

ADVANCED MOSQUITO BIOLOGY
ENY 6905 (sections 128D, 128E, 128F), 3 credits

Course instructors: Dr. Chelsea T. Smartt ctsmart@ufl.edu 772-778-7200 x156
Dr. Barry Alto bwalto@ufl.edu 772-778-7200 x153
(Fax for both: 772-778-7205)

Office hours: Monday 1:00pm – 2:00pm
(Office hours will be conducted by either instructor on the e-Learning in Sakai system using the Chat Room tab. Please join the office hours room).

Venue and time: This course will be managed by e-Learning in Sakai (a broadband internet connection is strongly suggested). For suggested module section review dates, see course schedule. New lectures are available on Tuesdays and Thursdays during the fall semester in which the course is being offered; however as this is an online course, lectures may be viewed at any time after the beginning of the fall semester.

Co-taught course: ENY 4905

Course description: Advanced Mosquito Biology is an in depth course on mosquito classification, natural history, ecology, physiology, population dynamics, mosquito-borne disease and control. The relationships between mosquitoes, humans, and the environment, along with the mechanisms of pathogen propagation and transmission will be emphasized. The course will be offered in an online format by experts at UF Florida Medical Entomology Laboratory.

General course information:

This is a co-taught course being offered at the graduate and undergraduate levels. Although the lectures are the same, there are substantial differences in student expectations between the graduate and undergraduate levels. The lecture consists of modules encompassing broad fields of knowledge, each of which contains a number of sub-sections that detail these fields. Modules are provided by UF-Florida Medical Entomology Laboratory (FMEL) experts in these fields; email addresses are provided. To facilitate lecturer-learner interaction, students may contact the course instructors (Drs. Smartt and Alto) by email. Requests to take this course offline by CD/DVD should be sent to the course directors. Questions pertaining to the course organization or overall structure should be sent to one of the course directors. All course communication will be via the course web site and course email. Students are responsible for notices or

course updates posted using these methods and should notify the course directors if difficulty in electronic communication occurs or is expected.

Course objectives: Upon the successful completion of this course students shall be able to:

- 1) Understand the fundamental biological processes governing the various life stages of the mosquito.
- 2) Identify human practices that promote the proliferation of anthropophilic mosquito species.
- 3) Analyze the suitability of an environment to support immature and adult mosquitoes in terms of its ecological factors, and to furthermore evaluate the suitability of the environment for mosquito-borne disease transmission.
- 4) Review and understand literature pertinent to mosquito biology including physiology, modeling, genetics, ecology, and disease transmission.
- 5) Scientifically and systematically assess contemporary issues related to mosquito ecology, control, and disease transmission.

Topic Outline:

Six critical areas of mosquito biology will be offered to students: (course modules)

- 1) Classification– an exploration of the origin and amazing diversity of mosquito species (Dr. R.C. Connelly)
- 2) Natural History and Ecology – the complex interactions of the mosquito with its environment (Drs. L.P. Lounibos and G.F. O’Meara)
- 3) Physiology – the details of the inner workings of the mosquito through its life stages (Drs. B.W. Alto and C.T. Smartt)
- 4) Population Dynamics– predicting and understanding the dynamics of mosquito populations (Drs. C.C. Lord and W.J. Tabachnick)
- 5) Mosquito-borne Disease– entomological mechanisms of pathogen propagation and transmission (Drs. B.W. Alto, J.F. Day, L.P. Lounibos and C.C. Lord)
- 6) Control of Mosquitoes– a comprehensive review of the approaches used to mitigate mosquito impacts on human health and development (Drs. J.R. Rey, and R.C. Connelly)

Prerequisites:

There are no prior coursework requirements to enroll; however this is an advanced course and basic knowledge of ecology, cell biology, genetics, and molecular biology is highly recommended. Graduate students are encouraged to contact the course director with questions prior to enrolling in the course.

Required and recommended textbooks:

Lectures and required reading materials will be posted on the e-Learning Sakai site, along with suggestions for further reading, usually in the form of primary literature. There is no required textbook for the course. The reading list is posted on Sakai via PDFs. The textbooks will be reserved and made available to students for use at the UF Marston Science Library (444 Newell Drive, Gainesville, FL 32611). Select excerpts of the textbooks will be made available on Sakai via PDFs.

Required textbooks:

None

Suggested textbooks:

Clements, A.N. 2000. The biology of mosquitoes, volume 1: Development, nutrition, and reproduction. CABI Publishing. New York, NY.

Beatty B.J. and Marquardt, W.H. 2004. Biology of Disease Vectors, 2nd Edition. Academic Press. Burlington, MA.

Abbreviated required reading list:

Borkent, A., Grimaldi, D.A. 2004. The earliest fossil mosquito (Diptera: Culicidae), in mid-cretaceous Burmese amber. *Ann. Entomol. Soc. Am.* 97: 882-888.

Ross, H.H. 1964. The colonization of temperate North America by mosquitoes and man. *Mosq. News* 24: 103-118.

Braks, M.A.H., Juliano, S.A., Lounibos, L.P. Superior reproductive success on human blood without sugar is not limited to highly anthropophilic mosquito species. *Med Vet Entomol* 20: 53-59.

Foster, W.A. 1995. Mosquito sugar feeding and reproductive energetics. *Ann. Rev. Entomol.* 40: 443-474.

O'Meara, G.F. 1985. Gonotrophic interactions in mosquitoes: Kicking the blood-feeding habit. 68: 122-133.

Bidlingmayer, W.L. 1974. The influence of environmental factors and physiological stage on flight patterns of mosquitoes taken in the vehicle aspirator and truck, suction, bait and New Jersey light traps. *J. Med. Entomol.* 11: 119-146.

Service, M.W. 1997. Mosquito (Diptera: Culicidae) dispersal- The

long and short of it. *J. Med. Entomol.* 34: 579-588.

Borovsky, D., Thomas, B.R. 1985. Purification and partial characterization of mosquito egg development neurosecretory hormone: Evidence for gonadotropic and steroidogenic effects. *Arch Insect Biochem Physiol* 2: 265-281.

Borovsky, D., Thomas, B.R. Carlson, D.A., Whisenton, L.R., Fuchs, M.S. 1985. Juvenile hormone and 20-hydroxyecdysone as primary and secondary stimuli of vitellogenesis in *Aedes aegypti*. *Arch Insect Biochem Physiol* 2: 75-90.

Champagne, D.E., Smartt, C.T., Ribeiro, J.M.C., James, A.A. 1995. The salivary gland-specific apyrase of the mosquito *Aedes aegypti* is a member of the 5'-nucleotidase family. *Proc. Natl. Acad. Sci. USA.* 92: 694-698.

Smartt, C.T., et al. 2001. *Aedes aegypti* glutamine synthetase: expression and gene structure. *Gene* 274: 35-45.

Focks, D.A., Haile, D.G., Daniels, E., Mount, G.A. 1993. Dynamic life table model for *Aedes aegypti* (Diptera: Culicidae): Simulation results and validation. *J. Med. Entomol.* 30: 1018-1028.

Black, W.C., et al. 2002. Flavivirus susceptibility in *Aedes aegypti*. *Arch. Med. Res.* 33: 379-388.

Kiszewski, A., Mellinger, A., Spielman, A., Malaney, P., Sachs, S.E., Sachs, J. 2004. A global index representing the stability of malaria transmission. *Am. J. Trop. Med. Hyg.* 70: 486-498.

Taylor, M.J., Makunde, W.H., McGarry, H.F., Turner, J.D., Mand, S., Hoeraug, A. 2005. Macrofilaricidal activity after doxycycline treatment of *Wuchereria bancrofti*: a double-blind, randomized placebo-controlled trial.

LeMenach, A., McKenzie, F.E., Flahault, A, Smith, D.L. 2005. The unexpected importance of mosquito oviposition behavior for malaria: non-productive larval habitats can be sources for malaria transmission. *Malaria J* 4: 23.

Lord, C.C., Day, J.F. 2001. Simulation studies of St. Louis encephalitis virus in south Florida. *Vector Borne Zoonotic Dis.* 1: 299-315.

Chen, A., Rogan, W.J. 2003. Nonmalarial infant deaths and DDT use for malaria control. *Emerg. Infect. Dis.* 9: 960-964.

Service, M.W. 1983. Biological control of mosquitoes-has it a future? *Mosq News* 43:113-120.

Begon, M., Townsend, C., and J. Harper. 2005. *Ecology- from individuals to ecosystems*, 4th edition. Blackwell Publishing. Danvers, MA. 752pp.

Evaluation:

Grading will be based on student performance on total percentage earned of total points on the following assignments that make up the evaluation criteria:

Evaluation criteria	Points	Due dates
Exam 1 (midterm)	115	October 11
Review project	50	November 20
Exam 2	100	December 4
Discussion group	11	N/A
Total	276	

Exams: Exam 1 (midterm) and Exam 2 include short answer and/or essays questions. Exams will differ between the co-taught graduate and undergraduate courses. Exams will be made available to students on the e-Learning in Sakai site at 10am EST on October 11 (Exam 1, midterm) and December 13 (Exam 2) and are due 48 hours later (10 am EST 2 days later). Exams are open book/notes, but are expected to be individual efforts. Students will be graded on the completeness of their answers, as well as their insight. Grading will be completed by UF-FMEL experts for their sections (see section on Topic Outline).

Review project: The review project should cover a topic relevant to mosquito biology. The review project may be delivered in alternative mediums such as a research paper (10 page maximum), power point presentation, and video or computer animation. Projects in media other than a paper should contain as much content as a 10 page review paper. Further specifics will be provided after approval of topics and formats. The mosquito review project topic and medium choice is due September 20 for approval by the course directors. Review projects are due by 5 pm on November 20.

Discussion group: Participation is mandatory for all students. A schedule of the discussion topics will be posted through e-Learning in Sakai. A discussion question(s) for each indicated module subsection will be posted on the last day of that module by a UF-FMEL expert in their field. A discussion group consists of student participation by answering the question(s) and contributing to the discussion string thereafter. There will be 12 discussion sessions (see discussion schedule).

Policy related to class attendance:

The course is offered through e-Learning in Sakai. Lectures are pre-recorded and made available from the start to the end of the semester. No specific class attendance is required. Students are expected to view lectures, read course materials, and participate in online discussion groups within the time frame set by the instructors.

Policy related to make-up exams or other work:

In general, acceptable reasons to make-up exams or other course related work is limited to serious illness, family emergencies, military obligation, or court imposed legal obligations. Students who have excused absences for University sponsored groups must arrange for missed examinations ahead of the exam with the lead instructors. Other reasons may also be approved but will be taken into consideration on a case-by-case basis.

Grades and Grade Points:

This course does NOT utilize “plus” or “minus” grades. Although the following link is for the undergraduate catalog, it applies to graduate students. For information on current UF policies for assigning grade points, see <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

The grading scale for this course is as follows:

Grading scale (%) of total points:

90-100	A
80-89.99	B
70-79.99	C
60-69.99	D
<60	E

Academic Honesty, Software Use, Campus Helping Resources, Services for Students with Disabilities:**Academic Honesty**

In 1995 the UF student body enacted an honor code and voluntarily committed itself to the highest standards of honesty and integrity. When students enroll at the university, they commit themselves to the standard drafted and enacted by students.

The Honor Pledge: We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.

On all work submitted for credit by students at the university, the following pledge is either required or implied: **"On my honor, I have neither given nor received unauthorized aid in doing this assignment."**

Students should report any condition that facilitates dishonesty to the instructor, department chair, college dean, Student Honor Council, or Student Conduct and Conflict Resolution in the Dean of Students Office.

(Source: 2011-2012 Undergraduate Catalog)

It is assumed all work will be completed independently unless the assignment is defined as a group project, in writing by the instructor.

This policy will be vigorously upheld at all times in this course.

Software Use

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

Campus Helping Resources

Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

- *University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, www.counseling.ufl.edu/cwc/*
 - Counseling Services
 - Groups and Workshops
 - Outreach and Consultation
 - Self-Help Library
 - Training Programs
 - Community Provider Database
- *Career Resource Center, First Floor JWRU, 392-1601, www.crc.ufl.edu/*

Services for Students with Disabilities

The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues.

0001 Reid Hall, 352-392-8565, www.dso.ufl.edu/drc/

Plagiarism: Plagiarism is a serious violation of the Student Honor Code. The Honor Code prohibits and defines plagiarism as follows: Plagiarism. A student shall not

represent as the student's own work all or any portion of the work of another. Plagiarism includes (but is not limited to):

a. Quoting oral or written materials, whether published or unpublished, without proper attribution.

b. Submitting a document or assignment which in whole or in part is identical or substantially identical to a document or assignment not authored by the student.

(University of Florida, Student Honor Code, 15 Aug. 2007

<<http://www.dso.ufl.edu/judicial/honorcode.php>>)

University of Florida students are responsible for reading, understanding, and abiding by the entire Student Honor Code (<http://www.dso.ufl.edu/sccr/honorcode.php>).

COURSE SCHEDULE
 ENY 6905, (sections 128D, 128E, 128F), 3credits
 Tuesday (a) and Thursday (b)

Lecture Topic	Week – Lecture	Suggested Review Date	Lecturer
Introduction			
Overview	(1 – lecture b)	23Aug	Alto
Classification			
Introduction		28Aug	Smartt
Mosquito Morphology and Structural Evolution	(2 - lecture a)	28Aug	Connelly
Taxonomy and Diversity	(3 - lecture b)	30Aug	Connelly
Natural History and Ecology			
Introduction		4 Sep	Lord
Mosquito Eggs	(4 - lecture a)	4 Sep	Lounibos
Mosquito Larval	(5 - lecture b)	6Sep	Lounibos
Adult Mosquitoes - I	(6 - lecture b)	8Sep	O’Meara
Adult Mosquitoes - II	(7 - lecture a)	11Sep	O’Meara
Physiology			
Introduction		13Sep	Smartt
Oogenesis	(8 - lecture b)	13Sep	Smartt
Digestion	(9 - lecture a)	18Sep	Alto/Smartt
Biology of Immature Mosquitoes - I	(10 - lecture b)	20Sep	Alto
Biology of Immature Mosquitoes - II	(11 - lecture a)	25Sep	Alto
Adult Mosquitoes - I	(12 - lecture b)	27Sep	Smartt
Adult Mosquitoes - II	(13 - lecture a)	2Oct	Smartt
Population Dynamics			
Introduction		4Oct	Lord
Modeling Vector-borne Disease - I	(14 - lecture b)	4Oct	Lord
Modeling Vector-borne Disease - II	(15 - lecture a)	9Oct	Lord
EXAM 1 (MIDTERM)		11Oct	
Mosquito Genetics & Pop. Genetics I	(16 - lecture a)	16Oct	Tabachnick
Population Genetics II & III	(17 - lecture b)	18Oct	Tabachnick

Mosquito-borne disease			
Introduction		23Oct	Lord
Arboviruses/ Epidemiology of			
Mosquito-borne Viruses –I	(18 - lecture a)	23Oct	Alto
Epidemiology of Mosquito-			
borne Viruses II & III	(19 - lecture b)	25Oct	Day
Malaria	(20 - lecture a)	30Oct	Lounibos
Filariasis	(21 - lecture b)	1Nov	Alto
Multispecies & Disease Models	(22 - lecture a)	6Nov	Lord
Control of Mosquitoes			
Introduction		8Nov	Smartt
Chemical Control	(23 - lecture b)	8Nov	Rey
Biological Control	(24 - lecture a)	13Nov	Rey
Source Reduction	(25 - lecture b)	15Nov	Rey
IPM and Control Programs	(26 - lecture a)	20Nov	Connelly
REVIEW PROJECT DUE		20Nov	
THANKSGIVING HOLIDAY		22Nov	
Introduction to Genetic			
Engineering	(27 - lecture b)	27Nov	Alto/Smartt
Genetic Engineering	(28 - lecture a)	29Nov	Smartt/Alto
EXAM 2		4Dec	

Lectures are of varying lengths and some consist of subsections. PDF files (low-resolution) of the slides for each lecture are provided to assist in review and time management.

Review project topic and medium are due September 20.

Discussion schedule
ADVANCED MOSQUITO BIOLOGY

Discussion topic / Lectures included	Discussion #	starts	ends
Classification	i	8/30	9/3
Mosquito Morphology and Structural Evolution			
Taxonomy and Diversity			
Natural History and Ecology – Immatures	ii	9/6	9/10
Mosquito Eggs			
Mosquito Larval			
Natural History and Ecology – Adults	iii	9/13	9/17
Adult Mosquitoes - I			
Adult Mosquitoes - II			
Physiology – Egg development	iv	9/20	9/24
Oogenesis			
Digestion			
Physiology – Immatures	v	9/27	10/1
Biology of Immature Mosquitoes - I			
Biology of Immature Mosquitoes - II			
Physiology - Adults	vi	10/4	10/8
Adult Mosquitoes - I			
Adult Mosquitoes - II			
Population Dynamics	vii	10/18	10/22
Modeling Vector-borne Disease - I			
Modeling Vector-borne Disease - II			
Population Genetics	viii	10/25	11/2
Mosquito Genetics & Pop. Genetics I			
Population Genetics II & III			
Epidemiology & Arboviruses	ix	11/3	11/12
Arboviruses/ Epidemiology of Mosquito-borne Viruses –I, II, III			
Mosquito-borne diseases	x	11/15	11/24
Malaria			
Filariasis			
Multispecies & Disease Models			
Control of Mosquitoes	xi	11/29	12/3
Chemical Control			
Biological Control			
Source Reduction			
(IPM if you want to read ahead!)			
Genetic Engineering	xii	12/6	12/10
Introduction to Genetic Engineering			
Genetic Engineering			

Discussions will be threaded forums under the discussion tool in Sakai. A starting question will be posted by an instructor on start date (indicated above). Feel free to explore other questions regarding the lectures and integrate material from other lectures or readings. Instructors will monitor the discussion and post additional ideas or clarifications as needed. The forum will close on the date listed. Your discussion grade will be based on the degree of participation in each forum.