

Evolutionary Biology
 Biology 350 — **REVISED SYLLABUS** — Spring, 2009
 T & R, 10:30 to 11:45 a.m., Olmsted 301

Professor: John Long
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 version: 21 April 09

Date	Day	Topic	Readings
<i>Jan 22</i>	R	The Origin of Species	Darwin, OoS, Chs 1-3
27	T	Descent with Modification: Patterns & Evidence	F & H, Ch. 2
29	R	Natural Selection and its Difficulties	Darwin, OoS, Chs 4-6
<i>February</i>			
3	T	Darwinian Natural Selection	F & H, Ch. 3
5	R	Instincts, Hybrids, Intermediates	Darwin, OoS, Chs 7-9
10	T	Tree-thinking: Phylogenetics	F & H, Ch. 4
12	R	Darwin's Birthday! Darwin Days Talks	Darwin, OoS, Chs 10-14
17	T	Darwin in Action: HIV	F & H, Ch. 1
19	R	Darwin in Action: Voyage of the Beagle	Darwin, VotB, Chs 1-11
24	T	What Darwin Lacked: Genetic Theory	F & H, Ch 5
26	R	Darwin in Action: Voyage of the Beagle	Darwin, VotB, Chs 12-23
<i>March</i>			
3	T	Population Genetics I	F & H, Ch 6
5	R	Finding Evolution in the Wild	Carroll, Chs 1-5
		<i>SPRING BREAK</i>	
24	T	Evolution of behavior	Arai <i>et al.</i> (2009); Clutton-Brock <i>et al.</i> (2002); Fehr & Gachter (2002).
26	R	Evolution of brains	Mekel-Bobrov <i>et al.</i> (2005); Marino <i>et al.</i> (2004); Northcutt (2002).
31	T	Evolution of hard tissues in sharks (Dr. Porter)	Coates (1998); Eames <i>et al.</i> (2007); Hall (1982); Koob & Long (2000).
<i>April 2</i>	R	Evolution of hominids	Bennett <i>et al.</i> (2009); Falk <i>et al.</i> (2005); Stedman <i>et al.</i> (2004).
7	T	Water to land: tetrapods evolve I	Clack (2007); Daeschler <i>et al.</i> (2006); Davis <i>et al.</i> (2007); Long <i>et al.</i> (2006).
9	R	Land to water: tetrapods evolve II	Gingerich <i>et al.</i> (2009); Thewissen <i>et al.</i> (2006); Thewissen <i>et al.</i> (1994).
14	T	Humans as agents of selection	Darimont <i>et al.</i> (2009); Kuparinen <i>et al.</i> (2009); Hendry <i>et al.</i> (2009).
Date	Day	Topic	Readings
16	R	Student-led discussions 1	Selected by students
21	T	Student-led discussions 2	Selected by students
23	R	Student-led discussions 3	Selected by students
28	T	Student-led discussions 4	Selected by students

30	R	Student-led discussions 5	Selected by students
May			
5	T	Evolutionary applications	Day & Stearns (2009); Nesse & Stearns (2009); Pepper <i>et al.</i> (2009); Read & Huijben (2009).

Primary literature

[Primary reading assignments are shown in blue as your initials in square brackets after the assigned reading. As a primary reader, you should focus your efforts on mastering the content of your primary paper. The other papers you should also read and be prepared to discuss.]

24 March: Evolution of behavior

1. Arai, J.A., Li, S., Hartley, D.M. and L.A. Feig (2009). Transgenerational rescue of a genetic defect in long-term potentiation and memory formation by juvenile enrichment. *J. Neuroscience* 29(5), 1496-1502. [ES, EH, PK, LN, MF, NH, LC]
2. Clutton-Brock, T.H., Russell, A.F., Sharpe, L.L., Young, A.J., Balmforth, Z. and G.M. McIlrath (2002). Evolution and development of sex differences in cooperative behavior in meerkats. *Science* 297, 253-256. [MG, BG, BP, LS, CH, LM, KB]
3. Fehr, E. and S. Gächter (2002). Altruistic punishment in humans. *Nature* 415, 137-140. [EK, NC, AB, GD, RS, JR, MK, AL]

26 March: Evolution of brains

1. Mekel-Bobrov, N., Glibert, S.L., Evans, P.D., Vallender, E.J., Anderson, J.R., Hudson, R.R., Tishkoff, S.A. and B.T. Lahn (2005). Ongoing adaptive evolution of ASPM, a brain size determinant in *Homo sapiens*. *Science* 309, 1720-1722. [LS, MK, RS, BP, MF, EH, AB]
2. Marino, L., McShea, D.W. and M.D. Uhen (2004). Origin and evolution of large brains in toothed whales. *Anat. Rec., A* 281A, 1247-1255. [JR, ES, LC, KB, EK, BG, NH]
3. Northcutt, R.G. (2002). Understanding vertebrate brain evolution. *Integ. & Comp. Biol.* 42, 743-756. [CH, LN, MG, LM, AL, NC, PK, GD]

30 March: Evolution of hard tissues in sharks

1. Coates, M. (1998) Spines and tissues of ancient sharks. *Nature* 396, 729-730. [JR, BP, RS, MK, AL, LM, PK]
2. Eames, B.F., Allen, N., Young, J., Kaplan, A., Helms, J.A. and R.A. Schneider (2007). Skeletogenesis in the swell shark *Cephaloscyllium ventriosum*. *J. Anat.* 210, 542-554. [CH, NH, MG, ES, NC, LC, BG]
3. Hall, B. (1982). Bone in cartilaginous fishes. *Nature* 298, 324. [AB, LN, LS, KB, EH, EK, MF, GD]
4. Koob, T.J. and J.H. Long, Jr. (2000). The vertebrate body axis: evolution and mechanical function. *Amer. Zool.* 40, 1-18.

2 April: Evolution of hominids

1. Bennett, M.R., Harris, J.W.K., Richmond, B.G., Braun, D.R., Mbuja, E., Kiura, P., Olago, D., Kibunjia, M., Omuomubo, C., Behrensmeyer, A.K., Huddart, D. and S. Gonzalez (2009). Early hominin foot morphology base on 1.5-million-year-old footprints from Ileret, Kenya. *Science* 323, 1197-1201. [BG, AL, BP, AB, MK, RS, GD]
2. Falk, D., Hildebolt, C., Smith, K., Morwood, M.J., Sutikna, T., Brown, P., Jatmiko, Saptomo, E.W., Brunnsden, B. and F. Prior (2005). The brain of LB1, *Homo floresiensis*. *Science* 308, 242-245. [LM, ES, PK, MF, CH, KB, NC]
3. Stedman, H.H., Kozyak, B.W., Nelson, A., Thesier, D.M., Su, L.T., Low, D.W., Bridges, C.R., Shrager, J.B., Minugh-Purvis, N. and M.A. Mitchell (2004). Myosin gene mutation correlates with anatomical changes in the human lineage. *Nature* 428, 415-418. [LN, JR, NH, EK, LC, MG, LS, EH]

7 April: Water to land: tetrapods evolve I

1. Clack, J.A. (2007). Devonian climate change, breathing, and the origin of the tetrapod stem group. *Integ. & Comp. Biol.* 47(4), 510-523. [CH, LN, BG, NC, LS]
2. Daeschler, E.B., Shubin, N.H. and F.A. Jenkins, Jr. (2006). A Devonian tetrapod-like fish and the evolution of the tetrapod body plan. *Nature* 440, 757-763. [KB, EK, LC, GD, RS]
3. Davis, M.C., Dahn, R.D. and N.H. Shubin (2007). An autopodial-like pattern of *Hox* expression in the fins of a basal actinopterygian fish. *Nature* 447, 473-476. [MF, BP, PK, AL, MK, JR]
4. Long, J.A., Young, G.C., Holland, T., Senden, T.J. & E.M.G. Fitzgerald (2006). An exceptional Devonian fish from Australian sheds light on tetrapod origins. *Nature*, 444, 199-202. [ES, EH, LM, NH, MG, AB]

9 April: Land to water: tetrapods evolve II

1. Gingerich, P.D., ul-Haq, M., von Koenigswald, W., Sanders, W.J., Smith, B.H. and I.S. Zalmout (2009). New protocetid whale from the Middle Eocene of Pakistan: birth on land, precocial development, and sexual dimorphism. *PLoS ONE* 4(2), e4366. [EK, LN, AL, RS, GD, ES, LS]
2. Thewissen, J.G.M., Cohn, M.J., Stevens, L.S., Bajpal, S., Heyning, J. and W.E. Horton, Jr. (2006). Developmental basis for hind-limb loss in dolphins and origin of the cetacean bodyplan. *Proc. Nat. Acad.* 103(22), 8414-8418. [KB, PK, BP, NC, BG, LM, CH]
3. Thewissen, J.G.M., Hussain, S.T. and M. Arif (1994). Fossil evidence on the origin of aquatic locomotion in Archaeocete whales. *Science* 263, 210-212. [JR, EH, AB, MK, LC, MG, MF, NH]

14 April: Humans as agents of selection

1. Darimont, C.T., Carlson, S.M., Kinnison, M.T., Paquet, P.C., Reimchen, T.E. and C.C. Wilmers (2009). Human predators outpace other agents of trait change in the wild. *Proc. Nat. Acad. Sci.* 106(3), 952-954. [ES, KB, LS, GD, RS, NC, JR]
2. Kuparinen, A., Kuikka, S. and J. Merila (2009). Estimating fisheries-induced selection: traditional gear selectivity research meets fisheries-induced evolution. *Evol. Applications* (advanced publication, web). [AL, BP, MG, PK, BG, MF, LN]
3. Hendry, A.P., Grant, P.R., Grant, B.R., Ford, H.A., Brewer, M.J. and J. Podos (2009). Possible human impacts on adaptive radiation: beak size bimodality in Darwin's finches. *Proc. R. Soc. B.* 276, 753-759. [EK, MK, EH, AB, NH, LM, LC, CH]

16 April: Student-led Discussions 1

1. Bobrow, D. and J.M. Bailey (2001). Is male homosexuality maintained via kin selection? *Evo. & Human Behavior* 22, 361-368. [Leader: EK. Team: JR, MG, LC, EH]
2. Hawkes, L.A., Broderick, A.C., Godfrey, M.H. and B.J. Godley (2007). Investigating the potential impacts of climate change on a marine turtle population. *Global Change Bio.* 13, 923-932. [Leader: CH. Team: LN, GD, ES, RS]
3. Klein, C., Nguyen, D., Lui, C.-H., Mizoguchi, A., Bhan, A.K., Miki, H., Takenawa, T., Rosen, F.S., Alt, F.W., Mulligan, R.G. and S.B. Snapper (2003). Gene therapy for Wiskott-Aldrich syndrome: rescue of T-cell signaling and amelioration of colitis upon transplantation of retrovirally transduced hematopoietic stem cells in mice. *Blood* 101(8), 2159-2166. [Leader: NC. Team: AB, KB, MF]
4. Deutsch, D., Henthorn, T., Marvin, E. and X. HongShuai (2006). Absolute pitch among American and Chinese conservatory students: prevalence differences, and evidence for a speech-related critical period. *J. Acoust. Soc. Am.* 119(2), 719-722. [Leader: NH. Team: LS, AL, BP]
5. Simo, L.S., Krisky, C.M. and J.A. Sweeney (2005). Functional neuroanatomy of anticipatory behavior: dissociation between sensory-driven and memory-driven systems. *Cerebral Cortex* 15, 1982-1991. [Leader: LM. Team: PK, MK, BG]

21 April: Student-led Discussions 2

1. Ebert, D. (1998). Experimental evolution of parasites. *Science* 282, 1432-1435. [Leader: BG. Team: LS, BP, JR, MG, KB, LC]
2. Smith, K., Alberts, S.C. and J. Altmann (2003). Wild female baboons bias their social behavior towards paternal half-sisters. *Proc. Bio. Sciences* 270(1514), 503-510. [Leader: EH. Team: AB, AI, MF, NC, EK, GD]
3. Watson, K.K., Jones, T.K. and J.M. Allman (2006). Dendritic architecture of the von Economo neurons. *Neuroscience* 141, 1107-1112. [Leader: ES. Team: RS, LN, CH, PK, NH, LM, MK]

23 April: Student-led Discussions 3

1. Boesch, C., Crockford, C., Herbinger, I., Wittig, R., Moebius, Y. and E. Normand (2008). Intergroup conflicts among chimpanzees in Tai National Park: Letttha violence and the female perspective. *Am. J. Primatology* 70, 519-532. [Leader: RS. Team: LC, NC, AB.]
2. Champagne, F.A., Weaver, I.C.G., Diorio, J., Dymov, S., Szyf, M. and M.J. Meaney (2006). Maternal care associated with methylation of the estrogen receptor- α 1b promoter and estrogen receptor- α expression in the medial preoptic area of female offspring. *Endocrinology* 147(6), 2909-2915. [Leader: MG. Team: Lm, Ek, BG, NH]
3. Khativich, P., Lockstone, H.E., Wayland, M.T., Tang, T.M., Jayatilaka, S.D., Guo, A.J., Zhou, J., Somel, M., Harris, L.W., Holmes, E., Paabo, S. and S. Bahn (2008). Metabolic changes in schizophrenia and human brain evolution. *Genome Biol.* 9, R124. [Leader: LN. Team: MF, JR, EH, PK]
4. Schillad, M.A. (2006). Sexual selection and the evolution of brain size in primates. *PLoS One* 1(1): e62. [Leader: LS. Team: BP, Ch, MK]
5. Tyedmers, J., Madariaga, M.L. and S. Lindquist (2008). Prion switching in response to environmental stress. *PLoS Biol.* 6(1), e294. [Leader: KH. Team: GD, ES, AI]

28 April: Student-led Discussions 4

1. Carter, C.S., DeVries, A.C. and L.L. Getz (1995). Physiological substrates of mammalian monogamy: the prairie vole model. *Neuroscience and Biobehavioral Reviews* 19(2), 303-314. [Leader: GD. Team: LC, ES, LS, MK]
2. Chapillon, P., Patin, V., Roy, V., Vincent, A. and J. Caston (2001). Effects of pre- and postnatal stimulation on development, emotional, and cognitive aspects in rodents: a review. *Dev. Psychobiol.* 41, 373-387. [Leader: BP. Team: MF, EK, EH, CH]
3. Edelaar, P., Siepielski, A.M. and J. Clobert (2008). Matching habitat choice causes directed gene flow: a neglected dimension in evolution and ecology. *Evolution* 62(10): 2462- 2472. [Leader: JR. Team: KB, AL, RS, AB, LM]

30 April: Student-led Discussions 5

1. Hegreness, M., Shores, N., Damaian, D., Hartl, D. and R. Kishony (2008). Accelerated evolution of resistance in multidrug environments. *PNAS* 105(37), 13977-13981. [Leader: AL. Team: LC, EH, PK, AB, NC]
2. Polimeni, J., Reiss, J.P. and J. Sareen (2005). Could obsessive-compulsive disorder have originated as a group-selected adaptive trait in traditional societies? *Medical Hypotheses* 65, 655-664. [Leader: MF. Team: KB, LM, MG, ES, RS]
3. Zhao, Z. and E.A. Reece (2005). Nicotine-induced embryonic malformations mediated apoptosis from increasing intracellular calcium and oxidative stress. *Birth Defects Research (Part B)* 74, 383-391.

2 May: Evolutionary applications

1. Day, T. and S.C. Stearns (2009). Editorial: evolutionary medicine special issue. *Evol. Applications* 2(1), 7-10. [Everybody](#).
2. Nesse, R.M. and S.C. Stearns (2009). The great opportunity: evolutionary applications to medicine and public health. *Evol. Applications* 2(1), 28-48. [MK, EH, RS, LS, PK, JR, NC]
3. Pepper, J.W., Findlay, C.S., Kassen, R., Spencer, S.L. and C.C. Maley (2009). Cancer research meets evolutionary biology. *Evol. Applications* 2(1), 62-70. [LC, AL, BG, LN, GD, CH, MG, LM]
4. Read, A.F. and S. Huijben (2009). Evolutionary biology and the avoidance of antimicrobial resistance. *Evol. Applications* 2(1), 40-51. [BP, MF, ES, EK, AB, KB, NH]

Required books

Carroll, S.B. (2009). *Into the Jungle, Great Adventures in the Search for Evolution*. Pearson, NY.

Darwin, C. (1989). *The Voyage of the Beagle: Charles Darwin's Journal of Researches*. Penguin Classics, NY.

Darwin, C. (2001). *On the Origin of Species*, A Facsimile of the First Edition. Harvard University Press, Cambridge, MA. NOTE: You must get this specific, first edition facsimile copy of *Origin*; Darwin wrote six editions, and it is the sixth that is usually sold as "the" *Origin of Species*. Also, the first edition has all the original page numbers that are used in the many scholarly discussion of this book.

Freeman, S. & J.C. Herron (2007). *Evolutionary Analysis, Fourth Edition*. Pearson, NY. If you plan to purchase a used copy of this textbook, make sure that you get the 4th Edition and that you get the bundled software resources. Early editions are not acceptable.

Goals

By the end of the course, you should be able to understand the major tenets of early and current evolutionary theory, recognize flawed evolutionary arguments, judge evidence used to test evolutionary theory, generate predictions from hypotheses, and develop methods to test evolutionary predictions. You will develop these abilities by first writing a series of concise essays that focus on understanding and evaluating evidence. You will then put your skills to work by writing a full grant proposal, as if to the National Science Foundation, where you review literature, generate hypotheses with testable predictions, and develop a program to test those predictions. As part of your research, you will lead a class discussion about your area of interest.

Policies

Disability policy: Academic accommodations are available for students with disabilities who are registered with the Office of Disability and Support Services (DSS). Students in need of disability accommodations should schedule an appointment with me early in the semester to discuss any accommodations for this course that have been approved by the DSS, as indicated in your DSS accommodation letter.

Late-assignment policy: All late assignments will be penalized by a reduction of 2% (of total possible points) for each day late. If you cannot make it to class, email your assignment to me ("jolong") to establish time of submission. An extension will only be given if it is requested by your Class Advisor.

You must hand in all assignments to receive a passing grade in this course. Please also retain a copy of each assignment that you submit, in case either or us have any question later about whether or not you submitted a particular assignment.

Assignments

	<u>Due date & time</u>	<u>% total grade</u>
Essay 1: Why pigeons, Chuck?	10:30 a.m., R, 29 Jan	5
Essay 2: Darwin in the news: What's up, Chuck?	10:30 a.m., R, 12 Feb	10
Essay 3: Darwin Days at Vassar: news report	10:30 a.m., R, 19 Feb	15
Essay 4: Where Darwin went wrong: scientific review	10:30 a.m., R, 26 Feb	15
Discussion: select paper and lead (groups of three)	10:30 a.m., Rs, in April	10
Final Project: NSF grant pre-proposal	10:30 a.m., R, 26 March	10
Final Project: NSF grant proposal	10:30 a.m., R, 30 April	25
Participation & Attendance		<u>10</u>
	Total	<u>100</u>

Please keep a copy of all of your assignments.

Darwin Days at Vassar College in the Aula

Thursday, February 12

Hands-on Activities 9:00 – 10:30 a.m. (1) “Make your Own Glowing Bacteria, (setup experiment)”, (2) Spore “Creature Creator”, and (3) “Evolution Simulation” game.

Jeff Walker, Earth Science 10:30-11:15 a.m.. “John Burroughs and the American School of NeoLamarckism.”
Randy Cornelius, Psychology 11:15 – 12:00 noon. “Charles Darwin and the Evolution of Facial Expressions of Emotion.”

Kathleen Hart, French 1:00 – 2:00 p.m. “Naked Apes & Naked Emperors: Darwinian Approaches to Literature.”

Wilson Salls, Earth Science 2:15- 3:00 p.m. “A Galapagos Travelogue.”

Lucy Johnson, Anthropology 3:15 – 4:00 p.m. “Survival of the Fittest: Spencerian Social Evolution.”

Mark Schlessman, Biology 4:15 – 5:00 p.m. “Darwin’s ‘wetched-looking little weeds:’ insights on evolution from the fascinating flora of the Galapagos.”

Friday, February 13

Hands-on Activities 9:00 – 10:30 a.m.

Kirsten Menking, Earth Science 9:45 – 10:45 p.m. “Animals in the Galapagos – What Darwin Saw”

John Long, Biology & Cognitive Science 11:00 – 12:00 noon. “Evolving Robots to Understand the Origins of Vertebrates”

Yu Zhou, Geography 1:00 – 1:45 p.m.. “What does Darwin have to do with innovation?”

Jill Schneiderman, Geology 2:00 – 2:45 p.m. “Irreducible Complexity, Intelligent Design and Geology.”

Jodi Schwarz, Biology 4:00 – 5:00 p.m. “Results of Hands-on Experiments.”

Reception, 5:00 to 5:30 p.m.