. **3) Utilize the discussion sections-** Each week, you will have opportunities to talk through questions with both your peers and our TA, Haley. While some of these sessions will focus on particular activities, many will serve as general review sessions with practice problems. **4) Come to office hours** – Both Haley and I will be holding regular office hours throughout the semester. Theses time slots are set aside specifically to interact with you outside of class –please take advantage of them. Of course, if the posted times clash with your schedule, don't hesitate to schedule another appointment. **If all else fails- send me an email** - I will endeavor to respond to emails promptly. If responding to your inquiry requires some thought on my end, I will send you a quick email acknowledging that I received your message and when to expect a proper response. I think that reciprocal dialogue is almost always the best way to resolve issues, so I strongly encourage students to utilize the other four methods first.

Grading and assignments

Grades for the semester will be assigned based on the following table:

Category	Percentage of final grade
Exam I	25
Exam II	25
Exam III	30
Quizzes (10)	10
Discussion assignments (4)	10

Exams – There will be three exams throughout the semester. The dates are: **February 21, April 4, and May, XX (final exam schedule not posted yet).** The material in the course builds on itself as the semester progresses. In that sense, all of the exams are somewhat cumulative (you won't be able to forget the information from week 2 and expect to do well on the material for week 12). However, Exam II will not directly ask you about material covered in Exam I. Exam

III will concentrate *primarily* on material covered since Exam II, but there will be some questions relating directly to material covered since the beginning of the semester.

Exams will involve a combination of **multiple choice, short answer, and problem-based questions**. I will provide a list of the necessary equations for each exam.

Each exam grade will be curved upwards appropriately so that class average is at least 75 and at least 10% of the class is above 90.

Quizzes – During the semester, we will have a series of unannounced 3 questions quizzes during class. These will be simple multiple choice questions covering topics from the **week's assigned readings and the previous week's lecture material.** It's going to be in your best interest to stay engaged with this material throughout the course of the semester, rather than scrambling to catch up on readings right before the exams. These quizzes are a low-stakes way of incentivizing you to do that. I will drop your two lowest quiz grades. No make-up quizzes will be given. If you have more than two legitimate, *documented* absences, I will simply calculate your quiz average from the remaining quizzes. Please note that the quizzes will **not** focus on esoteric details from the readings. Rather, the intent here is to incentive you to come prepared by familiarizing yourself with the major themes of the subject matter before class.

Discussion assignments – Four times during the semester (see schedule), you will have

assignments associated with discussion activities. These will range from problem sets (doubling as practice for the exam) to short reflections on discussion topics. You will have the opportunity to work on these during the discussions and afterwards at home. They will be due during your assigned discussion section the following week. These assignments will be graded on the following simple scale: **check plus** (3) – assignment in correct and/or shows considerable effort and thought, **check** (2) – answer are incorrect, but assignment shows appropriate effort, **check minus** (1) – assignment turned in but does not demonstrate sufficient effort, and 0 – nothing turned in.

Extra credit – There will be only one opportunity for "extra credit" during the semester, and it requires a non-trivial amount of effort on your part. This semester, the biology department's seminar series will feature research talks by two outstanding evolutionary biologists –Dr. Brett Payseur of the University of Wisconsin on 3/24 and Dr. David Althoff of Syracuse University on 3/31. You can choose to earn extra credit for **one** of these two events (of course, you're welcome to come to both talks, but each student only has a chance to get points once). To earn credit, you must write a one page (single-spaced) coherent synopsis of the speaker's research and include one question about future direction of work presented in the talk. For each speaker, I will have a Turnitin assignment posted on Blackboard for ten days after each talk. If you choose to do this, I will add **five points to your lowest exam grade**. I will not offer any additional extra credit opportunities on an individual basis –it's simply not fair to other students.

Course Policies

Official BU policy of credit hours and work expectations- This course is a 4-credit course, which means that students are expected to do at least 12.5 hours of course-related work or activity each week during the semester. This includes scheduled class lecture/discussion meeting times as well as time spent completing assigned readings, studying for test and examinations, participating in discussion sessions, preparing written assignments, and other course -related tasks.

Disability-related Equal Access Accommodations – Students needing accommodations to ensure their equitable access and participation in this course should notify the instructor with an Academic Accommodation Authorization from Binghamton University's Services for Students with Disabilities (SSD) office as soon as they're aware of their need for such arrangements. Please visit the SSD website (www.binghamton.edu/ssd) for more detailed information. The office is located in University Union, 119.

Academic Dishonesty- I fully expect each of you to abide by the University's *Student Academic Honesty Code* (follow link on https://www.binghamton.edu/harpur/faculty/acad-honesty.html) in all of your work connected with this course. Please note that I reserve the right to use plagiarism detection software on any material you turn in. Any infractions will be reported to the Harpur College Academic Honesty Committee and will result in a grade of zero for the assignment.

Dealing with stress and difficulties this semester – One of the things that has impressed me about BU in my short time here is the university's explicit efforts to provide support for its students. College or grad school can be very stressful. If during this semester, you find yourself under undue personal or academic stress – please reach out for support. The people at this university, myself included, really want you to succeed and care about your well-being. Please don't hesitate

to talk to me about any issues that may affect your work in my class. Additionally, I am more than happy to help you in reaching out to any one of a wide variety of campus resources.

Tentative lecture schedule and reading assignments

week	date	subject	reading
1	1/17	Introduction	
	1/19	Descent with modification	Ch 2. P37-67
2	1/24	Natural Selection 1	Ch 3.1-3.4 p73-90
	1/26	Natural Selection2	Ch 3.5-3.7 p90-104
3	1/31	Genetics overview	
	2/2	Raw materials	Ch 5 p147-174
4	2/7	Pop gen 1 –H.W.	Ch 6.1 p179-191
	2/9	Pop gen 2 – s & μ	Ch 6.2-6.3 p191-216
5	2/14	Pop gen 2 – s & μ **END for ExamI**	Ch 6.4-6.5 p216-227
	2/16	Pop Gen 3 drift	Ch 7.1-7.2 p233-260
6	2/21	**Exam I**	
	2/23	Pop Gen 4 – migration	Ch 7.3-7.4 p260-285
7	2/28	Shifting balances	
	3/2	Linkage disequilibrium	Ch 8.1-8.2 p291-313
8	3/7	No class	
	3/9	Quantitative genetics 1	Ch 9.1-9.3 p329-347
9	3/14	Quantitative genetics 2	Ch 9.4-9.7 p348-367
	3/16	Evolution of sex	Ch 8.3 p314-324
10	3/21	Sexual selection	Ch 11 407-448
	3/23	Speciation I	Ch 16 609-641
11	3/28	Speciation II **END for ExamI**	
	3/30	Evol. Aging	Ch. 13.1-13.3 & 13.6
12	4/4	**Exam II**	
	4/6	Evol. Social behavior	Ch 12 p455-487
13	4/11	NO CLASS	
	3/13	NO CLASS	
14	4/18	Coevolution	
	4/20	EvoDevo	Ch 19 p735-765
15	4/25	Macroevolution	Ch 18.3-18.5 p707-727
	4/27	History of Life	Ch 18.1-18.2 p691-706

16	5/2	History of Life	
	5/4	NO CLASS (counts as M)	
17	5/9	Human evolution	Ch 20 769-807
	5/x	FINAL EXAM	

Tentative Discussion Section Schedule

Week	W	R	M	Topic
1	1/18	1/19	1/23	**Introduction**
2	1/25	1/26	1/30	**Phylogenetics I**
3	2/1	2/2	2/6	**Phylogenetics II**
4	2/8	2/9	2/13	**Problem set I**
5	2/15	2/16	2/20	**Exam I Review**
6	2/22	2/23	2/27	**Integrative case study I**
7	NA	NA	NA	**No discussion**
8	3/8	3/9	3/13	**Problem set II**
9	3/15	3/16	3/20	**Primary literature**
10	3/22	3/23	3/27	**Integrative case study II**
11	3/29	3/30	4/3	**Exam II review**
12	4/5	4/6	4/10	**Eugenics**
13	NA	NA	NA	
14	4/19	4/20	4/24	**Humans and Coevolution**
15	4/26	4/27	5/1	**Evolutionary Medicine**
16	5/3	**5/4***	5/8	**Exam III Review –note weird "Thursday" date**