Comparative and Functional Anatomy of Vertebrates (Biology 281)

Syllabus, Spring 2008

(REVISED version 14 Apr 08)

Instructors:	John Long	Marianne Porter
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Phone:	x7305	best if reached via email
Office:	Olmsted 317	Olmsted 137
Office hours:	T, 10:30 a.m. to 12 noon	R, 10:30 a.m. to 12:00 noon

Lecture:	T and R, 9:00 to 10:15 a.m., Olmsted 300	
Lab:	R and F, 1:30 to 5:30 p.m., Olmsted 228	

Thursday's intern:	Virginia Engel	(viengel@vassar.edu)
Friday's intern:	Anne Hutchinson	(annhutchinson@vassar.edu)

Required texts (purchase, borrow, or share):

Kardong, K. and Zalisko, E.J. (2005). *Comparative Vertebrate Anatomy: A Laboratory Dissection Guide, 4th Ed.* McGraw Hill. Abbreviated **K&Z** below.

Liem, K., Bemis, W. ,Walker, W.F, and Grande, L. (2001). *Functional Anatomy of the Vertebrates: An Evolutionary Perspective, 3rd Ed.* Brooks Cole. Abbreviated **LBWG** below.

Other readings (available on class' Blackboard site or by email from John**):**

Ahlberg, P.E. and Clack, A. (2006). A firm step from water to land. *Nature* 440, 747-749.

Boback, S.M., Cox, C.L., Ott, B.D., Carmondy, R., Wrangham, R.W. and Secor, S.M. (2007). Cooking and grinding reduces the cost of meat digestion. *Comp. Biochem. & Physiol.,* Part A 148, 651-656.

Brainerd, E.L. and Owerkowicz, T. (2006). Functional morphology and evolution of aspiration breathing in tetrapods. *Resp. Physiol. & Neur.* 154, 73-88.

Cheng, Y-N., Wu, X-C. and Qiang, J. (2004). Triassic marine reptiles gave birth to live young. *Nature* 432, 383-387.

Clack, J.A. (2004). From fins to fingers. *Science* 304, 57-58.

Clark, A.J. and Summers, A.P. (2007). Morphology and kinematics of feeding in hagfish: possible functional advantages of jaws. *J. Exp. Biol.* 210, 3897-3909.

Delsuc, F., Brinkmann, H., Chourrout, D. and Philippe, H. (2006). Tunicates and not cephalochordates are the living relatives of vertebrates. *Nature* 439, 965-969.

Donley, J.M., Sepulveda, C.A., Konstantinidis, P., Gemballa, S. and R.E. Shadwick (2004). Convergent evolution in mechanical design of lamnid sharks and tunas. *Nature* 429, 61-66.

Ellerby, D.J., Spierts, I.L.Y. and Altringham, J.D. (2001). Fast muscle function in the European eel (*Anguilla anguilla*) during aquatic and terrestrial locomotion. *J. Exp. Biol.* 204, 2231-2238.

Holland, N.D. and Chen, J. (2001). Origin and early evolution of the vertebrates: new insights from advances in molecular biology, anatomy, and palaeontology. *BioEssays* 23, 142-151.

Koob, T.J. and Long, J.H. Jr. (2000). The vertebrate body axis: evolution and mechanical function. *Amer. Zool.* 40, 1-18.

Long, J.H. Jr., Hale, M.E., McHenry, M.J., Westneat, M.W. (1996). Functions of fish skin: flexural stiffness and steady swimming of longnose gar *Lepisosteus osseus*. *J. Exp. Biol.* 199, 2139-2151.

Striedter, G.F. (2005). Conservation in vertebrate brains. Ch. 3 in *Principles of Brain Evolution*. Sinauer.

Striedter, G.F. (2006). Precis of *Principle of Brain Evolution*. *Behav. & Brain Sci.* 29, 1-36.

Vogel, S.V. (2003). Size and scale. Ch. 3 in *Comparative Biomechanics*. Princeton Univ. Press.

Vogel, S.V. (2003). A matter of materials. Ch. 15 in *Comparative Biomechanics*. Princeton Univ. Press.

Vogel, S.V. (2003). Using muscle: tuning and transmissions. Ch. 23 in *Comparative Biomechanics*. Princeton Univ. Press.

Goals of this course:

Skills-based —

1. Anatomical analysis *via* dissection. This is a quintessentially hands-on skill, coupling your vision, haptic systems, and internal 3D maps to produce an internal model in your head of other animals. If you don't quickly find this process to be totally awesome, then you're in the wrong class. Seriously.
2. Phylogenetic reconstruction and character evolution.
3. Biomechanical analysis and modeling.
4. Comprehension and critique of the primary scientific literature.

Knowledge-based —

1. Vertebrate diversity — naming names. Memorization? What? You've got to be kidding.
2. Vertebrate anatomy — bones, muscles, hearts, brains, and nerves; skin, guts, and gills.
3. Biomechanics — force, work, power; levers; locomotion.
4. Evolutionary theory — natural selection, mosaic evolution.
5. Phylogenetic theory — homology, synapomorphy, sympleisiomorphy, characters, states.

Assignments, Grades, Due Dates:

	Grade (%)	Due Date
Practical exam I — 28 & 29 February, 1:30 to 5:30 p.m.	20	2/28 & 2/29, 1:30 p.m.
Practical exam II — Final exam	20	To be announced.
Character evolution project: annotated bibliography	5	3/6 (R), 9:00 a.m.
Character evolution project: presentation	10	5/1, 5/2, 5/6, 9:00 a.m.
Character evolution project: manuscript	15	5/6, 5:00 p.m.
Phylogenetic reconstruction	10	2/14 (R), 9:00 a.m.
Biomechanical analysis	10	4/3 (R), 9:00 a.m.
Attendance & participation	10	Every day.
Total	**100**	

Date	Lecture	Reading for Lecture	Lab	Reading for Lab
24 Jan (R)	Principles of Comparative Anatomy	—	1. Vertebrate diversity	K&Z, Chs 1, 2
25 Jan (F)	—		1. Vertebrate diversity	K&Z, Chs 1, 2
29 Jan (T)	Evolution of vertebrates	LBWG, Ch 1 & 2 Delsuc et al. 2006		
31 Jan (R)	Diversity of craniates	LBWG, Ch 3 Holland & Chen 2001	2. Jawless vertebrates	K&Z, Ch 3 Clark & Summers, 2007
1 Feb (F)	—		2. Jawless vertebrates	K&Z, Ch 3 Clark & Summers, 2007
5 Feb (T)	Functional analysis	LBWG, Ch 5		
7 Feb (R)	Skin, scales, and feathers	LBWG, Ch 6	3. Integument	K&Z, Ch 4 Long *et al*. 1996
8 Feb (F)			3. Integument	K&Z, Ch 4 Long *et al*. 1996
12 Feb (T)	Biomaterials	Vogel, Ch 15		
14 Feb (R)	The axis of evil	LBWG, Ch 8	4. Skeletal systems I	K&Z, Ch 5 Koob & Long, 2000
15 Feb (F)	—		4. Skeletal systems I	K&Z, Ch 5 Koob & Long, 2000
19 Feb (T)	The head bone(s)	LBWG, Ch 7		
21 Feb (R)	All arms and legs	LBWG, Ch 9	5. Skeletal systems II	K&Z, Ch 5 Clack, 2004; Ahlberg, '06
22 Feb (F)	—		5. Skeletal systems II	K&Z, Ch 5 Clack, 2004; Ahlberg, '06
26 Feb (T)	The physics of size	Vogel, Ch 3		
28 Feb (R)	The physics of life	—	6. Practical Exam I	—
29 Feb (F)	—	—	6. Practical Exam I	—
4 Mar (T)	Muscles as motors	LBWG, Ch 10		
6 Mar (R)	Muscular systems	LBWG, Ch 10	7. Muscles I	K&Z, Ch 6 Donley *et al*. 2004
7 Mar (F)	—	—	7. Muscles I	K&Z, Ch 6 Donley *et al*. 2004
	Spring Break			
25 Mar	Animals as machines	Vogel, Ch 22		

27 Mar	Locomotion	LBWG, Ch 11	8. Muscles II	K&Z, Ch 6 Ellerby *et al*. 2001
28 Mar	—	—	8. Muscles II	K&Z, Ch 6 Ellerby *et al*. 2001
1 Apr (T)	Feeding mechanisms	LBWG, Ch 16		
3 Apr (R)	Guts and glory	LBWG, Ch 17	9. Digestive Systems	K&Z, Ch 7 Boback *et al*. 2007
4 Apr (F)	—	—	9. Digestive Systems	K&Z, Ch 7 Boback *et al*. 2007
8 Apr (T)	Gills and lungs	LBWG, Ch 18		
10 Apr (R)	Hearts and arteries	LBWG, Ch 19	10. Circulatory & Respiratory Systems	K&Z, Ch 8 Brainerd & Ower., 2006
11 Apr (F)	—	—	10. Circulatory & Respiratory Systems	K&Z, Ch 8 Brainerd & Ower., 2006
15 Apr (T)	**Senses & Sensibility**	**LBWG, Ch 12**		
17 Apr (R)	**Spinal Cord**	**LBWG, Ch 13**	**11. Structured Review**	—
18 Apr (F)	—	—	**11. Structured Review**	—
22 Apr (T)	**Nerves & Brains**	**LBWG, Ch 13 & 14**		
24 Apr (R)	**A brain for vertebrates**	**LBWG, Ch 14**	12. Nervous systems I	K&Z, Ch 10 Striedter, 2005
25 Apr (F)	—	—	12. Nervous systems I	K&Z, Ch 10 Striedter, 2005
29 Apr (T)	**Presentations: Alexis, Andrew M., Annamarie, Eric, Jonathon**			
1 May (R)	**Presentations: Caitlin L., Camille, Courtney, Grace, Josh, Keon, Lucy, Nooreen, Phillipe, Robertino**		13. Nervous systems II	K&Z, Ch 10 Striedter, 2006
2 May (F)	—	—	13. Nervous systems II	K&Z, Ch 10 Striedter, 2006
6 May (T)	**Presentations: Andres, Andrew S., Cailtin B., Elizabeth, Kyle, Kristine, Laura, Lauren, Lindsey, Margaret, Molly, Nicole, Sarah**			

Policies:

1. Attendance: while we strongly encourage you to attend all lectures, **attendance in laboratories is mandatory.** The only valid excuse is one from your Class Advisor (Dean of Studies office). Missed laboratories, excused or unexcused, must be made up on your own time. Even with a valid excuse, you may not temporarily switch laboratory sections without prior permission from both professors.

2. Late penalties: assignments will be penalized 2% per day late, including weekends. Extensions will be given only with the permission of your Class Advisor.

3. Disabilities: Academic accommodations are available for students with disabilities who are registered with the Office of Disability and Support Services. Students in need of disability accommodations should schedule an appointment with me early in the semester to discuss any accommodations for this course which have been approved by the Office of Disability and Support Services, as indicated in your DSS accommodation letter.