

Mammal Diversity and Evolution (Fall 2015)

ANAT 445; BIOL 345/445

Class (C): Tuesdays and Thursdays, 2:45-4:00 pm, Medical School (East Wing) E408 (Robbins Room)

Lab (L): Wednesdays, 2:00-5:00 pm; unless noted otherwise; labs meet in Classroom C of the [Cleveland Museum of Natural History](#)

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Date	Topic and Activity	Textbook Readings, DVDs	Journal Article(s)	Quiz, Deadline, etc.
Aug. 25	C1 (DC): Mammal characteristics and classification	V: Ch. 1, 3-4; DVD 10: Food for thought		
Aug. 26	L1: Intro. to osteology **E430A**			
Aug. 27	C2: Mammal origins, monotremes	V: Ch. 2, 5, 20; DVD 1: A winning design	Philips et al. 2009	
Sept. 1	C3: Afrosoricida, Macroscelidea, Tubulidentata	V: Ch. 7-8; DVD 2: Insect hunters	Lovegrove et al. 2014	
Sept. 2	L2: Intro. to cladistics **E430A**	W: Ch. 1-3		Quiz 1: C1-3, L1, DVD 2
Sept. 3	C4: Erinaceomorpha, Soricomorpha	V: Ch. 14	Stanley et al. 2013	Grad. presentation dates due
Sept. 8	C5: Cingulata, Pholidota	V: Ch. 10	Meredith et al. 2009	
Sept. 9	L3: Afrosoricida, Macroscelidea, Erinaceomorpha, Soricomorpha			Quiz 2: C4, DVD 3
Sept. 10	C6: Pilosa	V: Ch. 10; DVD 8: Life in the trees	Pauli et al. 2014	L2 Report Due
Sept. 15	C7: Scandentia, Dermoptera, Primates 1	V: Ch. 11-12	Shattuck and Williams 2010	Grad. skull guide groups due
Sept. 16	L4: Monotremata, Cingulata, Pilosa, Pholidota, Tubulidentata			Quiz 3: C5-6, DVD 8
Sept. 17	C8: Primates 2	V: Ch. 12; DVD 9: Social climbers	Lukas and Clutton-Brock 2013	
Sept. 22	REVIEW (C3-6)			Lab Notebook check-in
Sept. 23	(No class: CLPV Meeting)			
Sept. 24	REVIEW (C7-8)			
Sept. 29	C9: Chiroptera 1	V: Ch. 15, 22	Simmons et al. 2008	
Sept. 30	L5: Scandentia, Dermoptera, Primates, Chiroptera			Quiz 4: C7-8, DVD 9
Oct. 1	C10: Chiroptera 2	V: Ch. 15, 22	Corcoran and Conner 2014	
Oct. 6	REVIEW			

Date	Topic and Activity	Textbook Readings, DVDs	Journal Article(s)	Quiz, Deadline, etc.
Oct. 7	MIDTERM EXAM			
Oct. 8	C11: Rodentia 1	V: Ch. 13; DVD 4: Chisellers	Hopkins 2005	
Oct. 13	C12: Rodentia 2, Lagomorpha	V: Ch. 13	Rinderknecht and Blanco 2008; Millien 2008	
Oct. 14	(No class: SVP Meeting)			
Oct. 15	(No class: SVP Meeting)			
Oct. 20	(No class: Fall Break)			
Oct. 21	L6: Lagomorpha, Rodentia			Quiz 5: C11-12, DVD 4
Oct. 22	C13: Hyracoidea, Sirenia, Proboscidea	V: Ch. 9; DVD 7: Return to water	Hutchinson et al. 2011	
Oct. 27	C14: Cetacea	V: Ch. 19, 22	Pyenson et al. 2012	
Oct. 28	L7: Hyracoidea, Sirenia, Proboscidea, Cetacea			Quiz 6: C13-14, DVD 7
Oct. 29	C15: Perissodactyla	V: Ch. 17; DVD 3: Plant predators	Orlando et al. 2013	
Nov. 3	C16: Artiodactyla	V: Ch. 18	Davis et al. 2011	Grad. skull guide info. due
Nov. 4	L8: Artiodactyla, Perissodactyla			Quiz 7: C15-16, DVD 3
Nov. 5	C17: Carnivora 1	V: Ch. 16; DVD 5: Meat eaters	Tseng et al. 2013	
Nov. 10	C18: Carnivora 2	DVD 6: Opportunists	Meachen and Samuels 2012	
Nov. 11	L9: Carnivora			Quiz 8: C17-18, DVD 5-6
Nov. 12	C19: Marsupials 1	V: Ch. 6; DVD 1: A winning design	Ladevèse et al. 2011	
Nov. 17	C20: Marsupials 2	V: Ch. 6	Sandom et al. 2014	
Nov. 18	L10: Marsupials			Quiz 9: C19-20, DVD 1
Nov. 19	C21: Extinct S. American orders	Croft (1999)	Welker et al. 2015	
Nov. 24	L11: Extinct S. American orders **E408**			Zoo lab due
Nov. 25	(No class)			
Nov. 26	(No class: Thanksgiving)			
Dec. 1	REVIEW 1			
Dec. 2	LAB REVIEW (CMNH)			Quiz 10: C21
Dec. 3	REVIEW 2			
Dec. 8	FINAL EXAM: 12:30-3:30 pm **CMNH Classroom C**			Lab notebook due

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)
- W: Wiley, E.O., D. Siegel-Causey, D.R. Brooks, and V.A. Funk. 1991. The Compleat Cladist; a Primer of Phylogenetic Procedures. University of Kansas Museum of Natural History Special Publication No. 19. Available on [Blackboard](#).
- 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 and Hulu (and were previously available on Amazon). 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 dealing with mammal evolution. Two student-led seminars and one lab each week. Most labs will take place at the Cleveland Museum of Natural History. One weekend field trip to Cleveland Metroparks Zoo. This course satisfies a laboratory requirement for the biology major.

Classes

Most classes will be led by two undergraduates or one graduate student. At the beginning of the semester, students will submit their top four choices for classes to lead, and an effort will be made to accommodate such preferences. Students who are not leading class on a particular day are still expected to complete the assigned readings and watch the assigned videos prior to each class (except for the first day of the course) in order to actively participate in the discussions. Each class 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. It should provide a general overview of the group including: diversity and relevant families; evolutionary relationships; fossil record; recognition characteristics (especially skull and external morphology); 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 can be projected to help facilitate discussion.

Research Article Discussion (25 min.). One recent research article will be discussed each class. Students should come to class prepared to discuss that day's article.

Labs

Osteology Labs will focus on the osteology of extant mammal groups. All except the first lab 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*. Activities and observations from osteology labs should be recorded in a lab notebook (see below). You are free to bring a camera to photograph specimens for future reference. Additionally, an online, photographic [guide to mammal skulls](#) has been developed for this course.

The Phylogenetics Lab will focus on understanding modern phylogenetic techniques and will be computer-based. NOTE: You should download [Phylip](#) and [Mesquite](#) (both free programs) to your computer beforehand.

The Zoo Lab can be completed individually or in conjunction with the class field trip to Cleveland Metroparks Zoo. The class trip will take place the weekend before Thanksgiving (Nov. 21-22).

Student Assessment

Quizzes (25% of final grade): Most labs will begin with a short quiz (10-15 points, short answer and/or multiple-choice questions) covering the previous week's lectures, readings associated with those lectures, and videos. Details of the schedule and content are noted on the syllabus. Each student's lowest quiz score will be dropped from the final grade.

Lab Reports (15% of final grade): The cladistics lab and the zoo lab will each have an associated lab report. Some aspects of the report will be completed during lab, others will require additional out-of-class time. The cladistics lab report will be due one week later (at the beginning of class on the following Thursday). The zoo lab can be completed at any time during the semester but must be handed in no later than November 26. The two labs will be weighted equally.

Lab Notebook (20% of final grade): Students will maintain a notebook for all osteology labs in order to practice and develop their observational skills. At a minimum, it should include: (1) responses to lab guide questions, including justifications; and (2) sketches and descriptions of relevant anatomical regions of lab specimens (i.e., those related to lab guide questions, taxonomic identification, or form-function relationships). The notebook can be submitted in any format (e.g., lab notebook, 3-ring binder, PDF file), and may include additional information. It will be handed in for an ungraded "check-in" on Sept. 22nd to ensure that expectations are being met. The notebook is due the day of the final exam (December 8th) and will primarily be graded on completeness and effort put into observations, descriptions, and conclusions.

Midterm and Final Exams (15% and 25% of final grade, respectively): These exams will cover class and lab material and will take place at the CMNH (see syllabus). Each exam will have three components: (1) identification of osteological specimens (mainly skulls) to order and family; (2) identification of photos 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. 1st. The final exam will be comprehensive.

Class Engagement: Class presentations and other involvement will be subjectively factored in to each student's final grade based on the assessment of the instructor and the teaching assistant.

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

Paleo Presentations: Graduate students will give two short (12-15 minute) presentations reviewing: (1) the anatomy and paleobiology of an extinct mammal species/group; or (2) the fossil record (diversity, paleogeography, etc.) of a group of living mammals. Each presentation must be based on at least one paper from the primary literature. Presentations will take place during lab time and must be scheduled by Sept. 5th. Only one presentation can be scheduled per lab, and at least one of the two presentations must be scheduled prior to Oct. 22nd. The general presentation topic must match that of the lab (e.g., some aspect of the rodent or rabbit fossil record should be discussed on the day of the Rodentia and Lagomorpha lab). Specific topics must be approved at least 10 days before the scheduled presentation. A draft of the slides can be presented for review up to two days before the presentation (this is optional).

Skull Guide Data: Graduate students will gather information from the primary literature for 10 families and/or subfamilies for the [on-line guide to mammal skulls](#) that has been developed for this course. Families and/or subfamilies must be selected by September 15th, and content (with citations) must be handed in by November 3rd.

How to Succeed in This Course

- Do the assigned readings and scan the relevant handouts before class. This will facilitate learning by making you 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 smart 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 them and their parts. Sketching bones is a great strategy for learning anatomy.
- 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 an effective strategy.
- For information on mammals, bear in mind that sources vary, and that the field is constantly changing. 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?
 - Fossil record: What do fossils tell us about the evolution of the group, including the topics noted above?
- 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
- [GeoRef](#) (OhioLINK): bibliographic service for geological sciences (including paleontology)
- [Mammal Crania](#) (Dokkyo U.): photo archive with lots of mammal crania, many of very high resolution
- [Mammal Images](#) (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.
- [Mammalogy Database](#) (UMass): neat site with useful taxonomic characters and photos of mammal skulls
- [Mammals of Australia](#) (Australian Government): PDFs of Australian mammal families with nice images and references
- [Mesquite](#): software for evolutionary investigations
- [Ohio Mammals](#) (Ohio DNR): nice descriptions of Ohio's more common mammals
- [Phylip](#): software package for computing phylogenies and doing other useful things related to systematics
- [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
- [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, and J.F. Merritt. 2007. *Mammalogy: Adaptation, Diversity, Ecology*, 3rd 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)
- Martin, R.E., R. Pine, and A.F. DeBlase. 2000. *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](#).