

ENDOCRINOLOGY

(BIO 448, Fall 2013)

Dr. Christopher A. Loretz

Office: 647 Hochstetter Hall

Office Phone: 645-4985

e-mail: loretz@buffalo.edu

Office Hours: T & Th 8:30-9:20 a.m.,

M, W & F 09:00-09:50 a.m.,

and by appointment

Time/Place: T & Th 9:30-10:50 a.m.

114 Hochstetter Hall, North Campus

Course Aim: BIO 448 is an introduction to the biology of chemical mediation at the organismal, cellular and molecular levels. Whereas emphasis will be on the regulation of physiological and other processes in vertebrates (especially mammals), lectures and readings are designed to present principles and concepts that are applicable to other taxonomic groups as well.

Learning Objectives: Students successfully completing this course will:

- ¹understand basic principles of homeostatic regulation of biological systems;
- ²be familiar with the tools and techniques used in the study of hormones and chemical messengers;
- ³know the structures and biosynthetic pathways of major families of chemical messengers;
- ⁴recognize the diversity of hormone receptor systems and transduction pathways;
- ⁵acquire a systems-based working knowledge of important hormonally-regulated physiological processes;
- ⁶master basic quantitative skills important for analyzing, understanding and presenting endocrinological data;
- ⁷appreciate current scholarly and popular issues in endocrinology; and
- ⁸be able to find and access primary literature resources, and to synthesize current knowledge in reporting on a topic of endocrinological interest.

Assessment: Student achievement of learning objectives will be assessed by:

- two hourly exams and a comprehensive final exam of combined multiple-choice and free-response questions, for testing knowledge acquisition (learning objectives 1-5, and 7) and quantitative skills development (learning objective 6);
- occasional worksheets and homework sets, for developing and testing quantitative skills mastery (learning objective 6); and
- a written term project, for measuring library and scientific reporting skills development (learning objectives 6-8).

Texts:

[Required] Kovacs & Ojeda (eds.), *Textbook of Endocrine Physiology*, 6th edition, Oxford University Press, 2012; ISBN-10: 0199744122; ISBN-13: 978-0199744121; available at the campus bookstore, or on-line at Amazon, Barnes & Noble, or elsewhere

[Recommended; do not purchase this, but do use whatever you already own] Sherwood, Klandorf and Yancey, *Animal Physiology: From Genes to Organisms*, 2005; or an equivalent, current, comprehensive physiology text that you already own

[Optional; do not purchase] Resource books available to you in the library:

Norris, *Vertebrate Endocrinology*, 4th edition, 2007

Hadley & Levine, *Endocrinology*, 6th edition, 2007

Norman & Litwack, *Hormones*, 2nd edition, 1997

Attendance: Perfect lecture attendance by each registered student is expected. This expectation of regular attendance is intended to promote student and overall class learning. Documented medical and other legitimate, urgent absences from exams will be excused. For expected and/or planned absences during an exam (academic program interviews, scheduled medical procedures, *etc.*), please notify the course instructor (Dr. Loretz) in advance. Any student absent without notice from an exam and without a physician's written note of excuse or other documentation of urgency will receive a zero for the exam.

Participation: Class participation is encouraged throughout the semester and, especially, during presentations of methodologies and techniques involving mathematical analyses, interpretation of experimental data, and subjects not covered in the primary text readings. Active student engagement in discussion and in question-and-answer periods will promote comprehension and learning.

Grading: Grades will be calculated and determined according to the following scheme:

First Exam	100 points
Second Exam	100 points
Final Exam	125 points
Term Project	50 points
Worksheets/Homework	25 points
Total	<hr/> 400 points

The first and second exams will focus on course material from defined blocks of lectures (please refer to the course schedule included in this document). The final exam will emphasize material from the final block of lectures and will additionally include questions that are comprehensive or cumulative or review in nature. Each student will be graded carefully and fairly. All exams (first, second, and final) and the term project must be completed in order to pass this course.

Incomplete "I" grades will be assigned only in accordance with University policy. The University has a specific and well-defined policy regarding the Incomplete "I" grade. The I grade is not intended for cases of non-attendance or unexcused absences from class exams or other activities. The complete University policy for the Incomplete "I" grade is available on-line at:

<http://undergrad-catalog.buffalo.edu/policies/grading/explanation.shtml#incomplete>

Academic honesty is important, and each student is expected to do and to submit her/his own work according to instructions. Some in-class activities and out-of-class homework assignments may include allowances for among-student consultation or collaboration, but, in the end, each student should nevertheless submit her/his own paper. The University has an academic integrity policy that applies to this course. The policy is published in the Undergraduate Catalog and elsewhere, and students are asked to review this policy if they are not already familiar with it. The URL for the official University policy is:

<http://undergrad-catalog.buffalo.edu/policies/course/integrity.shtml>

Academic Policies and Procedures: The on-line version of the Undergraduate Catalog contains a full, detailed presentation of University policies relating to academic policies and procedures. All students should be familiar generally with the University's policies relating to course expectations and to grading, and to other matters. These are available at:

<http://undergrad-catalog.buffalo.edu/policies/>

Attendance: Perfect lecture attendance by each registered student is expected. This expectation of regular attendance is intended to promote student and overall class learning. Documented medical and other legitimate, urgent absences from exams will be excused. For expected and/or planned absences during an exam (academic program interviews, scheduled medical procedures, *etc.*), please notify the course instructor (Dr. Loretz) in advance. Any student absent without notice from an exam and without a physician's written note of excuse or other documentation of urgency will receive a zero for the exam.

Participation: Class participation is encouraged throughout the semester and, especially, during presentations of methodologies and techniques involving mathematical analyses, interpretation of experimental data, and subjects not covered in the primary text readings. Active student engagement in discussion and in question-and-answer periods will promote comprehension and learning.

Accessibility Resources: If you have a disability and may require some type of instructional and/or examination accommodation, please inform the instructor early in the semester so that accommodations can be arranged. If you have not already done so, please contact the university's Office of Accessibility Resources. The office is located at 25 Capen Hall and the telephone number is 645-2608. Classroom instructional and exam accommodations will be made for students individually on the advice and guidance of the Office of Accessibility Resources. For a full description of available services, refer to the Office of Accessibility Resources Web site at:

<http://www.student-affairs.buffalo.edu/ods/>

Religious Accommodation: Any student desiring a reasonable religious accommodation should make the request directly to the course instructor. It is expected that the student will provide sufficient notice of the need for an accommodation to the course instructor in order for the accommodation to be implemented. In the event that a student's request for religious accommodation involves an alternative examination time or date, any make-up examinations given for purposes of test security must be comparable, in terms of format and difficulty, to the examinations given to the remainder of the class. If there are concerns about the requested accommodation, the instructor should consult his/her department chair, dean's office and/or the university's Office of Equity, Diversity and Inclusion (EDI). The instructor will not unilaterally deny a request for a reasonable religious accommodation without first consulting EDI. The EDI Web site is:

<http://equity.buffalo.edu/>

Course Management System: All registered students have access via UBlerns (<http://ublearns.buffalo.edu>) to the BIO 448 Endocrinology course content area. Please monitor regularly for posted announcements and class assignments from the instructor, and for other useful course documents and links.

Annotated Bibliography Term Project

The term project provides each student independently the opportunity to explore and to report on an endocrine topic of personal interest. The selection of topic is up to each student, with the approval of the course instructor. Some sample topics are provided below, but students may select any topic appropriate to the field of endocrinology or chemical communication broadly. At the first exam, individual topics should be submitted for approval by the instructor.

An annotated bibliography is a collection of citations to primary research papers and/or review articles from refereed scientific journals. Each of the articles selected for inclusion on the bibliographic list should have informative value to a scientific reader seeking to know something about a topic. The target reading audience is a trained life scientist, but not a specialist in endocrinology. Value to the reader may come in the form of historical perspective to the topic, description of a new or interesting experimental technique applied to the topic, a recent finding that challenges current thinking on the topic, etc. There are two components to each entry in the bibliography: (1) a complete citation to the paper in a standard journal format; and (2) a brief, 2-4 sentence summary of the major points or findings from the work, or of the significance of the work. The brief summary is not a re-statement or abridgement of the abstract. Instead, it is the bibliography writer's succinct statement of the experiment that was done or the technique that was developed, the key findings in the published report, and their significance to the topic. An example bibliography is provided below.

The final submitted project should begin with a title for the bibliography writer's selected topic, and a one-paragraph introduction that prepares the reader for the bibliographic listings. Include at least 5 references, but not more than 7 references. Projects should be submitted in printed form, and should not exceed 2 pages in length. A sample format is provided on the next page.

Most scientific journals have on-line access to their articles. Students have free access to the many articles in those journals for which the university's library holds subscriptions. Access these journals through the University Libraries web portal at <http://ublib.buffalo.edu>. The University Libraries web site also provides on-line access to searchable bibliographic databases such as *Web of Science* and *MEDLINE*. Be aware that on-line articles and information posted to wikis and other internet sites are not peer-reviewed or refereed in the widely-accepted scientific sense. Although these resources may be useful in helping to explore topics, please do not include these postings, articles, and web sites in the annotated bibliography—use primary literature reports and reviews from reputable, established journals. If in doubt when selecting your bibliography citations, ask the instructor.

The project is due on the last day of class (Thursday, 12/05/2013).

[EXAMPLE FORMAT—DO NOT INCLUDE BRACKETED TEXT IN YOUR SUBMISSION]

[STUDENT BIBLIOGRAPHER'S NAME AT TOP OF FIRST PAGE]

John/Jane Student

[TOPIC TITLE]

Environmental Calcium Sensing by Aquatic Organisms

[INTRODUCTION]

Sensing of ionic calcium in the aquatic environment is important because of the critical involvement of calcium in physiological processes. Since calcium concentrations can vary by more than ten-fold between fresh water (0.1 to 0.5 $\text{mmole}\cdot\text{L}^{-1}$) and seawater (about 10 $\text{mmole}\cdot\text{L}^{-1}$), homeostatic control systems must be able to sense the calcium concentration, and to respond in appropriate fashion. For example, a salmon migrating from a freshwater stream to the ocean leaves an environment where the external concentration of calcium is lower than that of the blood plasma and extracellular fluids (2 - 5 $\text{mmole}\cdot\text{L}^{-1}$) and enters one where the concentration is higher. The membrane-bound extracellular calcium-sensing receptor may be the physiological sensor.

[ANNOTATED BIBLIOGRAPHY ENTRIES; three examples of the 5-7 that are required]

Loretz CA, Pollina C, Hyodo S, Takei Y, Chang W, and Shoback D. cDNA cloning and functional expression of a Ca^{2+} -sensing receptor with truncated carboxyterminal tail from the Mozambique tilapia (*Oreochromis mossambicus*). *J. Biol. Chem.* **279**: 53288-53297, 2004.

[\[http://www.jbc.org/cgi/reprint/279/51/53288\]](http://www.jbc.org/cgi/reprint/279/51/53288)

This paper reports on the molecular cloning and sequencing of a teleost fish extracellular calcium-sensing receptor (CaSR). The cloned tilapia CaSR cDNA was expressed in a cultured cell line to confirm the functional properties of the receptor. Although the teleost CaSR has a shorter C-terminal intracellular tail than tetrapod CaSRs, it is nevertheless capable of signal transduction in response to stimulation of calcium. By RT-PCR analysis, the receptor is expressed in both ion-transporting osmoregulatory and hormone-secreting endocrine tissues.

Loretz CA. Extracellular calcium-sensing receptors in fishes. *Comp. Biochem. Physiol. A* **149**: 225-245, 2008. [\[http://dx.doi.org/10.1016/j.cbpa.2008.01.037\]](http://dx.doi.org/10.1016/j.cbpa.2008.01.037)

In this review article, the structure, physiology, tissue expression and evolution of extracellular calcium-sensing receptors of fishes are presented and are compared with those of tetrapods. Although they are functionally similar in many regards, the structures of piscine and tetrapod receptors are subtly but distinctly different, reflecting their evolutionary histories. Calcium-sensing receptors are expressed in gill and olfactory tissues of fishes where they are positioned to sense environmental calcium concentrations.

Loretz CA, Pollina C, Hyodo S, and Takei Y. Extracellular calcium-sensing receptor expression in osmoregulatory and endocrine tissues of the tilapia. *Gen. Comp. Endocrinol.* **161**: 216-228, 2009.

[\[http://dx.doi.org/10.1016/j.ygcen.2008.12.020\]](http://dx.doi.org/10.1016/j.ygcen.2008.12.020)

In this report, the tissue expression pattern of the receptor is assessed using immunohistochemistry to visualize the receptor protein. The receptor is expressed in ion-transporting osmoregulatory tissues such as kidney, gills, and intestine where receptor activity might directly regulate ion-transport processes, and in endocrine tissues such as pituitary gland and corpuscles of Stannius where extracellular Ca^{2+} signals might indirectly regulate calcium homeostatic processes (including ion transport) through the stimulation or inhibition of hypercalcemic or hypocalcemic hormone synthesis and/or release.

Class Schedule

Week	Date	Lecture	Topic	Reading (Kovacs & Ojeda, 6/e)
Week 1	08/27 (T)	1	Nature of Chemical Mediation & Endocrine Systems	Ch. 1 (pp. 3-20)
	08/29 (R)	2	Tools & Techniques I	Ch. 2 (pp. 21-57) Ch. 4 (pp. 99-115)
Week 2	09/03 (T)	3	Tools & Techniques II	"
	09/05 (R)		No Class—Rosh Hashanah	
Week 3	09/10 (T)	4	Mechanisms of Hormone Action	Ch. 3 (pp. 58-98)
	09/12 (R)	5	Neuroendocrinology/Neurosecretion	Ch. 5 (pp. 116-125, 132-137)
Week 4	09/17 (T)	6	Hypothalamo-Hypophysial Axis	Ch. 6 (pp. 120-125, 148-150)
	09/19 (R)	7	Posterior Pituitary Gland	Ch. 6 (pp. 149-171)
Week 5	09/24 (T)	8	Anterior Pituitary Gland I	Ch. 5 (pp. 116-147)
	09/26 (R)	9	Anterior Pituitary Gland II	Ch. 11 (pp. 292-310)
Week 6	10/01 (T)	10	Catch-up, Special Topic and/or Pre-Exam Round-Up	(no reading assignment)
	10/03 (R)		EXAM 1 (covers lectures of 8/27-9/26, 9 lectures)	
Week 7	10/08 (T)	11	Steroid Chemistry and Metabolism I	Ch. 13 (pp. 346-373, 378-380)
	10/10 (R)	12	Steroid Chemistry & Metabolism II	
Week 8	10/15 (T)	13	Sexual Differentiation and Sexual Reproduction	Ch. 7 (pp. 172-193)
	10/17 (R)	14	Testis and Male Endocrine Physiology	Ch. 9 (pp. 239-263)
Week 9	10/22 (T)	15	Ovary and Female Endocrine Physiology	Ch. 8 (pp. 194-238)
	10/24 (R)	16	Pregnancy & Lactation	Ch. 10 (pp. 264-291)
Week 10	10/29 (T)	17	Thyroid Gland	Ch. 12 (pp. 311-345)
	10/31 (R)	18	Parathyroid Gland & Ultimobranchial Bodies	Ch. 14 (pp. 381-410)
Week 11	11/05 (T)	19	Catch-up, Special Topic and/or Pre-Exam Round-Up	(no reading assignment)
	11/07 (R)		EXAM 2 (covers lectures of 10/01-10/31, 9 lectures)	
Week 12	11/12 (T)	20	Gastrointestinal Physiology I	(no reading assignment)
	11/14 (R)	21	Gastrointestinal Physiology II	"
Week 13	11/19 (T)	22	Metabolic Endocrinology I	Ch. 13 (pp. 373-378)
	11/21 (R)	23	Metabolic Endocrinology II	Ch. 15 (pp. 411-440)
Week 14	11/26 (T)	24	Invertebrate Endocrinology I	(no reading assignment)
	11/28 (R)		Fall Recess—No Class	
Week 15	12/03 (T)	25	Invertebrate Endocrinology II and Origins of the Endocrine System	(no reading assignment)
	12/05 (R)	26	Environmental Endocrinology ANNOTATED BIBLIOGRAPHY PROJECT DUE	(no reading assignment)
Final Exam Week	12/12 (R) 8:00-11:00 114 Hochstetter		FINAL EXAM (covers lectures of 11/5-12/5, 8 lectures, for 100 points; plus comprehensive/cumulative component covering all lectures, for 25 points)	

Special Note: The assigned readings sometimes cover topics in a level of detail that, because of the very fine focus on specific clinical conditions or quantitative values, extends well beyond the scope of this class. Do not panic. With initial guidance, you will quickly learn to identify such chapter segments. You may safely skim these passages and pages without hazard. When in doubt, do not hesitate to ask.

Relationship of BIO 448 Course Objectives and Assessment to BIO Program Objectives

BIO Program Objective	Depth*	Specific Outcome Objectives for BIO 448	Assessment Instrument(s)
1. Provide breadth of knowledge of basic principles and concepts	1	Understand basic universal principles of chemical signaling, and the nature of hormonal communication in simple and complex organisms	Exam 1, and final exam
		Comprehend homeostasis, and positive and negative feedback control	Exam 1, and final exam; and worksheets
		Understand importance of functional integration among cells, tissues and organs for survival of the organism	Exams 1 and 2, and final exam; and worksheets
2. Provide depth within specialized areas	2	Describe interaction of biological signaling molecules with their receptors in quantitative fashion	Exams 1 and 2, and final exam; and worksheets
		Understand the chemical and physical properties of biological signaling molecules	Exam 1, and final exam; and worksheets
		Understand hierarchical control (endocrine axes) of physiological systems	Exams 1 and 2, and final exam; and worksheet
		Apply endocrinological principles to understanding regulation of physiological and developmental systems across the animal kingdom	Exam 2, and final exam; and worksheets
3. Provide an understanding of experimental design and methodology	0	N/A	N/A
4. Develop approaches for integration of information	2	Relate application of analytical techniques for assessing endocrine status to extraction and interpretation of useful biological information	Exams 1 and 2, and final exam; and worksheets
		Integrate endocrinological knowledge across scales of size (subcellular/cellular/tissue/organ/organism) to explain adaptive responses of organisms to challenge	Exam 2, and final exam; and worksheets
5. Encourage critical thinking and hypothesis building	1	Analyze and interpret real and simulated data from endocrinological observations and experiments	Exams 1 and 2, and final exam; and worksheets
		Describe current status of an endocrine topic or question, supported by primary literature references and synopsis of impact and relevance to the field	Term project
6. Provide skills in scientific communication	1	Express topic understanding in clear prose	Freeform response questions of Exams 1 and 2, and final exam; and term project
		Relate methods, processes and conclusions of data analysis and interpretation in clear narrative and in technically-correct quantitative graphical/diagrammatic form	Freeform quantitative response questions of exams 1 and 2, and final exam; and worksheets
7. Provide contemporary information	2	Understand contemporary endocrine issues relating to physiological acclimation and adaptation, and survival of organisms	Final exam; and term project
		Appreciate the complex endocrine interplay among organisms and the environment	Exam 1, and final exam; and term project
8. Encourage appreciation of scientific values	1	Recognize proper and correct interpretation of endocrinological data collected from the field and from the laboratory	Exams 1 and 2, and final exam; and worksheets
		Identify the importance of endocrinological knowledge to understanding biosystems generally, and the implications of that knowledge in informing scientific and public policy	Exams 1 and 2, and final exam

*Depth: 0 = not covered; 1 = moderately covered; 2 = extensively