EVOLUTIONARY BIOLOGY

ANTH 596

Fall 2015 – THE UNIVERSITY OF TENNESSEE-KNOXVILLE

Instructor **Dr. Benjamin M. Auerbach**

Contact Information

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(Dr. Auerbach does not read e-mails between 8:00 P.M. and 8:00 A.M.)
Office: 229 South Stadium Hall
Office hours: Walk-in hours are **Wednesdays from 2:00 to 3:30 P.M.**
You may make appointments via e-mail to Dr. Auerbach

Class meeting time Tuesdays, 5:45 to 8:35 P.M.
Class location 427 Hesler Biology Building

Course description

"Evolution is a light which illuminates all facts, a curve that all lines must follow." – Pierre Teilhard de Chardin

"Nothing in biology makes sense except in the light of evolution." – Theodosius Dobzhansky

"Nothing in evolution makes sense except in the light of population genetics." – Michael Lynch

Evolutionary theory is the foundation of modern biology, and links a range of disciplines from paleontology to ecology to molecular biology. Biological anthropologists and archaeologists have leveraged evolutionary ideas into studies about past and living primates, especially humans; anthropologists have been among the vanguard of researchers contributing to evolutionary theory. To be effective in our anthropological studies, we must continue to be informed and trained in current evolutionary theory and methods.

This course presents a critical understanding of the evolutionary processes that shape biological variation, and the effects of those processes on the cellular, organismal, population, and species levels. We make an intense study of basic population genetics, and branch into some quantitative evolutionary genetics. Focus is also placed on the processes associated with evolutionary developmental biology ("evo-devo"), species concepts, phylogenetics, and life histories.

Weekly course meetings will take the form of guided discussions based on assigned readings. (You are encouraged to read beyond these assigned readings.) Students are expected to bring critical, well-argued evaluations of the concepts presented in papers and in conversations, with an objective of building knowledge for the independent development of research problems that include an evolutionary component.

Prerequisites

Evolutionary Biology is intended for advanced graduate students. While the course does not have any listed prerequisites, students enrolling in the course should have a basic background in statistics (preferably Anthropological Statistics I and, ideally, Anthropological Statistics II), in biology, and in human evolution. Some mathematical background (algebra and basic calculus) will be advantageous as well.

Objectives

This course adds to an ongoing drive toward providing Master of Arts and Doctor of Philosophy students in anthropology with a fundamental background in theory. By the end of the course, students should

- have developed a comprehension of basic evolutionary processes,
- be competent in basic population genetics and its applications to evolutionary theory,
- critically evaluated the fundamentals of modern evolutionary theory,
- learned how to argue these concepts within the framework of anthropological problems.

Structure and expectations

This course is a graduate seminar. Class meetings will take place once a week (Tuesday evenings) throughout the semester. These meetings will be informal discussions of the assigned readings from the week, guided by Dr. Auerbach, who will also provide brief lectures on specific topics as necessary. A schedule of topics and readings is provided at the end of this syllabus. We may optionally meet after the 1st of December for a special seminar on evolutionary medicine, by popular demand.

Your participation in class is mandatory. This means that 1) you have completed all of the readings before class each week; 2) you engage in group discussions about the papers; and 3) you help lead those discussions. You are required to submit two questions to Dr. Auerbach via e-mail **no later than noon** on the Monday before class about the readings to be discussed that week. These questions will be used to help guide each seminar. In addition to weekly participation, you are expected to write two argumentative papers, the details of which are provided in the next section.

Evaluation

You will be evaluated on your weekly active participation in class, and on two argumentative essays that you will prepare. Class participation makes up 50% of your grade, and consists of:

- submission of two questions based on the week's assigned readings, to be submitted to Dr. Auerbach via e-mail no later than noon on the Monday before each class meeting. Late submissions will not be accepted. These questions will be posted to Blackboard ahead of class meetings.
- active participation in class. This may take the form of asking questions, raising points from the papers, and being prepared to answer questions posed by Dr. Auerbach and fellow students.

The two argumentative papers should not exceed 12 pages each (not including references), and will be on topics of your choice that relate to evolutionary biology. You should meet with Dr. Auerbach during office hours or by appointment to discuss the topic for each paper by the deadline specified below. The schedule for these papers is:

29 September – Topic for 1st paper
20 October – 1st paper due to Dr. Auerbach before class
3 November – Topic for 2nd paper
1 December – 2nd paper due to Dr. Auerbach before class

Early submissions are encouraged. Collaborative papers by two students are an option, though students must demonstrate that equal work was contributed in researching and writing the paper. Students wishing to write a collaborative paper will need to discuss this option with Dr. Auerbach.

Paper grades will be determined using the following rubric:

- **Argumentation (5 points)**: Is the analysis of your paper presented as a clear, coherent argument? This means that you take a position or assert a premise, and then provide evidence to support that position or premise throughout the text and analyses. While your conclusions are likely not definitive (they rarely are), you should at least make a positional conclusion.
- **Statement of the thesis / position (5 points)**: Does the paper present the main question and research goals clearly? Is the thesis presented with a specific argumentative position that allows for the consideration of multiple sources and perspectives?
- **Literature reviewed for thesis statement (10 points)**: Does the paper present sufficient background to support the main position? The background need not be exhaustive, but it needs to be complete enough to argue to the reader why the central topic of the paper is of interest.
- **Full literature review (15 points)**: Has the paper presented a thorough review of appropriate literature to explore all aspects of the main position? Do you consider all relevant papers that argue both in support of and against the thesis? Are related concepts introduced sufficiently to the reader, and is their relevance to the main topic explained? The key is making sure the reader understands the relevance of these topics to a thesis statement.
- **Synthesis (10 points)**: Does the paper ultimately combine the various perspectives and ideas that are introduced into a coherent synthesis? This should mirror the argumentative position of the paper's thesis. Furthermore, this should demonstrate a depth of understanding by you concerning the literature and positions taken by other researchers.
- **Relevance to biological anthropology and/or biology (5 points)**: Is the relevance to topics investigated in biological anthropology or to other biological disciplines (e.g. evolution, functional anatomy, or physiology) clearly demonstrated in the paper? You do not need to state this outright, but it should be evident throughout the paper why

researchers in one or more of these disciplines would want to know about the subject of the paper.

- **Organization (5 points)**: Does the paper follow a logical order and argument? Does the argumentation have adequate support from both references and data presented in the paper?
- **Grammar and language (5 points)**: Make sure that your paper has good sentence structure and writing. Avoid overly long sentences and complicated usages of subclauses; make the writing clear, succinct, and direct. Check for typographic errors and make sure you are employing proper word usage.

Required readings

All course readings are provided as PDFs via Blackboard (**bblearn.utk.edu**). You may look into acquiring copies of the following books: Futuyma's *Evolution (3rd Edition)*; Gillespie's *Population Genetics (2nd Edition)*; Hallgrímsson & Hall's *Variation*; Hallgrímsson and Hall's *Epigenetics*; Hamilton's *Population Genetics* (a 2nd edition will be published in Fall 2015).

Tips for getting the most out of the course:

As a crucial part of this course is keeping up with the reading before class meetings, you need to give ample time to reflect on the perspectives presented in the chapters and papers you read. On average, you are expected to read between 100 and 150 pages a week in assigned chapters and articles. You are *strongly* encouraged to read broadly, looking into additional sources to help you better develop an understanding of the topics covered. An excellent place to start is always in the references cited within the assigned readings. I am also available to point you toward additional resources as specific questions arise. However, you should use this course as an opportunity to develop skills at independently locating and reading relevant sources to supplement those that are assigned.

Students with special needs:

If you require accommodation because of special needs in learning, please contact the Office of Disability Services at 2227 Dunford Hall (974-6087). Please also contact me immediately via e-mail after you register with the Office of Disability Services. Arrangements will be made to adjust the course to fit your needs.

COURSE SCHEDULE: ANTH 690 (001) – *EVOLUTIONARY BIOLOGY* | FALL 2015

All assigned readings should be completed ***before*** each class meeting, unless otherwise noted. Readings are available on Blackboard.

COURSE SECTION	DATE	TOPIC	READINGS (listed in order of recommended reading)
The language of evolutionary theory	25 August	Introduction to the course What is evolutionary theory?	Syllabus Lynch 2007 (Chapter 13); Levins 1966; Godfrey-Smith 2006; Weisberg 2006
	1 September	The importance of variation	Wagner 2011 (Chapter 1); Bowler 2005; Van Valen 2005; Jones & German 2005; Larsen 2005
	8 September	Principles of population genetics	Roff 2003; Gillespie 2004 (Chapter 1); Hamilton 2009 (Chapters 1-2)
Basics of evolutionary processes	15 September	Genetic drift	Gillespie 2004 (Chapter 2: sections 2.1-2.5, 2.7); Futuyma 2013 (Chapter 10); Hamilton 2009 (Chapter 3: pp. 53-87)
	22 September	Defining adaptation	Sober 2005; Orr 2009; Gillespie 2004 (Chapter 3: sections: 3.1-3.4); Futuyma 2013 (Chapter 11)
	29 September	Critiques of optimization theory	Gould & Lewontin 1979; Lauder 1996; Pigliucci & Kaplan 2000; Seger & Stubblefield 1996; Wagner 2011 (Chapter 7)
Evolutionary change within organisms	6 October	Evolvability & constraint I	Arnold 1992; Schluter 1996; Hansen & Houle 2004; Rolian 2014
	13 October	Evolvability & constraint II	Hansen & Houle 2008; Rolian, 2009; Hansen et al. 2011
	20 October	Epigenetics & integration	Hall 2011; Lieberman 2011; Zelditch & Swiderski 2011; Hansen 2011
	27 October	Modularity and evo-devo	Schlosser 2004; Carroll et al. 2005 (Chapters 4 & 6); Wagner et al. 2007
Evolution at & above the species level	3 November	What is a species?	Tattersall 1992; Holliday 2003; Kramer, 2005; Hublin 2013; Lordkipanidze et al. 2013
	10 November	Phylogenetics and homology	Housworth et al. 2004; Collard & Wood 2007; von Cramon-Taubadel 2009
	17 November	Niche construction, life histories, and extinction	Laland et al. 2000; Futuyma 2013 (Chapters 7 & 14)
	24 November	The structure of human evolution	Roseman & Weaver 2007; Hunley et al. 2009; Hunley 2015; Creanza et al. 2015; Roseman & Auerbach 2015
Evolution & society	1 December	Addressing evolution in research and the public sphere	Ayala 2010; Scott 2009 (Chapter 1); Ellstrand 1983

COURSE READINGS

Arnold, S.J. 1992. Constraints on phenotypic evolution. *American Naturalist* 140:S85-S107.

Ayala, F.J. 2010. *Am I a Monkey? Six Big Questions about Evolution*. Baltimore: Johns Hopkins University Press.

Bowler, P.J. 2005. Variation from Darwin to the Modern Synthesis. In (Hallgrímsson, B., & Hall, B.K., *editors*): *Variation*. New York: Elsevier Academic Press, pp. 9-27.

Carroll, S.B., Grenier, J.K., & Weatherbee, S.D. 2005. *From DNA to Diversity: Molecular Genetics and the Evolution of Animal Design*. Second edition. New York: Blackwell Publishing.

Collard, M., & Wood, B. 2007. Hominin homoiology: an assessment of the impact of phenotypic plasticity on phylogenetic analyses of humans and their fossil relatives. *Journal of Human Evolution* 52:573-584.

Creanza, N., Ruhlen, M., Pemberton, T.J., Rosenberg, N.A., Feldman, M.W., & Ramachandran, S. 2015. A comparison of worldwide phenomic and genetic variation in human populations. *Proceedings of the National Academy of Sciences USA* 112(7):1265-1272.

Ellstrand, N.C. 1983. Why are juveniles smaller than their parents? *Evolution* 37(5): 1091-1094.

Futuyma, D.J. 2013. *Evolution*. Third edition. Sunderland, MA: Sinauer and Associates, Inc.

Gillespie, J.H. 2004. *Population Genetics: A Concise Guide*. Second edition. Baltimore: Johns Hopkins University Press.

Godfrey-Smith, P. 2006. The strategy of model-based science. *Biology and Philosophy* 21(5): 725-740.

Gould, S.J., & Lewontin, R.C. 1979. The spandrels of San Marco and the Panglossian paradigm: a critique of the adaptationist programme. *Proceedings of the Royal Society of London B* 205:581-598.

Hall, B.K. 2011. A brief history of the term and concept epigenetics. In (Hallgrímsson, B., & Hall, B.K., *editors*): *Epigenetics: Linking Genotype and Phenotype in Development and Evolution*. Berkeley: University of California Press, pp. 9-13.

Hamilton, M.B. 2009. *Population Genetics*. New York: Wiley-Blackwell.

Hansen, T.F. 2011. Epigenetics: adaptation or contingency? In (Hallgrímsson, B., & Hall, B.K., *editors*): *Epigenetics: Linking Genotype and Phenotype in Development and Evolution*. Berkeley: University of California Press, pp. 357-376.

Hansen, T.F., & Houle, D. 2004. Evolvability, stabilizing selection, and the problem of stasis. In (Pigliucci, M., & Preston, K., *editors*): *Phenotypic Integration: Studying the Ecology and Evolution of Complex Phenotypes*. Oxford: Oxford University Press, pp. 130-150.

Hansen, T.F., & Houle, D. 2008. Measuring and comparing evolvability and constraint in multivariate characters. *Journal of Evolutionary Biology* 21:1201-1219.

Hansen, T.F., Pélabon, C., & Houle, D. 2011. Heritability is not evolvability. *Evolutionary Biology* 38:258-277.

Holliday, T.W. 2003. Species concepts, reticulation, and human evolution. *Current Anthropology* 44(5): 653-673.

Housworth, E.A., Martins, E.P., & Lynch, M. 2004. The phylogenetic mixed model. *The American Naturalist* 163(1): 84-96.

Hublin, J.J. 2013. Paleoanthropology: *Homo erectus* and the limits of a paleontological species. *Current Biology* 24(2):R82-R84.

Hunley, K.L., Healy, M.E., & Long, J.C. 2009. The global pattern of gene identity variation reveals a history of long-range migrations, bottlenecks, and local mate exchange: implications for biological race. *American Journal of Physical Anthropology* 139(1):35-46.

Hunley, K. 2015. Reassessment of global gene-language coevolution. *Proceedings of the National Academy of Sciences USA* 112(7):1919-1920.

Jones, D.C., & German, R.Z. 2005. Variation in ontogeny. In (Hallgrímsson, B., & Hall, B.K., *editors*): *Variation*. New York: Elsevier Academic Press, pp. 71-85.

Kramer, A. 2005. Biospeciation versus morphospeciation in the later human fossil record: Lessons learned from non-human primate socioecology. *Anthropologie* 43:213-220.

Laland, K.N., Odling-Smee, J., & Feldman, M.W. 2000. Niche construction, biological evolution, and cultural change. *Behavioral and Brain Sciences* 23:131-175.

Larsen, E. 2005. Developmental origins of variation. In (Hallgrímsson, B., & Hall, B.K., *editors*): *Variation*. New York: Elsevier Academic Press, pp. 113-129.

Lauder, G.V. 1996. The argument from design. In (Rose M.R., & Lauder G.V., *editors*): *Adaptation*. New York: Academic Press, pp. 55-92.

Levins, R. 1966. The strategy of model building in population biology. *American Scientist* 54(4): 421-431.

Lieberman, D.E. 2011. Epigenetic integration, complexity, and evolvability of the head: rethinking the functional matrix hypothesis. In (Hallgrímsson, B., & Hall, B.K., *editors*): *Epigenetics: Linking Genotype and Phenotype in Development and Evolution*. Berkeley: University of California Press, pp. 271-289.

Lordkipanidze, D., Ponce de León, M.S., Margvelashvili, A., Rak, Y., Rightmire, G.P., Vekua, A., & Zollikofer, C.P.E. 2013. A complete skull from Dmanisi, Georgia, and the evolutionary biology of early *Homo*. *Science* 342:326-331.

Lynch, M. 2007. *The Origins of Genomic Architecture*. Chapter 13: Genomfart. Sunderland, MA: Sinauer and Associates, Inc.

Orr, H.A. 2009. Fitness and its role in evolutionary genetics. *Nature Reviews Genetics* 10(8): 531-539.

Pigliucci, M., & Kaplan, J. 2000. The fall and rise of Dr Pangloss: adaptationism and the Spandrels paper 20 years later. Trends in Ecology and Evolution 15:66-70.

Roff, D. 2003. Evolutionary quantitative genetics: are we in danger of throwing out the baby with the bathwater? *Annales Zoologici Fennici* 40:315-320.

Rolian, C. 2009. Integration and evolvability in primate hands and feet. *Evolutionary Biology* 36:100-117.

Rolian, C. 2014. Genes, development, and evolvability in primate evolution. *Evolutionary Anthropology* 23:93-104.

Roseman, C.C, & Auerbach, B.M. 2015. Ecogeography, genetics, and the evolution of human body form. *Journal of Human Evolution* 78:80-90.

Roseman, C.C, & Weaver, T.D. 2007. Molecules versus morphology? Not for the human cranium. *Bioessays* 29:1185-1188.

Schlosser, G. 2004. The role of modules in development and evolution. In (Schlosser, G., & Wagner, G.P., *editors*): *Modularity in Development and Evolution*. Chicago: University of Chicago Press, pp. 519-582.

Schluter, D. 1996. Adaptive radiation along genetic lines of least resistance. *Evolution* 50(5):1766-1774.

Scott, E.C. 2009. *Evolution vs. Creationism: An Introduction*. Second edition. Berkeley, CA: University of California Press.

Seger J., & Stubblefield J.W. 1996. Optimization and adaptation. In (Rose M.R., & Lauder G.V., *editors*): *Adaptation*. New York: Academic Press, pp. 93-123.

Sober, E. 2005. The two faces of fitness. In (Singh, R.S., Krimbas, C.B., Paul, D.B., & Beatty J., *editors*): *Thinking About Evolution: Historical, Philosophical, and Political Perspectives*. Cambridge: Cambridge University Press, pp. 309-321.

Tattersall, I. 1992. Species concepts and species identification in human evolution. *Journal of Human Evolution* 22(4-5), 341-349.

Van Valen, L. 2005. The statistics of variation. In (Hallgrímsson, B., & Hall, B.K., *editors*): *Variation*. New York: Elsevier Academic Press, pp. 29-47.

von Cramon-Taubadel, N. 2009. Revisiting the homoiolgy hypothesis: the impact of phenotypic plasticity on the reconstruction of human population history from craniometric data. *Journal of Human Evolution* 57:179-190.

Wagner, A. 2011. *The Origins of Evolutionary Innovations*. Oxford: Oxford University Press.

Wagner, G.P., Pavlicev, M., & Cheverud, J.M. 2007. The road to modularity. *Nature Reviews Genetics* 8:921-931.

Weisberg, M. 2006. Forty years of 'the strategy': Levins on model building and idealization. *Biology and Philosophy* 21(5): 623-645.

Zelditch, M.L., & Swiderski, D.L. 2011. Epigenetic interactions: the developmental route to functional integration. In (Hallgrímsson, B., & Hall, B.K., *editors*): *Epigenetics: Linking Genotype and Phenotype in Development and Evolution*. Berkeley: University of California Press, pp. 290-316.