NJIT BIOLOGY

Course Syllabus

SPRING 2017

BIOLOGY 612 -002: COMPARATIVE ANIMAL PHYSIOLOGY

INSTRUCTOR:	Dr. Daphne Soares, soares@njit.edu, 428G CKB
OFFICE HOURS	Tues.: 11:30-12:30 pm
COURSE SCHEDULE:	T, R: 10:00am-11:25am [FMH 411]

COURSE DESCRIPTION:

We will use a comparative approach to examine the physiology of animals including major physiological systems. Topics to be covered include metabolic, temperature, osmotic and ionic regulation; respiration and circulatory transport, digestive, muscle, nervous, and locomotor systems; endocrine regulation and biological rhythms. We will further examine how physiological systems are integrated and thus allow animals to respond, physiologically, in different environments. This course will explore how animals, from invertebrates to vertebrates, function from the cellular to the organism level. The study of the structure and function of the various organs provides insight into how animals survive extreme environments and how they respond to changes in their environment. The comparative approach shows that the underlying physiological principles that govern life are common to all animals and yet animals have evolved unique and sometimes startling physiological solutions to problems posed by their particular environments.

COURSE MATERIALS:

We will be using assigned primary literature weekly. Any comparative physiology could be use as reference but I use: Environmental Physiology of Animals, 2nd edition. Willmer, Stone and Johnson. 2005. Blackwell Publishing.

GRADING POLICY:

Grades will be based participation, presentation and writing assignments.

COMPONENT	POINTS
Participation	20 points
Three written critiques of papers	10 pts ea. (30 points)
Exam 1	50 points
Exam 2	50 points
Exam 3	50 points
Final Exam	50 points
TOTAL	**250 points**

LETTER GRADE	SCALE
A	90-100%
B+	85 – 89%
B	80 – 84%
C+	75 – 79%
C	70 – 74%
D	60 – 69%
F	0-59%

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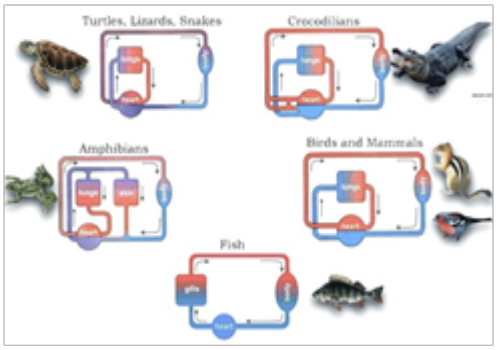
WRITING ASSIGNMENTS: Writing is the currency of science. We will have two essays scheduled for the semester (right before spring break and after the last class). Essays are based on the previous topics discussed in class. Your task is to pick one article from the primary literature and summarize it in one page. Make sure you identify the hypothesis. I will give feedback to all assignments as needed.

HOW THIS COURSE RUNS: This is a work intensive course. Be prepared to be 100% committed to doing a LOT of reading every week and we will only be discussing primary literature. ALL students have to read ALL the papers EVERY WEEK. We will split up the class into teams and each team will have to lead the discussion of their assigned paper, but again ALL students have to read ALL the papers EVERY WEEK. If you have never presented a paper in a journal club or class, or are uncomfortable doing it, you should meet with me ahead of time and I'll help you prepare. Participation points cone from here!



CODE OF ACADEMIC INTEGRITY: Each student in this course is expected to follow the Code of Academic Integrity. The Code is explained on Academic Integrity Code.

SCHEDULE AND COURSE OUTLINE: Please note that this is the proposed schedule. We may make changes to the schedule when needed; you will be notified of any changes. Readings and assignments will be posted to the course website.

Learning Outcomes:

This is a "curiosity-based" graduate-level course that seeks to expand student's knowledge in fields of their own interest. The educational goals of this course are to improve students' ability to find, understand, integrate, and present primary scientific data, hypotheses, and methodologies.

Students should be able to:

- Understand important physiological challenges animals face, how those challenges vary in relation to the animals' environment, and the processes by which animals deal with these challenges.
- Identify and describe structural differences of major physiological systems that characterize different taxonomic groups of animals.
- Relate physiological processes, from the biochemical to the system level, to the function of the entire organism in its environment.
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- Develop an understanding of current research topics in animal physiology using the primary literature and to develop research questions and methodology to address these questions.

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***DO NOT SCHEDULE TRAVEL DURING THE FINAL EXAM PERIOD UNTIL AFTER THE NJIT FINAL EXAM SCHEDULE HAS BEEN ANNOUNCED.

DATE	LECTURE TOPIC	READINGS	OTHER
1/17	Course overview, administrative issues, and themes in physiology, animal form and function		Student survey
1/19	Historical development of comparative evolutionary physiology	New directions in ecological physiology. Cambridge Univ. Press. Mayr, E. 1961. **Cause and effect in biology**. Science 134:1501-1506	**Jan 23: Last day to add/drop**
1/24	Evolution and the Phenotypic Hierarchy	Garland, T. Jr. and P. A. Carter. 1994. **Evolutionary physiology.** Annual Review of Physiology 56:579-621.	Jan 24 W Grades Posted for Course Withdrawals
1/26	Allometry and Scaling	B. Z. Stanger. 2008. **The biology of organ size determination**. Diabetes, Obesity and Metabolism, 10 (Suppl. 4), 16–22 Stern D.L. and D.J. Emlen. **The developmental basis for allometry in insects**. Development 126, 1091-1101	
1/31	Interspecific Comparisons and why Phylogeny Matters	Garland T Jr, Bennett AF, Rezende EL. 1005. **Phylogenetic approaches in comparative physiology**.J Exp Biol.208(Pt 16):3015-35. Gonzalez A, Pagé B, Weber JM. 2015 **Membranes as a possible pacemaker of metabolism in cypriniform fish: does phylogeny matter?** J Exp Biol. 218(Pt 16):2563- 72.	
2/2	Thermoregulation and Resting Metabolism 1	Angilletta, M. J. Jr. P. H. Niewiarowski, and C. A. Navas. 2002. **The evolution of thermal physiology in ectotherms.** Journal of Thermal Biology 27:249-268. Ocko SA, Mahadevan L. 2013. **Collective thermoregulation in bee clusters.** J R Soc Interface. 11(91):20131033.	
2/7	Thermoregulation and Resting Metabolism 2	Tracy, R. L. and G. E. Walsberg. 2001. **Developmental and acclimatory contributions to water loss in a desert rodent: investigating the time course of adaptive change.** J. of Comparative Physiology B 171:669-679. Gibbs.A 2002. **Water balance in desert Drosophila: lessons from non-charismatic microfauna.** Comparative Biochemistry and Physiology - Part A: Molecular and Integrative Physiology , November 2002, Vol. 133 Issue: Number 3 p781-789	

2/9	Thermal adaptation	Harding MM, Anderberg PI, Haymet AD. 2003. **'Antifreeze' glycoproteins from polar fish.** Eur J Biochem. 270(7):1381-92	**Paper critique 1 due**
2/14	**Exam 1**	**Exam 1**	**Exam 1**
2/16	Locomotor Performance and Energetics 1	T Garland 1984. **Physiological correlates of locomotory performance in a lizard: an allometric approach.** Vol. 247 no. 5, R806-R815 Full RJ, Zuccarello DA and Tullis A.1990. **Effect of variation in form on the cost of terrestrial locomotion.** J Exp Biol 150, 233-246.	
2/21	Locomotor Performance and Energetics 2	Shillington, C. and C. C. Peterson. 2002. **Energy metabolism of male and female tarantulas (Aphonopelma anax) during locomotion.** Journal of Experimental Biology 205:2909-2914. R. J. Full. 1986. **Locomotion without lungs: energetics and performance of a lungless salamander.** Vol. 251 no. 4, R775-R780	
2/23	Sensory 1 vision	Lacalli TC. 2001 **New perspectives on the evolution of protochordate sensory and locomotory systems, and the origin of brains and heads.** Philos Trans R Soc Lond B Biol Sci Oct 29;356(1414):1565-72 Arendt D. 2003. **Evolution of eyes and photoreceptor cell types.** Int J Dev Biol. 2003;47(7-8):563-71.	
2/28	Sensory 2 hearing	Albert JT, Göpfert MC. 2015. **Hearing in Drosophila.** Curr Opin Neurobiol. 34:79-85. Coleman MN, Boyer DM. 2012. I**nner ear evolution in primates through the Cenozoic: implications for the evolution of hearing**. Anat Rec 295(4):615-31	
3/2	Sensory 3 chemo	Ping Wen, Bao-Zhong Ji , David Sillam-Dussès 2014.**Trail Communication Regulated by Two Trail Pheromone Components in the Fungus- Growing Termite Odontotermes formosanus (Shiraki).** PLOS ONE 9(3): e90906. Y Kiyokawa, Y Kodama, T Kubota. 2013. **Alarm Pheromone Is Detected by the Vomeronasal Organ in Male Rats.** Chem. Senses. doi: 10.1093/chemse/bjt030	
3/7	Sensory 4 weird	Goerlitz HR1, ter Hofstede HM, Zeale MR, Jones G, Holderied MW. 2010 **An aerial-hawking bat uses stealth echolocation to counter moth hearing**. Curr Biol.20(17):1568-72.	**Paper critique 2 due**

		James J., A. Longtin, L. Maler. 2014 **Long-term Behavioral Tracking of Freely Swimming Weakly Electric Fish**. J. Vis. Exp. **(85), e50962,** URL: http://www.jove.com/video/50962	
3/9	**Exam 2**	**Exam 2**	**Exam 2**
3/14-3/16	**SPRING BREAK: MARCH 12-19, 2017**		
3/21	Hot and dry habitats: deserts	Tekei Y, Bartolo RC, Fujihara H, Ueta Y and Donald JA (2012) **Water deprivation induces appetite and alters metabolic strategy in Notomys alexis: unique mechanisms for water production in the desert.** *Proc. R. Soc. B* 7 July 2012 vol. 279 no. 1738 2599-2608	
3/23	High altitude	Scott GR (2011) **Elevated performance: the unique physiology of birds that fly at high altitudes.** J Exp Biol 214, 2455-2462.	
3/28	Transient water bodies and extreme transience	McLachlan A, Ladle R (2001) Life in the puddle: behavioural and life-cycle adaptations in the Diptera of tropical rain pools. Biol Rev Camb Philos Soc. 2001 Aug;76(3):377-88.	
3/30	Osmotically peculiar habitats and thermally extreme water	Laverty G and Skadhauge E. 2012 Adaptation of teleosts to very high salinity. Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology 163 (1) 1–6	
4/6			**Paper critique 3 due**
4/11	**Exam 3**	**Exam 3**	**Exam 3**
4/13	Reproduction 1	Ram JL, Fong PP and Garton DW. 1996. **Physiological Aspects of Zebra Mussel Reproduction: Maturation, Spawning, and Fertilization** Amer. Zool. 36 (3): 326-338. Werner J, Griebeler EM. 2011. **Reproductive biology and its impact on body size: comparative analysis of mammalian, avian and dinosaurian reproduction**. PLoS One. 6(12)	
4/18	Reproduction 2	Ramm SA, Schärer L, Ehmcke J, Wistuba J. Mol Hum Reprod. 2014. **Sperm competition and the evolution of spermatogenesis.** 20(12):1169-79. Perry JC. 2011. **Mating stimulates female feeding: testing the implications for the evolution of nuptial gifts**. J Evol Biol.24(8):1727- 36.	
4/20	Circulatory 1	Bettex DA, Prêtre R, Chassot PG. 2014. **Is our heart a well-designed pump? The heart along animal evolution.** Eur Heart J. 2014 Sep 7;35(34):2322-32 Scott GR. 2015. **Early insights into the evolution of respiratory and cardiovascular physiology in vertebrates**. J Exp Biol. 2015 Sep;218(Pt 18):2818-20. doi: 10.1242/jeb.109868.	
4/25	Circulatory 2	Lillywhite HB, Albert JS, Sheehy CM 3rd, Seymour RS. 2012. **Gravity and the evolution of cardiopulmonary morphology**	

		in snakes. Comp Biochem Physiol A Mol Integr Physiol. 161(2):230- 42. Pierson DJ. 2009. **The physiology of dinosaurs: circulatory and respiratory function in the largest animals ever to walk the earth**. Respir Care. 54(7):887-911.	
4/27	Excretion	Vize PD, Smith HW. 1943. **A Homeric view of kidney evolution: A reprint of H.W. Smith's classic essay with a new introduction.** **Evolution of the kidney.** Anat Rec A Discov Mol Cell Evol Biol;277(2):344-54. Ley RE, Hamady M, Lozupone C, Turnbaugh PJ, Ramey RR, Bircher JS, Schlegel ML, Tucker TA, Schrenzel MD, Knight R, Gordon JI. 2008. **Evolution of mammals and their gut microbes.** Science. 320(5883):1647-51.	
5/2	Last interesting bits	Torday JS. 2013. **Evolution and Cell Physiology.** **1. Cell signaling is all of biology.** Am J Physiol Cell Physiol. 305(7):C682-9. Somero GN. 2010. **The physiology of climate change: how potentials for acclimatization and genetic adaptation will determine 'winners' and 'losers'.** J Exp Biol. 213(6):912-20.	**Paper critique 4 due**
5/5-11	**Exam 2 - During Final Exam Week*** **		http://www5.njit.edu/registrar/exams/
FINALS	**FINAL EXAM WEEK: MAY 05-11, 2017**		