

Mammal Diversity and Evolution (Fall 2017)

BIOL 345/ANAT 445

Seminar (S): Tuesdays and Thursdays, 4:00-5:15 pm, SOM (East Wing), room E429C

Lab (L): Wednesdays, 3:20-6:00 pm, SOM (East Wing), room E430A unless noted otherwise

Instructor: Darin A. Croft, Ph.D., SOM (East Wing) EG03; 368-5268; dcroft@case.edu; TA: Russell Engelman (rke3@case.edu)

Date	Topic and Activity	Textbook Readings, DVDs	Journal Article(s)	Quiz, Deadline, etc.
Aug. 29	S1 (DC): Mammal characteristics and classification	V: Ch. 1, 3-4; DVD 10: Food for thought		
Aug. 30	L1: Mammal osteology	Elbroch 2006, Ch. 1-2 (on Canvas)		
Aug. 31	S2: Mammal origins, monotremes	V: Ch. 2, 5, 20; DVD 1: A winning design	Philips et al. 2009	
Sept. 5	S3: Afrosoricida, Macroscelidea, Tubulidentata	V: Ch. 7-8; DVD 2: Insect hunters	Lovegrove et al. 2014	Grad. presentation dates due
Sept. 6	L2: Phylogenetics (*CMNH*)	"Tree Thinking" (on Canvas)		Quiz 1: C1-2, L1
Sept. 7	S4: Eulipotyphla	V: Ch. 14	Stanley et al. 2013	
Sept. 12	(No class)			
Sept. 13	(No class)			
Sept. 14	(No class)			
Sept. 19	S5: Cingulata, Pholidota	V: Ch. 10	Ciancio et al. 2017	
Sept. 20	L3: Afrosoricida, Macroscelidea, Erinaceomorpha, Soricomorpha			Quiz 2: C3-4, DVD 2
Sept. 21	S6: Pilosa	V: Ch. 10; DVD 8: Life in the trees	Pauli et al. 2014	
Sept. 26	S7: Scandentia, Dermoptera, Primates 1	V: Ch. 11-12	Shattuck and Williams 2010	
Sept. 27	L4: Monotremata, Cingulata, Pilosa, Pholidota, Tubulidentata			Quiz 3: C5-6, DVD 8
Sept. 28	S8: Primates 2	V: Ch. 12; DVD 9: Social climbers	Lukas and Clutton-Brock 2013	
Oct. 3	S9: Chiroptera 1	V: Ch. 15, 22	Simmons et al. 2008	
Oct. 4	L5: Scandentia, Dermoptera, Primates, Chiroptera			Quiz 4: C7-8, DVD 9
Oct. 5	S10: Chiroptera 2	V: Ch. 15, 22	Corcoran and Conner 2014	
Oct. 10	S11: Rodentia 1	V: Ch. 13; DVD 4: Chisellers	Hopkins 2005	
Oct. 11	LAB REVIEW (*CMNH*)			
Oct. 12	REVIEW (C3-6)			
Oct. 17	REVIEW (C7-10)			
Oct. 18	MIDTERM EXAM			

Date	Topic and Activity	Textbook Readings, DVDs	Journal Article(s)	Quiz, Deadline, etc.
Oct. 19	S12: Rodentia 2, Lagomorpha	V: Ch. 13	Rinderknecht and Blanco 2008; Millien 2008	
Oct. 24	(No class: Fall Break)			
Oct. 25	L6: Lagomorpha, Rodentia			Quiz 5: C11-12, DVD 4
Oct. 26	S13: Hyracoidea, Sirenia, Proboscidea	V: Ch. 9; DVD 7: Return to water	Pyenson and Vermeij 2016	
Oct. 31	S14: Cetacea	V: Ch. 19, 22	Thewissen et al. 2017	
Nov. 1	L7: Hyracoidea, Sirenia, Proboscidea, Cetacea			Quiz 6: C13-14, DVD 7
Nov. 2	S15: Perissodactyla	V: Ch. 17; DVD 3: Plant predators	Sandom et al. 2014	
Nov. 7	S16: Artiodactyla	V: Ch. 18	Jones and DeSantis 2017	
Nov. 8	L8: Artiodactyla, Perissodactyla			Quiz 7: C15-16, DVD 3
Nov. 9	S17: Carnivora 1	V: Ch. 16; DVD 5: Meat eaters	Van Valkenburgh et al. 2004	
Nov. 14	S18: Carnivora 2	DVD 6: Opportunists	Meachen and Samuels 2012	
Nov. 15	L9: Carnivora			Quiz 8: C17-18, DVD 5-6
Nov. 16	S19: Marsupials 1	V: Ch. 6; DVD 1: A winning design	Ladevèse et al. 2011	
Nov. 18	Cleveland Metroparks Zoo (optional)			
Nov. 21	S20: Marsupials 2		Wroe 2008	
Nov. 22	(No class)			
Nov. 23	(No class: Thanksgiving)			
Nov. 28	S21: Extinct S. American orders	Croft 1999	Gomes Rodrigues et al. 2017	
Nov. 29	L10: Marsupials			Quiz 9: C19-20, DVD 1
Nov. 30	L11: Extinct S. American orders			
Dec. 5	REVIEW 1			
Dec. 6	LAB REVIEW (*CMNH*)			Quiz 10: C21
Dec. 7	REVIEW 2			
Dec. X	FINAL EXAM: 12:30-3:30 pm **CMNH Classroom C**			

Office Hours: by appointment. Contact Dr. Croft or Russell directly to arrange a time.

Required Textbooks and Other Resources

- V: Vaughan, T.A., J.M. Ryan, N.J. Czaplewski. 2014. Mammalogy, 6th Ed., Jones and Bartlett Learning (ISBN: 9781284032093; Digital Version ISBN: 9781284038484)
- DVD: The Life of Mammals. 2003. Hosted by David Attenborough. Ten episodes on four DVDs. BBC. Nine of the episodes are currently available on Netflix. Arrangements will be made for viewing the 10th episode (Social Climbers).

Course Description and Aims

This course focuses on the anatomical and taxonomic diversity of mammals in an evolutionary context. The emphasis is on living (extant) mammals, but extinct mammals are also discussed. By the end of the course, students will be able to: (1) describe the key anatomical and physiological features of mammals; (2) name and describe [all orders and most families](#) of living mammals; (3) identify an unknown mammal skull to order and family; (4) explain how to create and interpret a phylogenetic tree; (5) discuss major historical patterns in mammal diversity and biogeography as revealed by the fossil record; (6) read and critique a scientific article dealing with mammal evolution. Two seminars and one lab each week. One weekend field trip to Cleveland Metroparks Zoo; additional individual and group visits to the Cleveland Museum of Natural History. This course satisfies a laboratory requirement for the biology major.

Seminars

Most seminars will be led by two undergraduates or one graduate student. At the beginning of the semester, students will submit their top four choices for seminars to lead, and an effort will be made to accommodate such preferences. Students who are not leading seminar on a particular day are still expected to complete the assigned readings and watch the assigned videos beforehand (except for the first day of the course) in order to actively participate in the discussions. Each seminar will have the following format:

Overview Presentation (20 min.). The overview presentation should include many images and relatively little text. Digital versions of the figures in the Vaughan et al. textbook will be made available, but students are encouraged to use additional resources. The presentation should provide a general overview of the group including: diversity and relevant families; evolutionary relationships; fossil record; recognition characteristics (especially external morphology and skull); geographic range; and Ohio representatives (if applicable). It should introduce topics to be addressed in the discussion (below); it does not need to be a thorough treatment. It will be timed and should adhere to the schedule. Slides must be submitted to the instructor and TA *by 8 am the day before the presentation* for fact-checking.

Presentation Discussion (30 min.). This discussion will delve more deeply into topics introduced in the overview presentation. The discussion should focus on form-function relationships including: skeletal anatomy, soft tissue anatomy, diet, size and body mass, locomotion, special adaptations, and ecological niche. Slides from the overview presentation may be revisited, and additional slides or other resources can be used to help facilitate discussion.

Research Article Discussion (25 min.). One recent research article will be discussed each seminar. All students should come to seminar prepared to discuss that day's article. The co-leader(s) must submit a one-page summary of the research article and a list of questions that will be used to facilitate discussion to the instructor and TA *by noon of that day*.

Labs

Labs will focus on the osteology of extant mammal groups using a combination of photographs, illustrations, casts, and specimens. Most labs will take place on campus, but two review labs will be held at the Cleveland Museum of Natural History and will use specimens from the research collections there. To prevent damage to these specimens, *no touching will be permitted*. You are free to photograph lab specimens for future reference. Additionally, an online, photographic [guide to mammal skulls](#) has been developed for this course. Each lab will start with a quiz (see below), which will be followed by student-led class discussion of a series of questions designed to highlight craniodental and postcranial features that are useful for identification and/or correlated with ecology. All students are expected to review all questions prior to lab, but each student will be assigned to co-lead discussion of one of the questions (see below).

Student Assessment

Seminar Presentations (15% of final grade): Presentation slides and research paper summaries will be graded primarily on clarity, accuracy, content (e.g., covering relevant topics, incorporating additional resources), and on-time submittal. How the leader(s) manage(s) the seminar discussion itself will also be incorporated into the grade for the day.

Quizzes (25% of final grade): Most labs will begin with a short quiz (10-15 points, short answer and/or multiple-choice questions) that will cover material from the previous two seminars and associated readings and videos (see schedule above). Each student's lowest quiz score will be dropped from the final grade.

Lab Discussion Questions (20% of final grade): For Labs 3-10, each student will submit their answer to one pre-assigned lab discussion question by noon the day of the lab and will co-lead discussion of that question during lab. This answer must include relevant annotated photographs and/or illustrations. Each question will be graded as unsatisfactory, satisfactory, or excellent, and the final score for this component will be calculated as $\%(\text{satisfactory or excellent}) + \#(\text{excellent})$ (e.g., 1 unsatisfactory, 4 satisfactory, and 3 excellent = 90.5%). Questions will be posted and assigned by 5 pm on the Friday preceding the lab.

Midterm and Final Exams (15% and 25% of final grade, respectively): These exams will cover class and lab material and have three components: (1) identification of osteological specimens (mainly skulls) to order and family; (2) identification of living mammals to family, plus associated short answer questions (e.g., size, diet, habitat, geographic range, order, etc., of that particular animal); and (3) written exam, mostly short answer questions (e.g., definitions, compare/contrast), basic phylogenetic methods, and some multiple choice questions. The midterm exam will cover material through Oct. 5th (i.e. bats but not rodents). The final exam will be comprehensive.

Class Engagement: For "borderline" final grades, class involvement will be factored in to determine the final grade.

Additional Requirements for Graduate Students (enrolled in ANAT/BIOL 445)

PaleoPlace Presentations: Graduate students will give three short (15-20 minute) presentations reviewing an ancient terrestrial ecosystem with particular focus on mammals. For each presentation, the student will be assigned a broad geographic area (e.g., western Europe) and geologic time interval (e.g., Oligocene Epoch) but will have latitude within those constraints to determine the particular fossil site or formation to discuss. The presentation must address: (1) the site's paleoenvironment (climatic conditions and vegetation structure); (2) the overall mammal community (a brief review of groups present); and (3) the

paleobiology of five species recorded at the site (from separate families and representing at least three orders). A minimum of 15 references must be uploaded to the class Google Drive folder in support of the presentation by five days prior to the presentation. A draft of the slides may be presented for review up to two days before the presentation (this is optional). Presentations will take place during lab time and must be scheduled by Sept. 5th. The first presentation must take place by Sept. 27th, the second between Oct. 4th and Nov. 1st, and the third between Nov. 8th and Dec. 6th.

How to Succeed in This Course

- Do the assigned readings and scan the relevant handouts before class. This will facilitate learning by helping you become familiar with the groups and names to be discussed.
- Learn the names and proper spellings of the groups we discuss in class. Taxonomy is how the great diversity of mammals is organized. You cannot learn about mammals without learning names of groups. Make flash cards if you think they will be helpful, or download a flash card app for your phone.
- Learn or review the bones of the skull and skeleton. We will have a lab on this early in the course, but one session will not be enough for you to really learn the details. Sketching bones is a great strategy.
- Appreciate the detailed structure of teeth. Few aspects of a mammal's anatomy are as important as its teeth. They provide information about ancestry (evolutionary relationships) as well as ecology (diet). Learn how to recognize different types of teeth (incisors, canines, etc.) and how to describe them. As for bones, sketching teeth is a very effective strategy.
- Mammalogy and paleomammalogy are constantly changing fields, and different sources can vary in the information they provide. In general, more recent references will be more accurate. When in doubt, ask or refer to class notes or texts.
- What should you know about each group by the end of this course? Generally speaking:
 - Taxonomy and Phylogeny: What is the group's name? Where does it fit into the taxonomic hierarchy? How is it related to other groups?
 - Biogeography: Where do these animals live on the globe?
 - Ecology: What do these animals eat? How big are they? How do they move and where do they spend their time? In what types of habitats do they live?
 - Identification: How can you recognize a member of this group, both by its skull and external features?
 - Fossil record: What do fossils tell us about the past diversity, adaptations, range, and evolution of the group?
- In general, you should focus on topics mentioned in class and lab. This may not cover everything you need to know, but it will cover the vast majority of material.

Handy Web Sites (suggestions welcome)

- [Animal Diversity Web](#) (U. of Michigan): Lots of information on specific taxa plus general information on teeth, bones, etc.
- [Australian Mammal Skulls](#) (Museum Victoria): great photos of mammal skulls, mostly marsupials
- [Digimorph](#) (U. of Texas): NSF-supported site with digitally rendered CT images of many animals, including mammals
- [ESkeletons](#) (U. of Texas): NSF-supported site with photos of primate postcranial bones and some skulls
- [Extreme Mammals](#) (American Museum of Natural History): an excellent exhibit highlighting mammalian diversity
- [Fauna of Australia: Mammals](#) (Australian Government): PDFs of Australian mammal families with nice images and references
- [Mammal Crania](#) (Dokkyo U.): photo archive with lots of mammal crania, many of very high resolution
- [Mammal Image Library](#) (American Society of Mammalogists): many excellent mammal photos

- [Mammal Species of the World](#) (Bucknell): taxonomy of all described species of extant mammals
- [Mammalian Lexicon](#) (Michigan State): an interesting list of the meanings of family-level and higher mammal names
- [Mammalian Species](#) (American Society of Mammalogists): detailed accounts (PDFs) of more than 800 species of mammals. Newer accounts require institutional access. (Use [the online link in the library catalog](#).)
- [Mammalogy Database](#) (UMass): neat site with useful taxonomic characters and photos of mammal skulls
- [Ohio Mammals](#) (Ohio DNR): nice descriptions of Ohio's more common mammals
- [Tooth Morphology](#): good pictures and explanations of teeth from the Animal Diversity Web (see above)
- [Web of Science](#): bibliographic service for general science; mostly recent articles (requires institutional access)
- [Will's Skull Page](#) (private): lots of nice mammal skull photos (many of British mammals) and descriptions

Other Recommended Texts (suggestions welcome)

- Elbroch, M. 2006. *Animal Skulls: A Guide to North American Species*. Stackpole Books. (A good book with nice photographs, also provides characters distinguishing species.)
- Feldhamer, G.A., L.C. Drickamer, S.H. Vessey, J.F. Merritt, and C. Krajewski. 2014. *Mammalogy: Adaptation, Diversity, Ecology*, 4th Edition. John Hopkins University Press. (An alternative mammalogy textbook.)
- Felsenstein, J. 2003. *Inferring Phylogenies*. Sinauer Associates.
- Hutchins, M., D.G. Kleiman, V. Geist, and M. C. McDade (Eds.). 2003. *Grzimek's Animal Life Encyclopedia*, 2nd Edition. Volumes 12-16, Mammals I-V. Gale Group. (An excellent resource on mammals, though a bit difficult to find and quite expensive; five volumes on mammals, plus others on birds, fishes, etc.)
- Lawlor, T.E. 1979. *Handbook to the Orders and Families of Living Mammals*. Mad River Press. (Nice summaries of mammal families, but some taxonomy is outdated.)
- MacDonald, D.W. 2009. *The Princeton Encyclopedia of Mammals*. Princeton U. Press. (Lots of excellent photographs and diagrams; up-to-date information and succinctly written; nearly 1,000 pages for about \$25!)
- Martin, R.E., R. Pine, and A.F. DeBlase. 2001. *A Manual of Mammalogy with Keys to Families of the World*, 3rd Edition McGraw-Hill. (Lab manual with some helpful keys.)
- Nowak, M. 1999. *Walker's Mammals of the World*, 6th Edition. The John Hopkins University Press. (The standard mammal reference, a two volume set of 2000+ pages.)
- Wilson, D.E. and D.M. Reeder. 2005. *Mammal Species of the World*, 3rd Edition. John Hopkins University Press. (A comprehensive guide to extant mammal taxonomy.) Online version is available [here](#).