

MOSQUITO BIOLOGY

ENY 4592 (sections 11A6, 11B3, 21EF), 3 credits

Course instructors:

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(Fax for both: 772-778-7205)

Teaching Assistant:

Ms. Rebecca Zimler razimler@ufl.edu

Office hours:

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

Venue and time:

This course will be managed by e-Learning in Canvas (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 6593. The lectures are the same for ENY 4592 and ENY 6593. However, there are differences in other content and expectations (see course objectives). Students registered for ENY 6593 have different exams and activities (weekly discussions, review project, additional readings) not required by students registered for ENY 4592.

Course description:

Mosquito Biology is an introduction to 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 undergraduate and graduate levels. Although the lectures are the same, there are substantial differences in student expectations between the undergraduate and graduate 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 e-mail. Questions pertaining to the course

organization or overall structure should be sent to one of the course instructors. All course communication will be via the course web site and course email. Students are responsible for notices or course updates posted (Announcement tool) and should notify the course instructors if difficulty in electronic communication occurs or is expected. This is a co-taught course being offered at the undergraduate and graduate levels and additional tasks for graduate students include a review project, discussion group, and more rigorous exams.

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.

More course objectives are expected for co-taught course ENY 6593

Topic Outline:

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

- 1) Classification– an exploration of the origin and 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, B.W. Alto 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)
- 7) Highlights of Medical Entomology– a review of research in mosquito biology (Drs. B.W. Alto, C.T. Smartt, I.E. Bargielowski, and N.D. Burkett-Cadena)

Prerequisites:

There are no prior coursework requirements to enroll; however basic knowledge of ecology, cell biology, genetics, and molecular biology is highly recommended. Students are encouraged to contact the course instructors with questions.

Required and recommended textbooks:

Lectures and required reading materials will be posted on the e-Learning Canvas site, along with suggestions for further reading, usually in the form of primary literature. There is no required

textbook for the course. 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 Canvas via PDFs. Additional reading materials are posted on Canvas via PDFs.

Required textbooks:

None

Suggested textbooks:

- 1) Clements, A.N. 2000. The biology of mosquitoes, volume 1: Development, nutrition, and reproduction. CABI Publishing. New York, NY.
- 2) Marquardt, W.H. 2004. Biology of Disease Vectors, 2nd Edition. Academic Press. Burlington, MA.

Textbooks with select excerpts:

- 1) Bates, M. 1949. The natural history of mosquitoes. The Macmillan Company, New York, NY.
- 2) Begon, M., Townsend, C., and J. Harper. 2005. Ecology- from individuals to ecosystems, 4th edition. Blackwell Publishing. Danvers, MA. 752pp.
- 3) Clements, A.N. 2000. The biology of mosquitoes, volume 1: Development, nutrition, and reproduction. CABI Publishing. New York, NY.
- 4) Foster, W.A., Walker, E.D. 2009. Mosquitoes (Culicidae), pp. 207-260. *In* G.R. Mullen and L.A. Durden (eds.), Medical and Veterinary Entomology, 2nd ed. Academic Press, New York, NY.
- 5) Marquardt, W.H. 2004. Biology of Disease Vectors, 2nd Edition. Academic Press. Burlington, MA.
- 6) Scott, M.E. 1994. Populations are dynamic, pp. 1-8. *In* Scott, M.E., Smith, G. Parasitic and Infectious Diseases: Epidemiology and Ecology. Academic Press, San Diego, CA.

Required reading list:

- 1) Bayoh, M.N., Mathias, D.K., Odiere, M.R. et al. 2010. *Anopheles gambiae*: historical population decline associated with regional distribution of insecticide-treated bed nets in western Nyanza Province, Kenya. *Malaira Journal*. 9:62.
- 2) Bhatt, S., Weiss, D.J., Cameron, E. 2015. The effect of malaria control on *Plasmodium falciparum* in Africa between 2000 and 2015. *Nature* 526: 207-211.
- 3) Borkent, A., Grimaldi, D.A. 2004. The earliest fossil mosquito (Diptera: Culicidae), in mid-cretaceous Burmese amber. *Ann. Entomol. Soc. Am.* 97: 882-888.
- 4) Brackney et al. 2010. Expression profiling and comparative analyses of seven midgut serine proteases from the yellow fever mosquito, *Aedes aegypti*. *J. Insect Physiol.* 56: 736-744.
- 5) Breaux, J.A., et al. 2014. What does not kill them makes them stronger: larval environment and infectious dose alter mosquito potential to transmit filarial worms. *Proc. R. Soc. B.* 281:20140459.
- 6) Cardoso, A.F., Cres, R.L., Moura A.S., Almeida F., Bijovsky A.T. 2010. *Culex quinquefasciatus* vitellogenesis: morphological and biochemical aspects. *Mem. Inst. Oswaldo Cruz* 105: 254-262.
- 7) Champagne et al. 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.
- 8) Chen, A., Rogan, W.J. 2003. Nonmalaria infant deaths and DDT use for malaria control. Emerg. Infect. Dis. 9: 960-964.
 - 9) Focks, D.A., et al. 1993. Dynamic life table model for *Aedes aegypti* (Diptera: Culicidae): Analysis of the literature and model development. J. Med. Entomol. 30: 1003-1017.
 - 10) Focks, D.A., et al. 1993. Dynamic life table model for *Aedes aegypti* (Diptera: Culicidae): Simulation results and validation. J. Med. Entomol. 30: 1018-1028.
 - 11) Focks, D.A., et al. 1995. A simulation model of the epidemiology of urban dengue fever: literature analysis, model development, preliminary validation, and samples of simulation results. Am. J. Trop. Med. Hyg. 53: 489-506.
 - 12) LeMenachet et al. 2005. The unexpected importance of mosquito oviposition behavior for malaria: non-productive larval habitats can be sources for malaria transmission. Malaria J 4: 23.
 - 13) Lord, C.C., Day, J.F. 2001. Simulation studies of St. Louis encephalitis virus in south Florida. Vector Borne Zoonotic Dis. 1: 299-315.
 - 14) Munstermann, L.E., Conn, J.E. 1997. Systematics of mosquito disease vectors (Diptera: Culicidae): Impact of molecular biology and cladistics analysis. Annu. Rev. Entomol. 42: 351-369.
 - 15) Nouzova, M., Edwards, M.J. Mayoral, J.G. Noriega, F.G. 2011. A coordinated expression of biosynthetic enzymes controls the flux of juvenile hormone precursors in the corpora allata of mosquitoes. Insect Biochem. Molec. Biol. 41: 660-669.
 - 16) Pesticide Action Network (PAN). 2006. DDT & Malaria: Setting the Record Straight. San Francisco, CA.
 - 17) Rey, J.R., Rutledge, C.R. 2001. Mosquito Control Impoundments. Document # ENY-648. Entomology and Nematology Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.
 - 18) Roberts et al. 1997. DDT, global strategies, and a malaria control crisis in South America. Emerg. Infect. Dis. 3: 295-302.
 - 19) Roberts et al. 2000. DDT house spraying and re-emerging malaria. Lancet 356: 330-332.
 - 20) Ross, H.H. 1964. The colonization of temperature North America by mosquitoes and man. Mosq. News 24: 103-118.
 - 21) Service, M.W. 1983. Biological control of mosquitoes-has it a future? Mosq News 43:113-120.
 - 22) Service, M.W. 1997. Mosquito (Diptera: Culicidae) dispersal- The long and short of it. J. Med. Entomol. 34: 579-588.
 - 23) Weaver and Forrester. 2015. Chikungunya: Evolutionary history and recent epidemic spread. Antiviral Research 120: 32-39.

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 12, 2017 (opening date)
Exam 2	100	December 12, 2017 (opening date)

Total	215	
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Exams:

Exam 1 (midterm) and Exam 2 include multiple choice, true/false, short answer and/or essays questions. Exams will differ between the co-taught undergraduate (ENY 4592) and graduate (ENY 6593) courses. Exams will be made available to students on the e-Learning in Canvas site at 10am EST on October 12 (Exam 1, midterm) and December 12, 2017 (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. Please cite materials used in the exams. Any citation style is satisfactory; however, the Entomological Society of America style link can be found at: <http://www.entsoc.org/pubs/publish/style> if you choose to use the ESA style. 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.

There will be a discussion forum open for questions about each exam 1 week prior to the exams. Students are encouraged to ask questions about exam materials. Additionally, the chat function on Canvas will be open for questions about the exam. The date for the chat hours will be determined closer to the time of the exam.

Policy related to class attendance:

The course is offered through e-Learning in Canvas. 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 and read course materials 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.

Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>.

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

As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following 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.”* You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: *“On my honor, I have neither given nor received unauthorized aid in doing this assignment.”*

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: <http://www.dso.ufl.edu/SCCR/honorcodes/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>).

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. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation (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>>)

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

COURSE SCHEDULE
 ENY 4592 (sections 11A6, 11B3, 21EF), 3credits
 Tuesday (a) and Thursday (b)

<u>Lecture Topic</u>	<u>Week – Lecture</u>	<u>Suggested Review Date</u>	<u>Lecturer</u>
Introduction			
Overview	(lecture b)	24Aug17	Alto
Classification			
Introduction	(lecture b)	24Aug17	Smartt
Mosquito Morphology and Structural Evolution	(1 - lecture b)	24Aug17	Connelly
Taxonomy and Diversity	(2 - lecture a)	29Aug17	Connelly
Natural History and Ecology			
Introduction		31Aug17	Lord
Mosquito Eggs	(3 - lecture b)	31Aug17	Lounibos
Mosquito Larvae	(4 - lecture a)	5Sep17	Lounibos
Ecology of Immature Stages	(5 – lecture b)	7Sept17	Alto
Adult Mosquitoes – I	(6 - lecture a)	12Sep17	O’Meara
Adult Mosquitoes – II	(7 - lecture b)	14Sep17	O’Meara
Physiology			
Introduction	(lecture a)	19Sep17	Smartt
Oogenesis	(8 - lecture a)	19Sep17	Smartt
Digestion (I and II)	(9 - lecture b)	21Sept17	Alto/Smartt
Biology of Immature Mosquitoes I	(10 - lecture a)	26Sept17	Alto
Adult Mosquitoes – I	(11 - lecture b)	28Sept17	Smartt
Adult Mosquitoes – II	(12 - lecture a)	3Oct17	Smartt
Population Dynamics			
Introduction	(lecture b)	5Oct17	Lord
Modeling Vector-borne Disease - I	(13 - lecture b)	5Oct17	Lord
Modeling Vector-borne Disease - II	(14 - lecture a)	10Oct17	Lord
EXAM 1 (MIDTERM)		12Oct17	
Mosquito Genetics & Pop. Genetics I	(15 - lecture a)	17Oct17	Tabachnick
Population Genetics II & III	(16 - lecture b)	19Oct17	Tabachnick
Mosquito-borne disease			
Introduction	(lecture a)	24Oct17	Lord

Arboviruses I	(17 - lecture a)	24Oct17	Alto
Epidemiology of Mosquito-borne Disease II & III	(18 - lecture b)	26Oct17	Day
Malaria	(19 - lecture a)	31Oct17	Lounibos
Filariasis	(20 - lecture b)	2Nov17	Alto
Multispecies & Disease Models I, II, III	(21 - lecture a)	7Nov17	Lord
Control of Mosquitoes			
Introduction	(lecture b)	9Nov17	Smartt
Chemical Control	(22 - lecture b)	9Nov17	Rey
Biological Control	(23 - lecture a)	14Nov17	Rey
Source Reduction	(24 - lecture b)	16Nov17	Rey
Mosquito Control and Integrated Pest Management	(25 - lecture a)	21Nov17	Connelly
REVIEW PROJECT DUE		21Nov17	
THANKSGIVING HOLIDAY		22-25Nov17	
Highlights of Medical Entomology			
Highlights of Medical Entomology I	(26 - lecture a)	28Nov17	Alto
Highlights of Medical Entomology II	(27 - lecture b)	30Nov17	Smartt
Guest Lectures (research)	(28 - lecture a)	5Dec17	FMEL Guests
Reproductive Interference			Bargielowski
Ecology of Arbovirus Transmission			Burkett-Cadena
EXAM 2		12Dec17	

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.