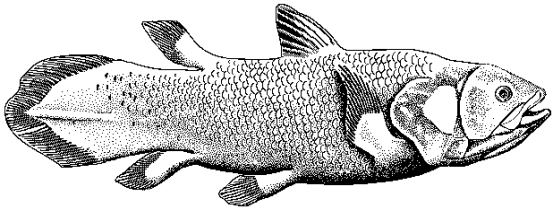


Biology 4010
Vertebrate Biology
Syllabus Fall 2021

Long ago God created the world. He created the sun, the moon, and the stars, as well as all the creatures which inhabit the earth. He created all of them out of nothing — not in a single instant of time, but over a vast period of time. Genesis 1:1 (An interpretive translation by John Sailhamer, 'Genesis Unbound', 1996)

There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved. Charles Darwin (from 'The Origin of Species', 1859)

It is wrong to hold creation and evolution as mutually exclusive alternatives. I am a creationist and an evolutionist. Evolution is God's…method of Creation. Theodosius Dobzhansky, 1973

Catalog Course Description BIO 4010 – Vertebrate Biology (3 units)
An exploration of the evolution of morphology, physiology, and behavior of the vertebrate lineage from hagfish to humans. Appropriate emphasis is given to the major evolutionary approaches of form and function, phylogenetic systematics, taxonomy, natural selection, evo-devo, and the study of fossils and molecular genetics. The course works its way from fish to tetrapods, surveying the distinguishing morphology, physiology, ecology, and lifestyle adaptations of each group. Conservation status and current threats from human impacts are covered. Students learn through readings, group activities and discussions, films, and a research project tracing the evolution of a currently threatened vertebrate species or group. Prerequisite: BIO 2011; Corequisite: BIO 4010L.

Instructor:	**Dr. Mike Mooring** Rohr Science 128	Email: mmooring@pointloma.edu
TAs:	**Wendy Berube**, Lab **Sarah Turcic**, Grader	Email: wberube2121@pointloma.edu Email: sdturcic123@pointloma.edu
Texts:	Vertebrate Life 10th edition, by Pough & Janis.; Oxford University Press, 2018. ISBN: 9781605356075 Labs for Vertebrate Zoology 2nd edition, by Gergus & Schuett, 2000 (reprint). ISBN: 9781884125782	
Required:	iClicker2 – bring to every class meeting; Dissection kit for all dissection labs	
Lecture:	Monday-Wednesday-Friday @ 1:30 - 2:25 PM in Rohr Science 40 (basement lab)	
Lab:	Wednesday @ 2:45-6:15 PM in Rohr Science 40, or field trip *On field trips days, we will flip the class and lab by meeting at 1:30 for the field trip to accommodate closing hours and do the classroom session from 5:20-6:15.*	

Course Learning Outcomes

Upon completion of the course, you will be able to:

- Explain how vertebrate form is a product of both function and evolutionary history.
- Assess the role of natural selection and evo-devo in the emergence of novel traits and body plans.
- Summarize the principles of the cladistic approach to evolutionary history and relatedness.
- Compare the major groups of vertebrates in terms of structural, physiological, and behavioral traits.
- Be familiar with taxonomic nomenclature and the phylogenetic tree of major vertebrate taxa.
- Research and describe the importance of protecting and conserving vertebrate biodiversity.
- Research, synthesize, and analyze data from the literature for an original research project.

Course Objectives

The goal of this course is to gain an intimate appreciation of God's design for life by analyzing and comparing the anatomy, physiology, ecology, and behavior of the vertebrates. We will examine how structure changes from one vertebrate group to another, and how structural changes are correlated with functional changes. Evolution, the mechanism of historical change and relatedness among groups of organisms, will be considered as God's creative tool. Such historical changes in the structure and function of vertebrates are not random, but reflect adaptations for solving different problems encountered in the environment. A unifying theme will be the role of evolutionary processes and the use of phylogenetic systematics (cladistics) to organize vertebrate diversity and to formulate hypotheses that seek to solve the 'mysteries' of vertebrate evolution. Current conservation efforts to save vertebrate species and retain biodiversity will be an underlying theme and a personal motivation.

COURSE DESIGN –

(1) Lecture and Lab: The lecture and lab components will cover most of the same topics, although they will not always be synchronized. Lab partners will complete exercises in phylogenetic systematics, comparative anatomy dissections, examination of mounted specimens, and field trips to the Birch Aquarium and the San Diego Zoo. For the comparative anatomy labs, you will need the Gergus & Schuett lab manual, a dissecting kit with sharp scalpel blades, and clothing that can get dirty.

(2) Textbook Readings and Questions: I have prepared a set of guided questions for each topic reading in the Pough & Janis textbook that is available on the Canvas Module for that week. The guided questions are designed to: (1) help you focus on the information that is most relevant to this course, (2) prepare you for iClicker quizzes and exams, and (3) give you the foundational knowledge for the in-class activities.

(3) Exams: The exams will include multiple choice, short answer, and essay questions that will allow you to demonstrate your grasp of whole concepts and ability to synthesize different material. Each exam will count equally; the midterms will be non-comprehensive and the final will be semi-comprehensive. Study guides will specify the material you need to know. I will not cover all the material in lecture, but you should be reading the assigned chapters in the textbook to prepare for exams.

(4) Term paper: You will be required to do your own research and to prepare a final paper and presentation on a conservation topic involving a single species or a taxonomic group of vertebrates.

(5) Canvas: All the class material will be available to you on the course Canvas site. Assignments will be submitted via Canvas Modules and graded online. Bring your laptops to class and lab, as the in-class assignments will be submitted online (paper use will be minimized). Note that Canvas does not support 'Pages', so PLEASE submit Word or PDF files.

(6) iClickers: Class will involve a combination of lecture and small group activities. Classroom quizzes based on readings and assignments will be administered using iClicker2, therefore you should always bring your clicker to class. You should have your own remote so that your participation is recorded. Clickers will be used to assess participation (engagement) and performance (getting the right answer). Total iClicker points will be adjusted to compensate for excused absences. (Note that I have a few loaner clickers.)

(7) Course Attendance Policy: You are required to sign the attendance roster at each and every class meeting. You are permitted 5 absences without penalty. Every absence in excess of 5 will incur a penalty to be deducted from your attendance participation points and will impact your final grade.

(8) Late Assignments: All assignments should be submitted before the due date and time indicated on Canvas. Late penalties will apply for all assignments submitted after the due date. For labs (15-20 pts) and readings (5 pts), 2 points and 1 point will be deducted for each day late, respectively; no points will be awarded after 10 days under normal circumstances. The intent of late penalties is to encourage you to turn in your work on time, and to be fair to those who do. If you have a legitimate reason for not submitting an assignment on time, please email both the grader and I in a timely fashion (as soon as possible).

(9) Academic Honesty: The PLNU policy on academic honesty is listed under the institutional policies below. My experience is that many students are not aware that some of their regular practices are considered plagiarism. For example, while you are free to discuss readings and lecture material among yourselves, I expect that you will each do your own work on individual assignments. In this case, teaming up with other students to write joint answers that are then turned in as if they were individual efforts is considered plagiarism. Do not share electronic files of your answers to an assignment with another student; if they subsequently use your answers in their assignment, you are also guilty of plagiarism.

(10) Electronic Etiquette: Recent studies have indicated that we are currently experienced an epidemic of 'digital distraction' caused by multi-tasking – moving quickly between tasks on electronic devices in which only partial attention is given to each task. In the classroom setting, studies reveal that the use of laptops and smartphones for non-course related tasks (checking emails, texts, social media) distracts attention from learning and results in reduced academic performance and lowered grades. The reality is that you cannot fully learn new information or master new concepts when distracted by multi-tasking. Evidence indicates that even classmates who see your screen are distracted and their performance reduced.

To ensure the best learning environment possible, classroom policy is that…

- **All electronic devices will be powered off and put away if not in use for classwork.**
- **If electronic devices are in use, they shall be used only for class work.**
- **Consider taking notes by hand, as the act of writing improves learning.**

A brief summary of recent research on the effect of multitasking on learning

1. Laptops and other electronic devises enable more than just note taking, and they introduce numerous distractions (web surfing, homework for other classes, social media, etc.) for you and your neighbors. You may think that you can multitask, but studies show that you cannot.
   'You'll Never Learn!'

2. As already mentioned, using your laptop in class can be less than neighborly. Your classmates' grades can also suffer due to the distracting pull of the laptop.
   'Laptop Multitasking Hinders Classroom Learning for Both Users and Nearby Peers'

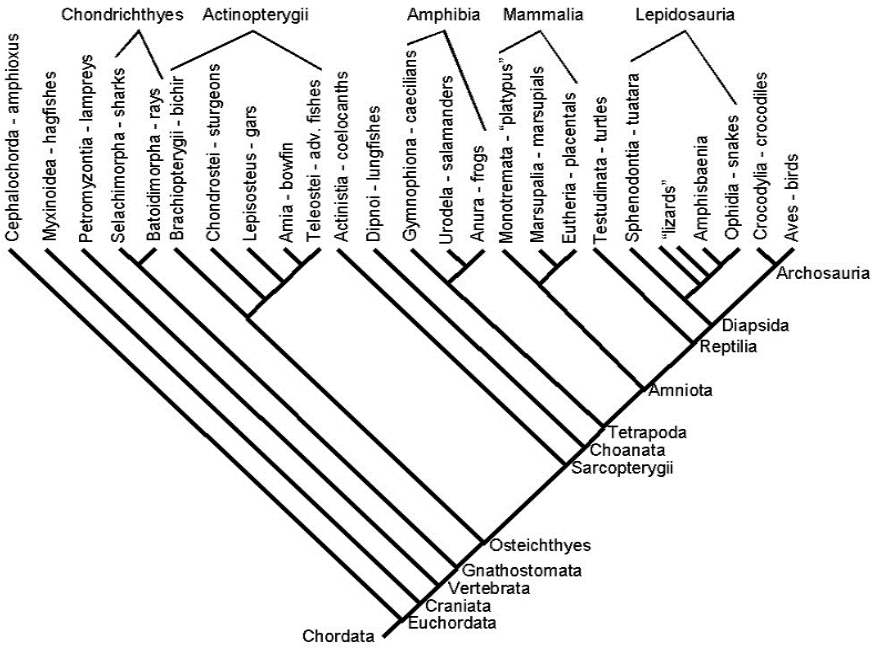
3. Writing is a more effective way of learning material than is typing. With typing, each letter is pretty much the same thing for the brain. Writing, however, uses different muscle groups with each word and encourages the brain to integrate material during the writing process. Typing may be easy and fast, but by making the brain passive, it discourages learning.
   'Attention, Students: Put Your Laptops Away'

4. Using electronic devises in class also impairs long-term retention, with one study suggesting that smartphone use in class can lower one's grade by half a letter grade.
   'The Myth of Multitasking'

Grading Criteria and Assessment

Assignment	Points
Exams: 3 @ 100 pts	300
Text questions: 21@ 5 pts	105
Clicker quiz points	50
Term paper	100
Classroom activities	50
Attendance participation	50
Lab reports: 13@ 20 pts	260
TOTAL	**915**

Letter	Percent	Letter	Percent
A	90	C	70
A-	88	C-	68
B+	86	D+	66
B	80	D	60
B-	78	D-	58
C+	76	F	<58



PLNU INSTITUTIONAL POLICIES

PLNU Mission: To Teach ~ To Shape ~ To Send
Point Loma Nazarene University exists to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service becomes an expression of faith. Being of Wesleyan heritage, we aspire to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

PLNU COPYRIGHT POLICY
Point Loma Nazarene University, as a non-profit educational institution, is entitled by law to use materials protected by the US Copyright Act for classroom education. Any use of those materials outside the class may violate the law.

PLNU ACADEMIC HONESTY POLICY
Students should demonstrate academic honesty by doing original work and by giving appropriate credit to the ideas of others. Academic dishonesty is the act of presenting information, ideas, and/or concepts as one's own when in reality they are the results of another person's creativity and effort. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for that assignment or examination, or, depending on the seriousness of the offense, for the course. Faculty should follow and students may appeal using the procedure in the university Catalog. See Academic Policies for definitions of kinds of academic dishonesty and for further policy information.

PLNU ACADEMIC ACCOMMODATIONS POLICY
PLNU is committed to providing equal opportunity for participation in all its programs, services, and activities. Students with disabilities may request course-related accommodations by contacting the Educational Access Center (EAC), located in the Bond Academic Center (EAC@pointloma.edu or 619-849-2486). Once a student's eligibility for an accommodation has been determined, the EAC will issue an academic accommodation plan ("AP") to all faculty who teach courses in which the student is enrolled each semester. PLNU highly recommends that students speak with their professors during the first two weeks of each semester/term about the implementation of their AP in that particular course and/or if they do not wish to utilize some or all of the elements of their AP in that course. Students who need accommodations for a disability should contact the EAC as early as possible (i.e., ideally before the beginning of the semester) to assure appropriate accommodations can be provided. It is the student's responsibility to make the first contact with the EAC.

PLNU ATTENDANCE AND PARTICIPATION POLICY
Regular and punctual attendance at all class sessions is considered essential to optimum academic achievement. If the student is absent for more than 10 percent of class sessions, the faculty member will issue a written warning of de-enrollment. If the absences exceed 20 percent, the student may be de-enrolled without notice until the university drop date or, after that date, receive the appropriate grade for their work and participation.

SPIRITUAL CARE
Please be aware PLNU strives to be a place where you grow as whole persons. To this end, we provide resources for our students to encounter God and grow in their Christian faith. If students have questions, a desire to meet with the chaplain or have prayer requests you can contact the Office of Spiritual Development.

Vertebrate Biology Class Schedule - Fall 2021

Readings are for Pough et al. 10th edition

DATE	TOPIC	CHAPTER	SECTION	PAGES
Aug 31	Evolution	1	1.2-1.3	5-9
Sept 1	Evo-Devo	1	1.4	11-14
	Duplication of Hox genes	2	2.4	27-28
Sept 3	*Summary of Vertebrate Diversity*	*1*	*1.1*	*1-4*
	Basic Vertebrate Attributes	2	2.1-2.6	19-36
Sept 6	**LABOR DAY**			
Sept 8	Earliest Fish	3	3.1-3.3	41-50
Sept 10	Arrival of Jaws	3	3.4-3.7	51-61
Sept 13	Living in Water	4	4.1-4.2	65-72
Sept 15	Radiation of Cartilaginous Fish	6	6.1-6.2	95-101
	Optional - Extant Sharks and Rays	*7*	*7.1-7.5*	*103-114*
Sept 17	Radiation of Bony Fish 1	8	8.1-8.3	121-130
Sept 20	Radiation of Bony Fish 2	8	8.1-8.3	121-130
	Optional - Extant Bony Fish	*9*	*9.1-9.8*	*133-56*
Sept 22-24	Life on Land: Arrival of Tetrapods	10	10.1-10.4	161-175
Sept 27-29	Amphibians	11	11.1-11.6	181-206
Oct 1	NO CLASS MEETING – *Dr. Mooring in Michigan*			
Oct 4	World of Turtles	16	16.1-16.6	283-295
Oct 6	♦**Exam 1** (Wed)			
Oct 8	Snakes and Lizards 1	17	17.1-17.10	301-323
Oct 11	Snakes and Lizards 2	17	17.1-17.10	301-323
Oct 13	Ectothermy	15	15.1-15.5	269-279
Oct 15	Crocodylians	18	18.1-18.6	239-337
Oct 18-20	Dinosaurs and Mesozoic Diapsids	19	19.1-19.11	343-366
Oct 22	**FALL BREAK**			
Oct 25	Origin of Flight 1	21	21.1-21.4	387-394
Oct 27	Origin of Flight 2	21	21.1-21.4	387-394
Oct 29	Avian Specializations	22	22.1-22.12	399-429
Nov 1	Evolution of Mammals	24	24.1-24.5	451-474
Nov 3	♦**Exam 2** (Wed)			
Nov 5	Common Features of Mammals	25	25.1-25.8	481-515
Nov 8	Specializations of Mammals	25	25.1-25.8	481-515
Nov 10-12	Ecology and Sociality of Mammals	25	25.1-25.8	481-515
Nov 15	Endothermy	20	20.1-20.4	371-383
Nov 17-19	Primate Evolution	26	26.1-26.7	519-549
Nov 22	Human Evolution			
Nov 24-26	**THANKSGIVING RECESS**			
Nov 29-Dec 3	Human Evolution	26	26.1-26.7	519-549
Dec 6-8	Vertebrate Conservation	Readings on next page		
Dec 10	Neotropical Mammalogy			

Dec 15 (Wed) ♦**Final Exam** (1:30 - 4:00 PM)

Vertebrate Biology TEXT READING SCHEDULE – 2021

- Readings are for Pough et al. 10th edition. Assignments are due at midnight of the date indicated.

DATE DUE	TOPIC	READING	SECTION	PAGES
Sept 7	Evolution – Phylogenetic Systematics	1	1.2-1.3	5-9
Sept 7	Evo-Devo	2	1.4 2.4	11-14 27-28
Sept 8	Basic Vertebrate Attributes	3	2.1-2.6	19-36
Sept 13	Earliest Fish	4	3.1-3.3	41-50
Sept 13	Arrival of Jaws	5	3.4-3.7	51-61
Sept 17	Radiation of Cartilaginous Fish	6	6.1-6.2	95-101
Sept 24	Radiation of Bony Fish	7	8.1-8.3	121-130
Sept 27	Life on Land: Arrival of Tetrapods	8	10.1-10.4	161-175
Oct 4	Amphibians	9	11.1-11.6	181-206
Oct 6	**Exam 1**			
Oct 11	World of Turtles	10	16.1-16.6	283-295
Oct 13	Snakes and Lizards	11	17.1-17.10	301-323
Oct 25	Crocodylians	12	18.1-18.6	239-337
Oct 25	Dinosaurs and Mesozoic Diapsids	12	19.1-19.11	343-366
Nov 1	Origin of Flight	13	21.1-21.4	387-394
Nov 3	Avian Specializations	14	22.1-22.12	399-429
Nov 3	**Exam 2**			
Nov 10	Evolution of Mammals	15	24.1-24.5	451-474
Nov 15	Specializations of Mammals	16	25.1-25.8	481-515
Nov 19	Ecology and Sociality of Mammals	17	Variety of readings	
Nov 29	Primate Evolution	18	24.1-24.6	581-611
Dec 3	Human Evolution	19	26.1-26.7	519-549
Dec 10	Vertebrate Conservation	20 - Readings below		
CONSERVATION READINGS	Declining Shark Populations	7	7.4	114
	Pollution, overfishing, and fish farming	9	9.8	155-156
	Why are amphibians disappearing?	11	11.6	205-206
	Fateful characteristics of turtles	16	16.6	295
	Lepidosaurs and climate change	17	17.10	323
	Crocodylians and the skin trade	18	18.6	337
	Birds and urbanization	22	22.12	428-429
	Mammals and trophy hunting	25	25.8	513-515
	Humans and other vertebrates	26	26.7	547-549

Vertebrate Biology Lab Schedule - Fall 2021

All on-campus labs are WEDNESDAY from 2:45-6:15 pm (field trips are 1:30-5:00). Labs that are starred (*) will involve dissection of preserved specimens; bring dissecting kit and wear appropriate clothing. G&S = Gergus & Schuett lab manual.

On field trip days we will flip our lecture-lab schedule and do the field trip first followed by the lecture class after returning to campus. We will meet at 1:30 for the field trip, return to campus by 5:00, and meet for class at 5:20 in Rohr Science 40.

DATE	LAB #	ACTIVITY	READING
Sept 1	1	Systematics: phylogenetic & taxonomic analysis	G&S Lab 1
Sept 8	2*	Hemichordata, Urochordata, & Cephalochordata	G&S Lab 2
	3*	Jawless Craniates: Myxinoidea & Petromyzontoidea	G&S Lab 3
Sept 15	4*	Gnathostomata: Chondrichthyes	G&S Lab 4
Sept 22	5	▲ Field trip to Birch Aquarium	Handout
Sept 29	6*	Osteichthyes: Actinopterygii, Latimeria & Dipnoi	G&S Lab 5
Oct 6	7*	Tetrapoda: Amphibia	G&S Lab 6
Oct 13	8*	Amniota: Reptilia (turtles, snakes, and lizards)	G&S Lab 7 – part 1
Oct 20	9	▲ Field trip to San Diego Zoo: *Amphibians & reptiles*	Handout
Oct 27	10*	Amniota: Reptilia (birds)	G&S Lab 7 – part 2
Nov 3	11	▲ Field trip to San Diego Zoo: *Birds*	Handout
Nov 10	12*	Amniota: Mammalia	G&S Lab 8
Nov 17	13	▲ Field trip to San Diego Zoo: *Mammals*	Handout
Nov 24	**THANKSGIVING RECESSS**		
Dec 1	14	Mammalia: Mounts, skins, skulls, and teeth	Handout
Dec 8	15	Research Project Presentations	