Biology 3435 – Evolution

Syllabus, Spring 2015

Image source: Tree of Life

Instructor

Dr. Michele A. Johnson
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Office hours: Mondays 1-3:30pm; Thursdays 10am-12pm
or by appointment (really!)

Course objectives

Evolution is **the** unifying concept of biology. The distinguished geneticist Theodosius Dobzhansky once said that "nothing in biology makes sense except in the light of evolution." So, if you're interested in ecology, human health, development, animal behavior, cell biology, genetics, you name it – you need to understand evolution. This course will survey the history of evolutionary thought, the mechanisms and patterns of evolutionary change, and the methods scientists use to study evolution. Topics we will explore include evolution by natural selection and genetic drift, adaptation, genomics, speciation and extinction, and applications of evolution in modern medicine.

My goals for you in this course, together with the lab section, are as follows:

1. To understand the history and major tenets of evolutionary theory
2. To be able to describe the mechanisms by which evolution occurs
3. To be able to generate evolutionary hypotheses and evaluate evidence used to test evolutionary hypotheses
4. To be able to apply evolutionary thinking to a wide range of topics

Required texts

- Zimmer, C. & Emlen, D.J. 2013. Evolution: Making Sense of Life. Roberts & Co., Greenwood Village, Colorado.
- Ridley, M. 2004. Evolution. (Oxford Readers). Oxford University Press, New York.
- Additional readings will be available on the course TLEARN site.

Grading and assessment

LECTURE (~70%)		*LAB (~30%)*	
Exam 1	100	Participation and lab exercises	100
Exam 2	100	Paper – dog phylogeny	75
Comprehensive final exam	150	Presentation – lizard evolution	75
Literature review	150	Poster – experimental evolution	75
Darwin Day presentation	50		
Genomics proposal	25		
Convergence activity	25		
Class participation	75	**TOTAL POINTS**	**1000**

If you have questions about how an assignment or exam was graded (or need a correction due to a tallying error), you must bring the assignment or exam, along with a **written** explanation of any item that you believe was mis-graded, to me within **two weeks** of the date of receipt.

Class attendance

Because this course includes class discussions and lectures on material that may not be in your assigned readings, you should plan to attend all class meetings. I expect that you will attend class, and that you will come to class prepared to participate. This includes completing all readings and assignments for this class *prior to class*, asking questions when there is material you do not understand, and focusing your attention on material for this class during all class meetings. Please turn off your cell phones and anything else that may distract you during class.

If you must miss a class, I expect that you will let me know beforehand. If you must miss class on the day of an exam, you may take a make-up exam **before** the exam date.

Email and Office Hours

I am excited to teach you about evolution, and I encourage you to ask questions any time there is something you do not understand, or if there is a topic you wish to discuss in more depth than we are able to explore in class. Feel free to email me with any questions about course procedures, assignments, etc., but please ask your content-driven questions in person – either in class, where your fellow students can benefit from your question, or in office hours, where I can better assess your level of understanding and provide a more complete answer to your question. I will do my best to respond to your email messages within one business day.

Honor Code

All students are covered by a policy that prohibits dishonesty in academic work. Under the Honor Code, a faculty member will (or a student may) report an alleged violation to the Academic Honor Council. It is the task of the Council to investigate, adjudicate, and assign a punishment within certain guidelines if a violation has been verified.

Further, any materials created by your instructor to enhance or assess your learning in this class (including but not limited to exams, exam keys, problem sets, and lecture slides) are proprietary materials that may not be shared with anyone without prior authorization from Dr. Johnson. Sharing these documents in any way is a violation of the Honor Code and infractions will be reported to the Honor Council. The sale or donation of these materials to any organization that, as a business or community service, provides study aids is included in this policy. This includes providing materials to such organizations over the internet.

Students who are under the Honor Code are required to pledge all written work that is submitted for a grade: “On my honor, I have neither given nor received any unauthorized assistance on this work” and their signature. The pledge may be abbreviated “pledged” with a signature.

Note to students with disabilities

The success of all students in this class is important to me. If you have a documented disability and will need accommodations in this class, please speak with me early in the semester so I may be prepared to meet your needs. All discussions will remain confidential. If you have not already registered with Disability Services for Students, contact the office at 999-7411 or dss@trinity.edu. You must be registered with DSS before I can provide accommodations.

Schedule of course topics, readings, and assignment due dates

January 15 *Introduction to course – why do we study evolution?*
- Zimmer and Emlen Chapter 1(*skim* at this point)
- Evolution Reader 61, Dobzhansky (1973) – pp. 400-409

January 20 *History of evolutionary thought*
- On the Origin of Species (1859, first edition!). Read the table of contents, Introduction, Chapter 1, Chapter 4 and conclusion (pp. 480-490). Available at http://darwin-online.org.uk/contents.html#origin

January 22 *Phylogenetics: "tree-thinking"*
- Zimmer and Emlen Chapter 4
- Evolution Reader 22, Mayr (1958) – pp. 134-137

January 27 *Patterns of evolution: homologies*
- Zimmer and Emlen Chapters 1 and 2

January 29 *The origin of variation: mutation*
- Zimmer and Emlen Chapter 5

February 3 *Natural selection*
- Zimmer and Emlen Chapter 6 and 8
- **DUE:** Darwin Day presentations, 5pm

February 5 *Genetic variation in populations*
- Zimmer and Emlen Chapter 6
- Evolution Reader 5, Wright (1932) – pp. 29-37

February 10 *Genetic drift and neutral theory*
- Zimmer and Emlen Chapter 9
- Evolution Reader 13, Kimura (1990) – pp. 75-81

February 12 *Evolution at multiple loci*
- Zimmer and Emlen Chapter 7

February 17 *Evolution and the age of genomics*
- Rokas, A. and Abbot, P. 2009. Harnessing genomics for evolutionary insights. Trends in Ecology and Evolution 24: 192-200.
- Holmes, E.C. 2007. Viral evolution and genomics. PLoS Biology 5: e278.

February 19 *In class: collaborative work on genomics proposal*

February 20 **DUE**: Genomics proposal, 5pm

February 24 **Exam I**

February 26 *Adaptation*
- Zimmer and Emlen Chapter 10
- Evolution Reader 20, Gould and Lewontin (1979) – pp. 114-123

March 3 *The evolution of sex, and sexual selection*
- Zimmer and Emlen Chapter 11
- Evolution Reader 48, Maynard Smith (1971) – pp. 307-310

March 5 *Life history evolution*
- Zimmer and Emlen Chapter 12
- Evolution Reader 46, Medawar (1951) – pp. 293-299

March 7-15 *Spring Break*

March 17 *Units of selection*
- Evolution Reader 21, Dawkins (1976) – pp. 123-130

March 19 *The comparative method*
- Harvey, P.H. and Pagel, M.D. 1991. The comparative method for studying adaptation. In: The Comparative Method in Evolutionary Biology. Oxford: Oxford University Press. Pp. 1-34.

March 24 *Behavioral evolution*
- Zimmer and Emlen Chapter 16

March 26 *In class: collaborative work on convergence activity*

March 27 **DUE**: Convergence activity, 5pm

March 31 *Your choice: evolution of the brain; evolution of human behavior; or evolution and human medicine*
- Reading TBA

April 2 **Exam II**

April 7 *What is a species?*
- Zimmer and Emlen Chapter 13
- Evolution Reader 23, Mayr (1963) – pp. 137-147
- Fraser, C., Alm, E. J., Ploz, M. F., Spratt, B.G., and Hanage, W.P. 2009. The bacterial species challenge: making sense of genetic and ecological diversity. Nature 323: 741-746.

April 9 *The process of speciation*
- Zimmer and Emlen Chapter 13
- Evolution Reader 27, Coyne and Orr (2000) – pp. 161-175
- Evolution Reader 28, Schluter (2000) – pp. 175-178

April 14 *The origin of life*
- Evolution Reader 42, Maynard Smith and Szathmáry (1999) – pp. 259-265
- Bada, J. L. and Lazcano, A. 2003. Prebiotic soup – Revisiting the Miller experiment. Science 300: 745-746.
- Cech, T.R. 2012. The RNA worlds in context. Cold Spring Harbor Perspectives in Biology 2012;4:a006742.

April 16 *Tempo and mode of evolution*

- Zimmer and Emlen Chapter 14
- Evolution Reader 44, Cooper and Fortey (1998) – pp. 275-284
- Evolution Reader 65, Palumbi (2001) – pp. 421-433

April 21 *Evo-devo and the diversification of life*

- Carroll, S. B. 2008. Evo-devo and an expanding synthesis: a genetic theory of morphological evolution. Cell 134: 25-36.

April 23 *Human evolution* (Dr. Jen Matthews, Department of Sociology and Anthropology)

- Zimmer and Emlen Chapter 17

April 24 **DUE**: Literature Review, 5pm

April 28 *The future of evolutionary biology*

- Schwenk, K., Padilla, D.K., Bakken, G.S., and Full, R.S. 2009. Grand challenges in organismal biology. Integrative and Comparative Biology 49: 7-14.
- Losos, J.B., Arnold, S.J., Bejerano, G. et al. 2013. Evolutionary biology for the 21st century. PLoS Biology 11:e1001466.

April 30 **Poster session**, experimental evolution with *E. coli*

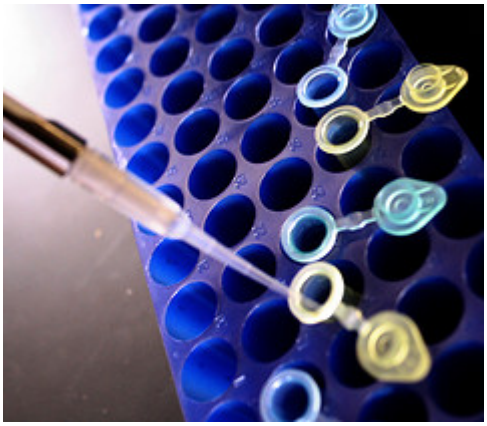
May 4-5 *Reading days*

May 8 **Final exam**, 8:30-11:30am

NOTE: This schedule is subject to change as needed. If and when changes occur, announcements will be made in class and on the course TLEARN site.

Biology 3435 – Evolution Lab

Syllabus, Spring 2015



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Teaching assistants

Ashley Tessnow, senior biology major
Email: atessnow@trinity.edu

Brittney Andre, Johnson lab technician
Email: bandre@trinity.edu

Course objectives

Evolution Lab is designed to provide practical exposure to some of the basic principles of evolutionary biology that you are learning in Evolution. At the same time, you will learn some of the basic research methodologies used by evolutionary biologists.

In this lab, my goals for you are:

- To become proficient with research techniques used by evolutionary biologists
- To design experiments to test evolutionary hypotheses
- To write about the results of your experiments in a scientific manner
- To use basic statistics to analyze evolutionary data

Class attendance and expectations

Laboratory attendance is mandatory. There is no way to learn what is covered in lab without being there, and no way to make up lab activities outside of class. If you have an unavoidable circumstance that will require you to miss a lab, you must let me know at the beginning of the semester.

As in lecture, I expect you to focus your attention on material for this class during all class meetings. Please turn off your cell phones and anything else that may distract you during class.

In addition, you are expected to behave responsibly around the laboratory and to keep your work area clean and safe. You are also expected to complete any preparatory reading or exercises in advance of the class.

Although you will work in groups during most laboratory assignments, your work must be your own. I strongly encourage discussion about laboratory activities, but you must complete all lab handouts and reports independently.

Grading and assessment

Your laboratory grade will be based on class participation (practical skills, completion of preparatory tasks, and participation in class discussion), your performance on laboratory exercises, and your written and oral presentations of our three major lab projects.

Participation and class exercises	100
Paper – dog phylogeny	75
Presentation – lizard evolution	75
Poster – experimental evolution	75
Total points from lab	325 (32.5% of course grade)

Laboratory schedule

In the first three weeks of lab, you'll develop basic skills for making and interpreting phylogenies. You'll build on these skills as we progress through multi-week projects on making a phylogeny of dog breeds, correlated trait evolution in lizards, and experimental evolution in *E. coli*.

January 21	1. Describing diversity: classification using vertebrate skulls
January 28	2. Banking genes and aligning sequences
February 4	3. Building molecular phylogenies
February 11	4. Genetic diversity of dogs 1(Introduction and primer design)
February 18	5. Genetic diversity of dogs 2 (gDNA isolation & PCR)
February 25	6. Set up *E. coli* experimental evolution study
March 4	7. Genetic diversity of dogs 3 (Sequence data analysis)
March 7-15	*SPRING BREAK*
March 18	8. Analysis and writing for dog project – **due March 20, 5pm**
March 25	9. **FIELD TRIP** to Palmetto State Park: Convergence in local plants. This trip will extend beyond the normal lab period.
April 1	10. Using the comparative method, and statistics in R
April 8	11. Collaborative work on comparative analyses
April 15	12. **Student presentations** of comparative projects
April 22	13. Set up *E. coli* competition assays
April 29	14. Collaborative work on experimental evolution posters