

ENVIRONMENTAL PHYSIOLOGY & ECOLOGY

Syllabus
Spring Semester, 2010

BIO 3610

Dr. John E. Silvius
ENS 272 Ph. 7948

COURSE DESCRIPTION:

A study of physiological mechanisms and adaptations by which plants and animals regulate life processes in response to light, temperature, moisture, and chemicals in their environment. The spring phase considers how organism-environment relationships account for distribution and activity of species within the wider context of biotic communities and bioregions of eastern North America.

GENERAL AIMS:

1. Studying environmental challenges that are common to both animals and plants in winter
2. Integrative approach that emphasizes physiological/ morphological aspects across taxonomic divides
3. Exploring how environmental physiology accounts for distribution in communities and bioregions.
4. Promote intellectual stimulation, guidance in vocational pursuits, and mutual edification in diverse learning settings

LEARNING OBJECTIVES: Successful completion of BIO 3610 will enable students to...

1. Analyze and discuss the concept of an *organism* based upon an understanding of the dynamic relationships between organism and environment involving energy metabolism and gas exchange, water relationships, nutrition, and environmental signaling.
2. Discuss morphological, physiological, and behavioral adaptations that allow sufficient energy, water, and nutrient acquisition by plants and animals in the midst of diurnal, seasonal, and long-term changes in the physical environment.
3. Explain how morphological and physiological adaptations account for the spatial distribution and activity of animal and plant species within the wider context of biotic communities and bioregions.
4. Demonstrate the skills necessary for, experimental design; care of plants, animals, and public/private lands; proper use of instrumentation and techniques for data collection, analysis, and interpretation; and proficient oral or written communication..
5. Discuss particular biological and ethical considerations that arise from recreational and commercial uses of forests, or that arise from agricultural and medical technology related to environmental physiology (*e.g.* human nutrition, cryopreservation, and biotechnology).

IMPLEMENTATION:

SCHEDULE: Lectures: MWF 9-9:50 am ENS 282
Laboratory: Tue 2:00 – 4:50 pm ENS 106

The course schedule must remain tentative due to unpredictable weather and other unforeseen circumstances.

RESOURCES:

P.J. Marchand. 1996. *Life in the Cold*, 3rd ed. Univ. Press of New England, Hanover, NH.
Barnes, B.V. & W.H. Wagner, Jr. 1981/2004. *Michigan Trees*. U. of Mich. Press, Ann Arbor, MI.
Molles, M.C. Jr. 2008. *Ecology: Concepts and Applications*, 4th ed. McGraw-Hill, Boston, MA.
Ecology and physiology journal articles will be assigned or selected by students
Study Assignment Guide – accessible via the online BIO 3610 Home Page

INDIVIDUAL STEWARDSHIP:

1. **Commitment** to God, to professor, and to the "community of learners" will be emphasized.
CHALLENGE: Participate as one who acknowledges Christ as Creator (Col. 1:16), Intelligent Designer (Gen. 1: 31; Rom. 1:20; Job 12:7-10), Lord of creation (Col. 1: 16-17; 2:3), and of your life (Romans 12: 1). A FRUIT (manifestation) of this commitment is a willingness to share in valuing the course objectives and accepting responsibility to achieve them. See Phil. 2:3-4; Col. 3:23-24.

2. **Responsibility** as an active participant in four settings:
 - a. **Out-of-Class** reading and study will be assigned as an essential preparation for and reinforcement of the other learning settings (see following).
CHALLENGE: Personally commit yourself to regular completion of reading/study assignments. Begin with prayer for an alert, inquiring mind. Make "Study Notes" and keep them topically synchronized with Study Outlines, lecture notes, and lab content. Set a high standard for research-related assignments – laboratory data analysis and interpretation; scientific journal access/study. Add to your lecture notes (“fill gaps”) and review notes soon after class.

 - b. **Laboratory** will aid your comprehension of lecture material, promote hands-on and scientific reasoning skills, and foster personal interaction. See page 4. “LABORATORY”.
CHALLENGE: Strive for active participation and cooperation; care of plants and animals, etc.

 - c. **Lecture-Discussions** will facilitate your learning by the following activities:
 - > INTEGRATING out-of-class and laboratory learning experiences
 - > REINFORCING learning by oral discussion, interaction, and clarification
 - > MOTIVATING and INSPIRING your best effort toward this part of your educationCHALLENGE: Come to lecture faithfully and on time, having read assignments in preparation to contribute and receive. Make good lecture notes;

 - d. **Office Hours** are provided for your additional assistance as scheduled on my door, ENS 272.
CHALLENGE: Please come by if I can help academically, or personally. Seek out additional help from Academic Assistance if necessary (see page ?).

GRADE CALCULATION:

Weighting:

Exam I -----	150
Exam II -----	150
Exam III -----	150
Exam IV -----	150
Laboratory* -----	200
Attendance/Quizzes -----	100
Personal Inquiry Project (PIP)--	100
Total -----	1000

Letter Grades:

A	900 - 1000	[Plus (+) and (-) grades are awarded.
B	800 - 899	for the upper or lower 20 points of each
C	700 - 799	grade interval respectively.]

Laboratory* -----	200	—>	*Laboratory Points Originate from the Following:
Attendance/Quizzes -----	100		Lab Reports (choices totaling 150 points) - 150
Personal Inquiry Project (PIP)--	100		Attendance/Contribution; indoor & field --- 50

TEACHER EDUCATION PROGRAM UNIT AND PROGRAM ASSESSMENTS ASSIGNED TO COURSE

Unit Outcome	Program Outcome	Decision Points	Assessment
Competence	NSTA Std 1a.	4	#1 Content Knowledge
Competence	NSTA Std 1a.	1, 2, 3, 4	#2 Content Knowledge

SPECIFIC DETAILS:**LABORATORY**

The purpose of the laboratory is to aid your comprehension of lecture material, enhance hands-on and scientific reasoning skills, and foster personal interaction through the following experiences:

1. Studies of plant and animal physiology under laboratory conditions using contemporary methods.
2. Field studies of plants and animals, and the biotic communities to which they are adapted.

EVALUATION of laboratory performance is based upon the expectations outlined in "Learning Objective" #4 on page 1. In keeping with these objectives, Laboratory Reports (your choice totaling 150 points) will be assigned with due dates specified in the Tentative Schedule, pages 4 and 5. Because it has been demonstrated that student revisions of graded reports improve writing skills, you may be permitted to rewrite a graded report with the offer of an increase in your score pending improvements. However, your original report must have evidenced considerable effort toward

- (a.) completeness in your display and analysis of the data,
- (b.) accurate and coherent discussion of the results, and
- (c.) a dedicated attempt to relate the results to current theory.

At least one Lab Practical will be given for Quiz points.

STEWARDSHIP – PARTICIPATION AND QUIZZES

Stewardship is a *qualitative* dimension of your participation as a member of the class (a "community of learners") as determined by an attitude that is demonstrated in both out-of-class preparation and in-class presence and participation. See the CHALLENGES on page 2. This stewardship will require a regular, Spirit-motivated, internal commitment to learning. However, an external motivation in the form of "oral reporting assignments" and quizzes will be given for *quantitative* evaluation and feedback.

PERSONAL INQUIRY PROJECT (PIP)

Recognizing that individual interests and learning styles vary, and recognizing the importance of familiarity with the "primary literature," you will be asked to choose one scientific journal article from pre-selected articles, or present a similar article for approval. Upon approval of an article, you will be asked to become thoroughly familiar with the methods, data, and conclusions; and locate two other related primary sources, which I will approve. Then, on an appointed day, lead a 30-40-minute discussion of your main article with supporting results from the related articles. Fellow students will receive copies of your main article and be prepared to ask questions or share insights as well. As you read assigned material early in the course, be thinking of a topic which you would like to study in more detail in the spirit of this "PIP" assignment.

SPECIAL PROVISIONS:

TECHNOLOGY: Use of calculators is permitted during some exams for computations, but must not contain related information which should instead be provided from memory. Wireless or remote electronic access technology may be used during class sessions (not during exams) provided the usage enhances your learning in the class meeting and does not distract others. Violation of this policy will constitute reason for denial of the privilege of using the technology in class in the future. Before class, please switch your cell phone to off or vibrate mode.

ACADEMIC ASSISTANCE: : It is my goal to assist you in every way possible to achieve your academic goals. If you have special needs for which I should make an allowance, please let me know. You should also inform the [Academic Enrichment Center](#), The Cove, directed by Mrs. Kim Algrim (Ext. 3845) to partner with us. If you believe you may need support in managing the impact of a disability, please contact Amy Frey, afrey@cedarville.edu, (Disability Services). Faculty rely on Disability Services to verify the need for academic accommodations and to identify reasonable and appropriate accommodation strategies. Disability Services is part

of the Academic Enrichment Center-The Cove located in the BTS building, or visit www.cedarville.edu/DisabilityServices. Examples of disability categories are AD/HD, Vision, Health Impairment, Psychological. If you have further questions or if I can assist you in any other way, please let me know.

ACADEMIC DISHONESTY POLICY is enforced in accordance with the spirit and procedures outlined in Appendix A of the **Student Handbook**.

TENTATIVE SCHEDULE – Spring, 2010:

PART I: FOUNDATIONAL CONCEPTS			
DATE	TOPIC	SA	READING-STUDY ASSIGN.
Jan. 5 Tu Lab	Course Introduction	01	75-minute Meeting, ENS 106
Jan. 6 W	What Is Environmental Physiology ?	02	Assigned Articles; Definitions of Experts
Jan 8 F	Environmental Factors	03	Marchand <i>Preface</i> ; Molles, pages 14-18; 83-86
Jan 11 M	Organism & Environment: Experiment Design		Lab Procedure Provided for Lab #1
Jan. 12 Lab 1	Organism & Environment: Energy Exchange		Small Mammal Exp. Design and Background Inf.
Jan.13,15 W F	Temperature Relationships	04	Marchand, Ch 4, p 93-98; Molles, pages 91-92
Jan. 18 M	Animal Metabolism and Measurement	06	Assigned Reading, “Animal Energetics” (Eckert)
Jan 19 Lab 2	Small Mammal Respiration		Lab Procedure [50-point Report; Lab 1 Rep. Due]
J 20,22 W,F	Physical Thermoregulation in Animals	07	Marchand, Chapter 4, pp 98–106
Jan 25 M	Physiological Thermoregulation in Animals	08	Marchand, Ch. 4, pages 104-107
Jan 26 Lab 3	Snow Properties & Subnivalian Environment	09	Marchand, Chapter 2; Lecture-Lab Combination
Jan. 27 W	“North Woods Trip” Orientation; Review		Itinerary & Logistics; [Lab 2 50-Point Rep. Due]
Jan 29 F	Exam I		
Feb. 1 M	Return and Discuss Exam I; Trip Preparation		Trip Resource Packet including Assignment #11
Feb 2 Lab 4	No Scheduled Laboratory		Open Time for Other Tasks
PART II: WINTER in the “NORTH WOODS” and Cell Physiology of Cold Temperature			
Feb 3 W	No Lecture (Prep. for Feb. 4 Discussion)		Plan for Departure on Feb. 4; Assign. SA #11
Feb 4 Lab 5	Departure: Animal/Plant Adapt. to Winter	11	Marchand, Chapter 1, pages 2-10
Feb 5 F	Winter Physiology-Ecology in North Woods	12	Resource Packet
Feb 6 Sat	Field Studies and Fireside Discussions	14	Marchand, p 104-25; Ch. 5, 7; Molles, p. 91-103
Feb 7 Sun	Return to Cedarville		
Feb 8 M	No Lecture – Reading Assign. See Right—>		Read Procedure Provided for Lab #6
Feb 9 Lab 6	Ice-Nucleating Protein and Supercooling		Lab Proced, [50 pt Rep.]; Begin Trip Debriefing
Feb 10 W	Debriefing from Trip (Continued from Lab 6)	15	Bring Field Data and Discussion Notes
Feb 12 F	Cell Physiology of Cold Temperature Survival	16	Marchand, Ch. 3, pages 41-56
F 15,17 M,W	Cold-Blooded Animal Acclimation to Cold	17	Marchand, Ch. 4, pages 125-141: “Frozen Frog”
Feb 16 Lab 7	Concluding Topics and Synthesis/Discussion		
Feb 19 F	Review Session		[Lab# 6 50-Point Report Due]
Feb 22 M	Exam II		Exam Coverage and Review Guide Provided
PART III: Environmental Physiology of Plants			
Feb 23 Lab 8	Thermogenesis in a Spring Wildflower		Lab Procedure – Field Study
Feb 24 W	Leaf Anatomy & Physiology; Discuss Exam II		
Feb 26 F	Measuring Photosynthesis and Transpiration		Reading Provided; Completion of IRGA Setup
Mar 1 - 5	<i>Spring Break</i>		No Classes

Mar 8 M	Measuring Photosynthesis and Transpiration	19	Plans for Data Gathering; Computations
Mar 9 Lab 9	Photosynthesis and Transpiration by IRGA		Laboratory Procedure [50-point Report]
Mar 10,12 W,F	Theory and Computations of NAR and E	20	Laboratory Data; Molles, pages 135-139
Mar 15 M	Leaf Morphology and Gas/Energy Exchange	21	From Laboratory Procedure
Mr 16 Lb 10	Introduction to Personal Inquiry Project (PIP)		PIP Articles Provided – choices due March 19
Mar 17,19 WF and Mar 22 M	Environmental Challenges of Plants: Selected Text & Journal Readings for Discussion →	22	Marchand., 3 p56–67; Molles Ch 4, 9 (parts); and, Selected Journal Articles (distinct from PIP)
Mar 23 Lab	Review Session; Consultations on PIP Articles		Discuss Your Presentation [Lab #9 Report Due]
Mar 24 W	Exam III – Partially a Take-Home Exam		Review Guide and Take-H Questions Provided
PART IV: Personal Inquiry Projects (PIP) -- Applications of Environmental Physiology to Biotic Community Level			
Mar 26 F	Discuss Exam III and PIP Presentation Schedule	24	Reading(s) on knowing “niche” of captive animal
Mar 29 M	Oral Present. of PIP – #1		Audience prints, reads, and comes prepared to discuss
Mar 30 Lab	Oral Present. of PIP’s – #2 and 3; Recap Themes		Audience prints, reads, and comes prepared to discuss
Mar 31 W	Oral Present. of PIP – #4		Audience prints, reads, and comes prepared to discuss
April 2 - 5	<i>Easter Break</i>		No Classes
April 6 Lab	Oral Present. of PIP – #5 and 6		Audience prints, reads, and comes prepared to discuss
April 7 W	Oral Present. of PIP – #7		Audience prints, reads, and comes prepared to discuss
April 9 F	No Class – Synthesize Themes of PIP Presentations		
April 12 M	Forest Community Structure and Succession		Molles, Chapter 20 (esp. Parts 20.1 and 21.2)
Apr 13 Lab 11	Forest Community I. Structure and Succession		Lab Procedure Provided - Field Study
April 14 W	Forest Community Structure and Succession		Molles, Chapter 20 (esp. Parts 20.1 and 21.2)
April 16 F	Ohio Geology & Ecology		Spring Trip Resources Provided
Apr 19,21 M,W	No Lecture		Open Time for Other Tasks
Apr 20 Lab 12	Hocking Hills Trip 2010 (Day-Trip)		Details and Materials Provided
April 23 F	Trip Debriefing – Forest Ecology		Trip Resources and Notes
April 26 M	Concluding Topics and Review		
April 30 F	Exam IV 10:30 am		

¹ Some content will be addressed during the "Winter Weekend in the North Woods" in place of certain otherwise-scheduled lectures and labs in the subsequent weeks. The course schedule must remain tentative due to unpredictable weather and other unforeseen circumstances.

SELECTED REFERENCES:

Animal Energetics and Temperature Relations, in: Eckert, R., *et al.* 1988. *Animal Physiology: Mechanisms and Adaptations*. W.H. Freeman and Co. New York, NY.

Gurevitch, Jessicah, Samuel M. Scheiner, Gordon A. Fox. 2006. *The Ecology of Plants*. 2nd ed. Sinauer Associates, Inc. Sunderland, MA.

Heinrich, Bernd. 2003. *Winter World: The Ingenuity of Animal Survival*. Harper-Collins, Ecco, New York.

Lee, R.E. Jr. 1989. Insect Cold-hardiness: To Freeze or Not to Freeze. *Bioscience* 39(5): 308-313.

Willmer, Pat, *et al.* 2000. *Environmental Physiology of Animals*. Blackwell Science, Oxford.