

Mammal Diversity and Evolution (Fall 2019)

BIOL 345/ANAT 445

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

Lab (L): Wednesdays, 3:20-6:00 pm, SOM (East Wing), E429C unless noted as CMNH
(= Cleveland Museum of Natural History, Classroom C)

Professor: Darin A. Croft, PhD, Robbins EG03; 368-5268; dcroft@case.edu

Teaching Assistant: Russell Engelman, MS; rke3@case.edu

Date	Topic and Activity	Textbook Readings, DVDs	Journal Article(s)	Quiz, Deadline, etc.
Aug. 27	S1 (DC): Mammal characteristics and classification	V: Ch. 1, 3-4; DVD 10: Food for thought		
Aug. 28	L1: Mammal skulls and teeth	Elbroch 2006, Ch. 1-2 (on Canvas)		
Aug. 29	S2: Mammal origins, monotremes	V: Ch. 2, 5, 20; DVD 1: A winning design	Asahara et al. 2016	
Sept. 3	S3: Afrosoricida, Macroscelidea, Tubulidentata	V: Ch. 7-8; DVD 2: Insect hunters	Stankowich and Stensrud 2019	
Sept. 4	L2: Phylogenetics	"Tree Thinking" (on Canvas)		Quiz 1: S1-2, L1
Sept. 5	S4: Eulipotyphla	V: Ch. 14	Stanley et al. 2013	
Sept. 10	S5: Cingulata, Pholidota	V: Ch. 10	Mitchell et al. 2016	
Sept. 11	L3: Afrosoricida, Macroscelidea, Eulipotyphla			Quiz 2: S3-4, DVD 2
Sept. 12	S6: Pilosa	V: Ch. 10; DVD 8: Life in the trees	Pauli et al. 2014	
Sept. 17	S7: Scandentia, Dermoptera, Primates 1 (Overview, Strepsirrhini)	V: Ch. 11-12	Shattuck and Williams 2010	
Sept. 18	L4: Monotremata, Cingulata, Pilosa, Pholidota, Tubulidentata			Quiz 3: S5-6, DVD 8
Sept. 19	S8: Primates 2 (Haplorrhini)	V: Ch. 12; DVD 9: Social climbers	Lukas and Clutton-Brock 2013	
Sept. 24	(No class)			
Sept. 25	(No class)			
Sept. 26	(No class)			
Oct. 1	S9: Chiroptera 1 (Overview, Yinpterochiroptera)	V: Ch. 15, 22	Simmons et al. 2008	
Oct. 2	L5: Scandentia, Dermoptera, Primates, Chiroptera (*CMNH*)			Quiz 4: S7-8, DVD 9
Oct. 3	S10: Chiroptera 2 (Yangochiroptera)	V: Ch. 15, 22	Corcoran and Conner 2014	
Oct. 8	S11: Rodentia 1 (Overview, non-hystricomorphs)	V: Ch. 13; DVD 4: Chisellers	Hopkins 2005	
Oct. 9	LAB REVIEW (*CMNH*)			
Oct. 10	REVIEW (S3-6)			Graduate student presentation 1 due
Oct. 15	REVIEW (S7-10)			
Oct. 16	MIDTERM EXAM			

Date	Topic and Activity	Textbook Readings, DVDs	Journal Article(s)	Quiz, Deadline, etc.
Oct. 17	S12: Rodentia 2 (Hystricomorpha), Lagomorpha	V: Ch. 13	Rinderknecht and Blanco 2008; Millien 2008	
Oct. 22	(No class: Fall Break)			
Oct. 23	L6: Rodentia, Lagomorpha			Quiz 5: S11-12, DVD 4
Oct. 24	S13: Hyracoidea, Sirenia, Proboscidea	V: Ch. 9; DVD 7: Return to water	Pyenson and Vermeij 2016	
Oct. 29	S14: Cetacea	V: Ch. 19, 22	Racicot et al. 2019	
Oct. 30	L7: Hyracoidea, Sirenia, Proboscidea, Cetacea (*CMNH*)			Quiz 6: S13-14, DVD 7
Oct. 31	S15: Perissodactyla	V: Ch. 17; DVD 3: Plant predators	Sandom et al. 2014	
Nov. 5	S16: Artiodactyla	V: Ch. 18	Louys et al. 2012	
Nov. 6	L8: Artiodactyla, Perissodactyla			Quiz 7: S15-16, DVD 3
Nov. 7	S17: Carnivora 1 (Overview, Feliformia)	V: Ch. 16; DVD 5: Meat eaters	Van Valkenburgh et al. 2004	
Nov. 12	S18: Carnivora 2 (Caniformia)	DVD 6: Opportunists	Meachen and Samuels 2012	
Nov. 13	L9: Carnivora			Quiz 8: S17-18, DVD 5-6
Nov. 14	S19: Marsupialia 1 (Overview, New World marsupials)	V: Ch. 6; DVD 1: A winning design	Ladevèse et al. 2011	
Nov. 16	Cleveland Metroparks Zoo (*optional; 1 pm*)			
Nov. 19	S20: Marsupialia 2 (Old World marsupials)		Price et al. 2017	
Nov. 20	L10: Marsupials			
Nov. 21	S21: South American native "ungulates"	Croft 1999	Gomes Rodrigues et al. 2017	Graduate student presentation 2 due
Nov. 26	L11: South American native "ungulates"			
Nov. 27	(No class)			Quiz 9: S19-20, DVD 1
Nov. 28	(No class: Thanksgiving)			
Dec. 3	REVIEW 1			
Dec. 4	LAB REVIEW (*CMNH*)			Quiz 10: C21
Dec. 5	REVIEW 2			
Dec. 11	FINAL EXAM: 12:00-3:00 pm			

Office Hours: by appointment. Contact Dr. Croft or the TA (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. This series will be made available via Google Drive.

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

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 (i.e., four dates), 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 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. Most labs will take place on campus and incorporate specimens from Dr. Croft's teaching collection; the remainder will be held at the Cleveland Museum of Natural History and will use specimens from the research collections

there. To prevent damage to 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. Most labs will start with a quiz (see below) and a discussion of the answers, which 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).

Student Assessment and Grading

Seminar Presentations (15% 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). Paying careful attention to the items listed will help maximize your score. Note that materials are due *8 am the day before class*.

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. 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 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%). Answers submitted late will automatically be graded as unsatisfactory. Questions will be posted and assigned by 5 pm on the preceding Friday.

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. 3rd (i.e. bats but not rodents). The final exam will be comprehensive.

Final Letter Grades are generally assigned 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 (15-20 minute) narrated (recorded) presentations reviewing an ancient terrestrial ecosystem with a 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). In support of the presentation, at least 15 references

(journal papers or book chapters) must also be uploaded to the Google Drive folder. The first presentation must be uploaded by October 10th and the second must be uploaded by November 21st.

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

- 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. 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 is true 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/ Phylogeny: 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? 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.
- [ASM Mammal Diversity Database](#): Up-to-date taxonomy on mammals species and higher-level groups
- [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 refs
- [Index Generum Mammalium](#) (Palmer 1904): etymologies (meanings of names) of mammal genera, living and extinct
- [Mammal Crania](#) (Dokkyo U.): photos of many mammal crania, many high resolution
- [Mammal Image Library](#) (American Society of Mammalogists): many mammal photos
- [Mammalian Lexicon](#) (Michigan State): an interesting list of the meanings of family-level and higher mammal names (but beware the background color!)
- [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.)
- 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!)

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](#).