

**Evolutionary Theory and Processes  
Anthropology 508 (16:070:508:01)**

**S. Cachel  
Spring, 2014**

**This syllabus can be downloaded from the Website of the Rutgers Department of Anthropology (<http://anthro.rutgers.edu/>); click on grad program; click on courses; click on 16:070:508, Spring 2014). The syllabus is also available from the class Sakai site, accessible via the Rutgers Sakai portal (<http://sakai.rutgers.edu/portal>).**

**Course Venue:** Wednesday, 2:15-5:15 P.M., Biological Sciences Building, Room 302, Douglass Campus

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Office hours (Spring Semester): Monday 1-4 P.M., or by appointment

**Course Objectives and Goals:** To introduce students to the history of evolutionary theory, the diversity of evolutionary processes, and the most recent developments in evolutionary thinking, so that they have the background objectively to assess oral presentations and published discussions concerning the nature of evolution itself, and details of animal evolution.

**Required Texts:**

Carroll, Sean B. 2005. *Endless Forms Most Beautiful. The New Science of Evo Devo and the Making of the Animal Kingdom*. New York: W.W. Norton & Company (paperback)

Hall, Brian K. & Hallgrímsson, Benedikt 2014. *Strickberger's Evolution*, 5<sup>th</sup> ed. Burlington, MA: Jones & Bartlett. (hardback)

Williams, George C. 1992. *Natural Selection: Domains, Levels, and Challenges*. Oxford: Oxford University Press (paperback)

These books are all available from New Jersey Books, 37 Easton Avenue, New Brunswick, 732-253-7666, and the Cook/Douglass Rutgers University Bookstore at Nichol St. & Lipmann Ave

**Downloadable Resource:**

A free, downloadable virtual stickleback fish evolution lab, financed by the Howard Hughes Medical Institute, is available at [BioInteractive.org/Science](http://BioInteractive.org/Science). Tablets and mobile devices are supported. There are three self-directed labs on the stickleback pelvic girdle and pelvic spines on this site: analyzing phenotypes in living fish; fossil fish and evolutionary change; and pelvic asymmetry.

Additional reference articles will be put on the class Sakai site. Enter this site via the Rutgers Sakai portal (<http://sakai.rutgers.edu/portal>). I will post course announcements via the class Sakai site, so students must regularly check their Rutgers e-mail account.

### **Course Requirements:**

Please turn off all cell phones in class.

Class participation accounts for 10% of the final grade. Three short (ca. 5 page, double-spaced) papers objectively synthesizing and analyzing debate on one of the general topics addressed in each one-third of the course account for 60% of the final grade (20% for each paper). An analytical bibliography of 10-15 references on an evolutionary topic of special interest to you accounts for 30% of the final grade.

Due dates for the short papers are February 19<sup>th</sup>, March 26<sup>th</sup>, and April 23<sup>rd</sup>. Please turn in hardcopies of the papers, and not electronic versions via e-mail. These short papers must be referenced in standard scientific format with no footnotes. Online references that are cited must include the URL of the journal or Website and the document identification number (DOI) of the paper, if a paper is cited, and not a blog entry (e.g., something on John Hawk's blog). The emphasis of the short papers should be on **synthesis and analysis**, rather than on compiling a list of undigested references.

The analytical bibliography is due on the first day of the final exam period (May 8<sup>th</sup>). It should be started by the middle of the course, because it is worth 30% of the final grade. Again, please give me a hardcopy version. The bibliography should have an introduction, indicating the topic, and its general theoretical importance. The bibliography should close with a brief summary. Each entry in the bibliography must contain a précis, and important references should be critiqued in detail. Check with me before choosing a bibliography topic. Because a number of existing graduate anthropology courses already deal with topics in social evolution, the bibliography must not duplicate material written in fulfillment of requirements for these courses. Any bibliography with duplicated material will be returned, and the student will receive an "Incomplete" for the course, until the bibliography is re-done.

### **Course Topics and Readings**

**January 22**            introductory; natural and artificial selection; natural selection in the wild; computer simulations of selection; artificial selection experiments; rates of evolution; stasis; implications of evolutionary rate changes for reading and interpreting the fossil record

- January 29** taphonomy and paleontology: what data are lost, and how is the fossil record skewed? FADs, LADs, and the fossil record; genetic variability and evolutionary change; too much genetic variability?—Lewontin’s critique of natural selection; small populations and Wright’s concept of genetic drift; the Founder’s Effect; examples of the Founder’s Effect in human populations and the St. Kitts vervets; sexual selection  
H & H, chapters 1, 4, 5, 18, & 19
- February 5** adaptation; Gould and Lewontin’s “The Adaptationist Program” and its rebuttals; Is phylogenetic analysis more important than the study of adaptations? Is functional morphology a moribund science? How does one study adaptation in modern species?...and in fossil species? (can this ever be done?); other bias on Gould’s part: using “plausible scenarios” to taint Samuel George Morton, anthropometry, and human variation, Charles Lyell promoting uniformitarianism to promote capitalism, etc.  
H & H, chapters 10, 11, & 13
- February 12** adaptive radiations; changing adaptive zones; examples from vertebrate evolution (the fossil record and island chains); convergent and parallel evolution; parallel speciation—Schluter’s empirical and abstract analyses; competition and character displacement; genotype/phenotype relationships in complex traits; phenotypic plasticity; examples from human biology; the Secular Trend in modern human history  
H & H, chapters 14, 15, & 16
- February 19** **1<sup>st</sup> short paper due**  
Problems in defining species (introduction); modes of species origin (speciation); evidence from modern and fossil mammals; allopatry in Amazonian mammals (including primates); sympatric speciation (ecological speciation); “Contemporary Evolution”; Lenski’s test tube speciation experiments; sexual selection and speciation  
H & H, chapters 17 & 2
- February 26** karyotyping and analysis of genetic diversity in natural populations—implications for sympatric speciation; genetic variation in the wild; hybrid zones and hybridization; lessons from the Awash baboons; Vrba’s model of climate-induced pulses

of faunal turnover and mammal evolution (mammals as models of climate-induced change); implications for Plio/Pleistocene primate evolution; species diversity in time and space

Begin reading Williams [**George Williams, was a member of the National Academy of Sciences, and was awarded the Elliot Medal (NAS) & the Crafoord Prize**]

**March 5**

species extinctions; species extinction a philosophical landmine for the 18<sup>th</sup> and 19<sup>th</sup> centuries; impending extinctions, ecosystem collapse, and “the future of evolution”; pulses or cyclicality of extinction? If so, why? (the Nemesis Hypothesis, “normal” astronomical forcing, etc.); major extinction events in the history of life and their presumed causes; Jablonski and Sepkosi: the nature of the fossil record; was the K/T extinction normal? neocatastrophism; the Burgess Shale and Gould’s contingency argument (“If we could re-play the tape of the history of life...,”); the Cambrian Explosion “exploded” by new finds—implications of this for broad patterns in the history of life; patterns of morphological divergence and morphospace; morphospace analysis

H & H, chapter 24

**March 12**

Stehlin’s “Grande Coupure” and mammal evolution; extinction of non-human primates in North America; extinction of the Miocene hominoid radiation; extinction of the Pleistocene Malagasy prosimians; MacArthur and Wilson: the Theory of Island Biogeography; species/area relationships; the Fragmented Forest Project in Amazonia; modern extinctions and habitat restriction

H & H, chapters 20 & 21

**March 19**

**NO CLASS—Spring Recess**

**March 26**

**2<sup>nd</sup> short paper due**

classical embryology and primate evolution (Schultz); imprinting; epigenetics; the current revolution in epigenetics; Morgan’s discovery of mutations and mutagens; Goldschmidt’s systemic mutations—the origins of major anatomical novelty? appreciation of population-level variability destroys the systemic mutation explanation for the origin of higher taxa

- April 2** evolutionary development; developmental genetics; heterochrony; *Hox* genes; implications of *Hox* genes for convergence and homoplasy; anatomical genomics; to what extent does development constrain morphology? Epigenetics again  
Begin reading Carroll [**Sean Carroll was elected to the National Academy of Sciences in May, 2007**]
- April 9** No Class—Annual meetings of the Paleoanthropology Society and the American Association of Physical Anthropologists (Calgary, Canada)
- April 16** Species concepts and species origins (speciation); the biological species concept; the phylogenetic species concept; the recognition concept of species; morphospecies; defining fossil species—how to do it? Five schools of classification—what to do? Speciation mode implied by cladistics; the homoplasy problem and cladistics; species and grades as fuzzy sets; grades and clades—grades denigrated by cladists; grade analysis can be productive; morphospace analysis studies grades; molecules versus morphology in systematics? Does soft-tissue give different information than bones and teeth do?  
H & H, chapter 3
- April 23** **3<sup>rd</sup> short paper due**  
Macroevolution; are macroevolutionary processes necessarily distinct from microevolutionary processes (e.g., natural selection, etc.)? “gradualism” versus Eldredge and Gould’s punctuated equilibria; the morphing of the punctuated equilibria theory; Stanley’s species selection and earlier versions; Potts’s variability selection; phenotypic plasticity versus variability selection; phenotypic plasticity and ecological release; ecological triggers to new adaptive zones or invasion of vacated niches? Ecological factors in speciation  
H & H, chapters 22 & 23
- April 30** faunal evolution; faunal turnovers; geographic invasions and dispersions; what determines the success of invading species? Modern naturalized species; invaders released from parasites? Rules for mammal evolution on islands; cenogram analysis and ancient ecosystems; reconstructing ancient niches and ancient communities? the evolution of species interactions; coordinated stasis—an idea that was quickly disproved; The FAUNMAP

project and Pleistocene communities in North America;  
morphological change in North American Quaternary mammals;  
energy flow and community structure; Damuth's avatar concept

**May 8      Analytical bibliography due (1<sup>st</sup> day of Final Exam period)**