

Mammal Diversity and Evolution (Fall 2023)

BIOL/ANAT 345 and ANAT 445

Seminar (S): Tuesdays and Thursdays, 2:30-3:45 pm, E321/323

Lab (L): Wednesdays, 3:20-6:00 pm, SOM (East Wing), E321/323 (but E322 for lab reviews)

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Date	Topic (or Activity)	Textbook Chapter(s), DVD	Journal Article(s)	Quiz, Deadline, etc.
Aug. 29	S1 (DC): Mammal characteristics, classification	V: Ch. 1, 3-4 D10: Food for thought		
Aug. 30	L1: Mammal skulls and teeth	Elbroch 2006, Ch. 1-2 KL: Basics of Mammal Anatomy		
Aug. 31	S2: Mammal origins, monotremes	V: Ch. 2, 5, 20 D1: A winning design	Krause et al. 2014	
Sept. 5	S3: Tubulidentata, Macroscelidea, Tenrecoidea	V: Ch. 7-8 D2: Insect hunters	Lovegrove and Mowoe 2017	
Sept. 6	L2: Phylogenetics	"Tree Thinking" (on Canvas)		Quiz 1: S1-2, L1
Sept. 7	S4: Eulipotyphla	V: Ch. 14	Smith and Angielczyk 2020	
Sept. 12	S5: Pholidota, Cingulata	V: Ch. 10	Mitchell et al. 2016 (& Gaudin and Lyon 2017)	
Sept. 13	L3: Macroscelidea, Tenrecoidea, Eulipotyphla			Quiz 2: S3-4, DVD 2
Sept. 14	S6: Pilosa	V: Ch. 10 D8: Life in the trees	Pauli et al. 2014	
Sept. 19	S7: Scandentia, Dermoptera, Primates 1 (Overview, Strepsirrhini)	V: Ch. 11-12	Sefczek et al. 2020	
Sept. 20	L4: Monotremata, Tubulidentata, Pholidota, Cingulata, Pilosa			Quiz 3: S5-6, DVD 8
Sept. 21	S8: Primates 2 (Haplorrhini)	V: Ch. 12 D9: Social climbers	Schwartz et al. 2020	
Sept. 26	S9: Chiroptera 1 (Overview, Yinpterochiroptera)	V: Ch. 15, 22	Amador et al. 2019	
Sept. 27	L5: Scandentia, Dermoptera, Primates, Chiroptera			Quiz 4: S7-8, DVD 9
Sept. 28	S10: Chiroptera 2 (Yangochiroptera)	V: Ch. 15, 22	Roeleke et al. 2022	
Oct. 3	REVIEW (S3-6)			
Oct. 4	LAB REVIEW (*E322*)			Quiz 5: S9-10
Oct. 5	REVIEW (S7-10)			Graduate student presentation 1 due
Oct. 10	S11: Rodentia 1 (Overview, non-hystricomorphs)	V: Ch. 13 D4: Chiselers	Hopkins 2005	
Oct. 11	MIDTERM EXAM			
Oct. 12	S12: Rodentia 2 (Hystricomorpha), Lagomorpha	V: Ch. 13	Engelman 2022	
Oct. 17	(No class: SVP meeting)			
Oct. 18	(No class: SVP meeting)			

Date	Topic (or Activity)	Textbook Chapter(s), DVD	Journal Article(s)	Quiz, Deadline, etc.
Oct. 19	(No class: SVP meeting)			
Oct. 24	(No class: Fall Break)			
Oct. 25	L6: Rodentia, Lagomorpha			Quiz 6: S11-12, DVD 4
Oct. 26	S13: Hyracoidea, Sirenia, Proboscidea	V: Ch. 9 D7: Return to water	Matsui et al. 2017	
Oct. 31	S14: Cetacea	V: Ch. 19, 22	Goldbogen et al. 2019	
Nov. 1	L7: Hyracoidea, Sirenia, Proboscidea, Cetacea			Quiz 7: S13-14, DVD 7
Nov. 2	S15: Perissodactyla	V: Ch. 17 D3: Plant predators	Sandom et al. 2014	
Nov. 7	S16: Artiodactyla	V: Ch. 18	Pansu et al. 2022	
Nov. 8	L8: Perissodactyla, Artiodactyla			Quiz 8: S15-16, DVD 3
Nov. 9	S17: Carnivora 1 (Overview, Feliformia)	V: Ch. 16 D5: Meat eaters	Domínguez-Rodrigo et al. 2022	
Nov. 14	S18: Carnivora 2 (Caniformia)	D6: Opportunists	Perri et al. 2021	
Nov. 15	L9: Carnivora			Quiz 9: S17-18, DVD 5-6
Nov. 16	S19: Marsupialia 1 (Overview, New World marsupials)	V: Ch. 6 D1: A winning design	Ladevèse et al. 2011	
Nov. 18	Cleveland Metroparks Zoo (*optional; 1 pm*)			
Nov. 21	S20: Marsupialia 2 (Old World marsupials)		Fabre et al. 2021	Graduate student presentation 2 due
Nov. 22	(No class)			
Nov. 23	(No class: Thanksgiving)			
Nov. 28	S21: South American native "ungulates" (extinct!)	Croft et al. 2020	Gomes Rodrigues et al. 2017 (& Croft et al. 2020)	
Nov. 29	L10: Marsupials			Quiz 10: S19-20, DVD 1
Nov. 30	L11: South American native "ungulates"			
Dec. 5	REVIEW 1			
Dec. 6	LAB REVIEW (*E322*)			Quiz 11: S21
Dec. 7	REVIEW 2			
Dec.19	FINAL EXAM (12:00-3:00 pm)			

Office Hours: By appointment; contact Dr. Croft 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)
- KL: Kelt, D.A. and Patton, J.L. 2020. A Manual of the Mammalia: An Homage to Lawlor's "Handbook to the Orders and Families of Living Mammals"
- D: The Life of Mammals (David Attenborough, host). 2003. This video series will be available on Google Drive (see link on Canvas). The number refers to the episode #.

Recommended Text

- MacDonald, D.W. 2009. The Princeton Encyclopedia of Mammals. Princeton U. Press. This is out of print, but it is possible to get a used version for < \$20 (including delivery). It has many excellent photographs and diagrams (~ 1,000 pp.), is relatively up-to-date, and is succinctly written by experts (each section has different authors). Scanned sections of this book will be available on Google Drive (see link on Canvas).

Course Description, Aims, and Learning Objectives

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 a mammal skull to order and family; (4) understand how to create and interpret a phylogenetic tree; (5) appreciate 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.

This course satisfies a laboratory requirement for the Biology major.

Prerequisite: BIOL 214 Genes, Evolution and Ecology.

Recommended preparation: At least one advanced evolution or anatomy course (e.g., BIOL 223 Vertebrate Biology, BIOL 225 Evolution, or BIOL 346 Human Anatomy).

Seminars

Seminars will be student-led, generally by at least two undergraduates or one graduate student. At the beginning of the semester, students will submit their top four choices for seminars to lead (i.e., four dates) by 8 am on the first Thursday of the semester, and an effort will be made to accommodate such preferences. Students who are not leading the seminar on a particular day are expected to complete the assigned readings and watch the assigned videos beforehand in order to actively participate in the discussions (excluding the first day of class). 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: names of families and approximate number of species (use updated numbers!)
- evolutionary relationships, including supraordinal and subordinal group(s)
- recognition characteristics: external appearance, key skull and dental features
- ecological niche: size, diet, habitat(s)
- present geographic range and biogeographic history (if known)
- special morphological or behavioral adaptations
- Ohio representatives (if applicable).

The presentation should introduce topics for the discussion (below); it does not need to be an exhaustive treatment. It will be timed and should adhere to the schedule. Slides must be sent to Dr. Croft *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 exact scope will depend on the preferences of the class, but in general, it should focus on form-function relationships including: skeletal anatomy, soft tissue anatomy, diet, size/body mass, locomotion, special adaptations, and ecological

niche. Slides from the overview presentation may be revisited, and additional slides, videos, etc. 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 prepared to discuss that day's article. The 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 Dr. Croft *by 8 am the day before the discussion*.

Labs

Labs will focus on the osteology of extant mammal groups using a combination of photographs, illustrations, casts, and specimens. Labs will take place on campus and incorporate specimens from Dr. Croft's teaching collection as well as the research collections of the Cleveland Museum of Natural History. (Normally some of the labs would take place at the museum, but due to a major museum renovation, that will not be possible this year.) To prevent damage to specimens, *no touching will be permitted*. You are free to photograph lab specimens for future reference, and you can ask Dr. Croft to reposition a specimen, if necessary. Additionally, an online, photographic [guide to mammal skulls](#) has been developed for this course that will be a useful reference. You might want to consider downloading a magnifying app to your cell phone for viewing small specimens. (Magnifying glasses will also be provided.) Most labs will start with a quiz (see below) and a discussion of the answers. This will be followed by viewing of specimens. The remainder of lab will consist of a student-led discussion of answers to questions designed to highlight craniodental and postcranial features of mammals that are useful for skull identification and/or correlated with mammal ecology. All students are expected to review all questions prior to lab, but each student will be assigned to co-lead discussion of one question (see below). You will find Kelt and Patton ("A Manual of the Mammalia") to be a very helpful resource for the lab component of the course; just refer to the corresponding section(s) of the book (e.g.,

Student Assessment and Grading

Seminar Presentation(s) (20% of final grade): All components of seminars (e.g., slides, presentation, research paper summary, discussion) will be graded using the rubric posted on Canvas (Useful References). Pay careful attention to the items listed to maximize your score. Note that materials are due by *8 am the day before class*.

Participation in Research Article Discussion (5% of final grade): Students are expected to actively participate in research article discussions by responding to questions posed by leaders and/or commenting on the paper from their own perspective. Each student must actively participate in the discussion of at least five articles to earn full credit for this component.

Quizzes (20% of final grade): Most labs will begin with a short quiz (10-15 points, short answer and/or multiple-choice questions, on Canvas) 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. Quizzes may be taken in advance (in the case of a planned absence). They may not be taken later without a note from a physician.

Lab Discussion Questions (20% of final grade): For Labs 3-10, each student will submit their answer to one lab discussion question before lab and co-lead discussion of that question during lab. Questions will be posted and assigned by 5 pm on the preceding Friday. You must send your answer to Dr. Croft by *8 am the day of the lab*. The answer must include relevant annotated photographs and/or illustrations. It should also include *the question itself*. An example of an answer will be posted to Canvas. Each assignment will be graded as unsatisfactory, satisfactory, or excellent, and the lowest grade will be dropped (i.e., your score

will be based on seven labs). The final score for this component will be calculated as % (satisfactory or excellent) + #excellent - 4 * #late. For example, 1 unsatisfactory, 5 satisfactory, and 2 excellent lab answers with 2 late submissions = 94% (100% + 2% - 8%).

Midterm and Final Exams (10% 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) theoretical 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 Sept. 28th (i.e., it will include bats but not rodents). The final exam will be comprehensive.

Technology for Exams: Quizzes and exams will be administered via Canvas and require Respondus Lockdown Browser. Before the course begins, you should visit [U]Tech's [page on this software](#), download the Getting Started for Students guide, and make sure it works on the device you will use for exams. If you have trouble installing the software, contact [U]Tech.

Final Letter Grades be assigned based on overall class performance, generally as follows: A, 90-100%; B, 80-89%; C, 70-79%; D, 60-69%, F, 59% and below. Class involvement and engagement in seminars and labs will be taken into account in the case of "borderline" letter grades.

Additional Requirements for Graduate Students (enrolled in ANAT 445)

PaleoPlace Presentations: Graduate students will prepare two short (15 to 20-minute) narrated (recorded) presentations reviewing an ancient terrestrial ecosystem with a particular focus on mammals. One of these must be a Paleogene site (Paleocene, Eocene, or Oligocene) and the other must be a Neogene site (Miocene, Pliocene, or Pleistocene). Additionally, the two sites must be from different global hemispheres (north and south or east and west). For example, the two sites could be the middle Eocene of Germany and the early Miocene of Argentina. 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 (which must be from different families and represent at least three orders). In support of the presentation, at least 15 references (journal papers or book chapters) must be uploaded to the Google Drive folder. The first presentation must be uploaded by October 5th, and the second must be uploaded by November 21st. Confirm your choices with Dr. Croft before working on them.

Disability Accommodations

In accordance with federal law, if you have a documented disability, you may be eligible to request accommodations from Disability Resources. In order to be considered for accommodations, you must first register with the Disability Resources office. To register or to get more information on how to begin the process, you can contact their office at 216-368-5230. Please keep in mind that accommodations are not retroactive.

How to Succeed in This Course

- Submit your slides, lab questions, and other materials on time.
- 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 or download a flash card app for your phone to help you.

- You must capitalize proper names of taxonomic groups (orders, families, genera, etc.). After the first couple weeks of class, points will be deducted for not doing this.
- 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.
- Learn to love 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. Practice sketching and labeling teeth.
- Knowledge of living and extinct mammals is constantly changing, especially with regard to diversity, taxonomy, and evolution. In general, more recent references are more accurate, but sometimes authorities simply differ in their opinions about a group. When in doubt, ask Dr. Croft or check [the taxonomy web page](#).
- What should you know about each group by the end of this course? Generally speaking:
 - o Taxonomy and Phylogeny: What is the group's name? Where does it fit into the taxonomic hierarchy? How is it related to other groups?
 - o Biogeography: Where do these animals live on the globe?
 - o 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?
 - o Identification: How can you recognize a member of this group, both by its skull and external features? What are its unique or unusual features?
 - o Fossil record: What do fossils tell us about the past diversity, adaptations, range, and evolution of the group?
 - o In general, you should focus on topics mentioned in class and in lab. This may not cover everything you need to know, but it will cover the vast majority of material.
- Check the useful web site links on Canvas for additional resources. [Animal Diversity Web](#) is a particularly good source for mammal information.

Academic Integrity

Any violation of the University's Code of Ethics will not be tolerated. All forms of academic dishonesty including cheating, plagiarism, misrepresentation, and obstruction are violations of academic integrity standards and will result in a minimum penalty of receiving a zero for the assignment, the potential for failing the entire course. Cheating includes copying from another's work, falsifying problem solutions or laboratory reports, or using unauthorized sources, notes or computer programs. Plagiarism includes the presentation, without proper attribution, of another's words or ideas from printed or electronic sources. It is also plagiarism to submit, without the instructor's consent, an assignment in one class previously submitted in another. Misrepresentation includes forgery of official academic documents, the presentation of altered or falsified documents or testimony to a university office or official, taking an exam for another student, or lying about personal circumstances to postpone tests or assignments. Obstruction occurs when a student engages in unreasonable conduct that interferes with another's ability to conduct scholarly activity. Destroying a student's computer file, stealing a student's notebook, and stealing a book on reserve in the library are examples of obstruction.

In addition, the incident will be reported to the Dean of Undergraduate Studies and Academic Review Board for undergraduates or Senior Associate Dean of Graduate Studies, for Graduate Students. The CWRU Statement of Ethics for graduate students can be found [here](#).