ENY 6576
Honey Bee Biology
Fall 2023 (3 credits)

***This course is co-taught with ENY 4571 Honey Bee Biology.**

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TA: Kathy McCray (For students last name A-L)
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Course Format: Online

Special Note on Contact via Email: Due to UF privacy laws, you must use your GatorLink account or the Canvas mail system when emailing the Instructor or TA. Emails sent from other accounts (gmail, hotmail, etc.) will not be answered by the Instructor or TA.

Office Hours: Please schedule by appointment.

Course Description: This course will provide an in-depth look into the fascinating world of honey bee biology. Herein, we will explore topics including honey bee sociality, taxonomy, biogeography, behavior, anatomy, physiology, reproduction, nutrition and genetics. Additionally, these topics will be discussed via the paradigm of the honey bee superorganism.

Course Learning Objectives:

1. Compare the life-history strategies of different honey bee species and contrast the different traits of honey bee subspecies.
2. Differentiate between the techniques used to discriminate honey bee subspecies and discuss how they could be used more broadly in apiculture.
3. Describe the different tasks of honey bee workers and distinguish how these might change depending on conditions within the colony.
4. Organize the different vectors of influence that affect honey bee social behavior based on their level of influence.
5. Identify the different structures of the honey bee anatomy and discuss how these function together as physiological systems.
6. Critique the concept of the honey bee superorganism and argue whether or not honey bees fit this paradigm.
7. Interpret the findings from recent honey bee biology research publications and discuss the relevance they have in other scientific disciplines.

Sample Syllabus

8. Summarize how feedbacks between nutrition and pathogens can possibly create a stress cycle that negatively impacts honey bee health
9. Explain the implications that a particular pest and/or pathogen might have on honey bee behaviors.
10. Create extension documents that will teach honey bee biology to non-scientific audiences.

Required Readings:

1. Textbook: Caron, D.W. 2013 (revised from 1999). Honey Bee Biology and Beekeeping. Wicwas Press. Cheshire, CT, 368 pp.
2. American Bee Journal articles written by Dr. Jamie Ellis which are appropriate for the content of this course.
3. Robinson et al., 2008. Genes and Social Behavior. Science 322: 896-900.
4. Bustamante et al. 2020. Comparing classical and geometric morphometric methods to discriminate between the South African honey bee subspecies *Apis mellifera scutellata* and *Apis mellifera capensis* (Hymenoptera: Apidae). Apidologie, 51:123-136.
5. Simone-Finstrom et al., 2017. Propolis counteracts some threats to honey bee health. Insects 8: 46; doi:10.3390/insects8020046
6. Reyes, M. et al. 2019. Flight activity of honey bee (*Apis mellifera*) drones. Apidologie 50: 669-680.
7. Aamidor et al., 2020. What mechanistic factors affect thelytokous parthenogenesis in *Apis mellifera caponizes* queens? Apidologie 51:329–341
8. Dolezal, A.G.; Toth, A.L. 2018. Feedbacks between nutrition and disease in honey bee health. Current Opinion in Insect Science, 26: 114–119.
9. Boncristiani, H. et al., 2020. World Honey Bee Health: The Global Distribution of Western Honey Bee *(Apis mellifera* L.) Pests and Pathogens. Bee World, 1-5. Doi:10.1080/0005772X.2020.1800330.
10. Mortensen et al. 2018. The discovery of *Varroa destructor* on drone honey bees, *Apis mellifera* at drone congregation areas. Parasitology Research 117: 3337-3339.
11. Simone-Finstrom, M. 2017. Social Immunity and the Superorganism: Behavioral Defenses Protecting Honey Bee Colonies from Pathogens and Parasites, Bee World, 94: 21-29.

Lectures: This is a fully online, Canvas-based course. The website for the syllabus, all lectures, reading materials, announcements, tests, etc. will be posted on eLearning: http://elearning.ufl.edu. All lectures for this course are narrated presentations and will include videos and supplemental readings. We will provide text from all the narrated presentations.

Please note that all video clips and photographs are copyrighted and are NOT to be used outside of this class. They may be viewed and used only by students this semester. Students are prohibited from copying and/or distributing these photographs or video clips. All class notes are provided for educational use only.

Course Notifications and Communication: All course communications (assignments, announcements, test information, etc.) will be made via the Announcements in Canvas. Please ensure that your Canvas profile is set to receive notifications (i.e. please check the appropriate

Sample Syllabus

box to receive all notifications). To do this, click on your name in the upper right corner of the Canvas homepage after logging into Canvas. Next, click “notifications” on the left. This will take you to the Notification Preferences page. Then, click the check symbol for at least the following notifications: Due Date, Course Content, Announcement, and Grading.

Students are encouraged to post general questions on topics taught in the class under the General Questions thread. The instructor and/or the TAs will respond to the questions. Other students are also encouraged to respond to the questions. Private questions should be sent to the TA via e-mail.

The instructor and TAs will do our best to respond within 24 hours during the week and 48 hours on weekends. We will also do our best to grade assignments within one week of the due date.

Course Schedule: This course is offered via Canvas as a distance education course. To stay on track, students must adhere to the course schedule.

Sample Syllabus

Module	Video Content	Weekly Readings	Module Quizzes	Critical Thinking Exercises	Extension Blog Posts Assignments	Featured Creature Project
Getting Started	Welcome video	Course syllabus; Tips for success	Aug. 25th			
Insects	Insecta, Hymenoptera, Differentiating bees and wasps, common bee groups, common wasp groups, bee/wasp mimics	Textbook: p. 21-26	Aug. 25th			
Sociality	What makes insects social?, Levels of sociality, Evolution of sociality	Textbook: p. 37-47 Robinson et al. 2008	Sep. 1st			
Honey Bee Taxonomy	Apidae, Apis, Honey bee taxonomy (Micrapis, Megapis and Apis)		Sep. 8th	Sep. 8th		
Biogeography and Taxonomy of genus Apis	florea, andreniformis, dorsata, laboriosa, nigrocinta, cerana, koshvenokvi, nuluensis, mellifera	Textbook: p. 26-28	Sep. 15th		Select Articles Sep. 15th	Featured Creature Topic Sep. 15th
Biogeography and Taxonomy of Apis mellifera	Overview of lineages, Lineage A, Lineage M, Lineage, C, Lineage O, Minor lineages	Textbook: p. 28-34 ABJ: Stocks of Bees Bustamante et al. 2020	Sep. 22nd	Sep. 22nd		
The Colony and the Nest	Adult members of a honey bee colony, Immature members of honey bee colonies, Components of a nest, Life cycle of a honey bee colony	Textbook: p. 49-57 ABJ: Members of a Colony; Components of Nests Simone-Finstrom et al. 2017	Sep. 29th			
Honey Bee and Colony Behaviors	Tasks of a worker, Honey bee dance language, Thermoregulation, Swarm preparation, The swarm, Choosing a nest site, Queen and drone behaviors	Textbook: 87-96 ABJ: Swarms; Tasks of Workers; Thermoregulation and Dance Language Reyes et al. 2019	Oct. 6th	Oct. 6th		
External Anatomy and Physiology	Head, Thorax, Abdomen	Textbook: 61-66 ABJ: External Anatomy	Oct. 13th			

Sample Syllabus

Internal Anatomy and Physiology	Digestive, Nervous, Circulatory, Respiratory, Reproductive, Muscular, Endocrine, Immune, Exocrine	Textbook: 67-73 ABJ: Internal Anatomy	Oct. 20th		1st Submission Oct. 20th	
Honey Bee Genetics	Introduction, Haplo-diploidy, Arrhenotoky, Thelytoky	Aamidor et al. 2020	Oct. 27th		Peer Review Oct. 27th	
Honey Bee Nutrition	Larval diet, adult diet, Nectar and honey, Pollen, Foraging habitats	Textbook: 133-145 Dolezal et al. 2018	Nov. 3rd	Nov. 3rd		1st Submission Nov. 3rd
Pest Pathogen Overview	Major arthropod pests, Minor arthropod pests, Pathogen stressors, Other stressors, Principle stressors, Overcoming bee defenses	Textbook: 309-325 ABJ: Biotic Stressors; Other Stressors Boncristiani et al. 2020	Nov. 13th			Peer Review Nov. 13th
Mating	Sexual maturation of the queen, Sexual maturation of the drones, Drone congregation areas, Honey bee mating, Post-mating maturation	Textbook: 116-131 ABJ: Mating Biology Mortensen et al. 2018	Nov. 17th		Final Submission Nov. 17th	
Superorganism	Overview, Food collection, Endocrine and exocrine systems, Respiration and thermoregulation, Immune system, Communication, Summary	Simone-Finstrom, 2017 ABJ: Superorganisms	Dec. 1st	Dec. 1st		Final Submission Dec. 1st

Sample Syllabus

Evaluation: The course grade is based on total points earned out of 650 possible points.

Module assessments	15 points each × 14 assessments	210 points
Section critical thinking exercises	45 points each × 5 exercises	225 points
Select Articles for Blog Posts	10 points	10 points
Submission of your peer evaluations of two of your peers' Blog Posts	10 points × 2 peer reviews (you get 10 points per peer review you submit)	20 points
Final draft of your Blog Posts	85 points	85 points
Featured Creature Project	100 points	100 points
	Total Course Points	650 points

Grades and Grade Points
For information on current UF policies for assigning grade points, see catalog.ufl.edu/UGRD/academic-regulations/grades-gradingpolicies/.

FINAL GRADING		
% grade	Letter grade	Points needed to achieve letter grade
100-93	A	≥ 605
90-92	A-	585 – 604
87-89	B+	566 – 584
83-86	B	540 – 565
80-82	B-	520 – 539
77-79	C+	501 – 519
73-76	C	475 – 500
70-72	C-	455 – 474
67-69	D+	436 – 454
63-66	D	410 – 435
60-62	D-	390 – 409
0-59	E	0 – 389

Assignments:

(1) Module Assessments: There is a 15-point assessment associated with each of the fourteen modules in this course. These assessments are ***open note*** (i.e. you ***are*** allowed to use class lectures, books, websites, etc. while taking the assessments). The assessments will be composed of true/false and multiple choice questions. **The assessments 1) open the Saturday morning after the previous section ends, 2) are timed (30 minutes each), and 3) are due on the following Friday at 11:59 pm on the date listed in the course schedule.** These are individual assessments so please do your own work and do not work in groups or share your answers. There is a large bank of test questions for each assessment and the assessment questions are selected randomly for each student. You will receive a 5-point deduction for each day a module assessment is late.

The first module assessment is a graded syllabus quiz on the "Getting Started" module. You need to read the syllabus and answer quiz questions related to it by **11:59 pm ET on the date listed in the course schedule**. You must complete the syllabus quiz before you are able to advance to the next module. This quiz will show you how your online assessments will be formatted as well as allow you to demonstrate that you understand how this course works and important due dates.

(2) Critical Thinking Exercises: The exercises are designed to encourage you to think critically about the content presented in the module lectures. The critical thinking exercises are worth 45 points each. There are

Sample Syllabus

separate exercises designed for graduate students incorporating additional questions from the scientific journal articles assigned to that section. These are individual exercises so please do your own work and do not work in groups or share your answers. All of the critical thinking exercises are open note and untimed. You can close and reopen the exercise as many times as you would like until the due date (see course schedule), but you will not be able to make any changes once you have officially submitted your final exercise. **The exercises are due at 11:59 pm on the date listed in the course schedule.** You will receive a 5 deduction for each day a module assessment is late.

(3) Extension Blog Posts: One of the most useful skills in any profession is writing. Furthermore, one of the missions of the Land Grant Institution is extension, which means we are communicating with the general public. As such, you are required to produce **two** blog posts which each explain a recent article (published within the last two years) related to honey bee biology. These blog posts should be written for a beekeeping audience. Technical jargon should be avoided or, if necessary to include, must be thoroughly explained to make it more easily understood. Selected articles should be relevant to honey bee biology and must be published in a peer reviewed scientific journal. Your blog posts should be written to have the potential for publication through the University of Florida's extension branch (Cooperative Extension Service). You **must** check with the TA before beginning your blog posts so that they can verify that such a blog post does not already exist on your selected articles and that the articles have not already been selected by another student. The instructor or TA can provide advice for finding an article, but the articles will be reserved on a first come first serve basis. **A grading rubric will be provided in Canvas to facilitate the development of your Blog Posts.**

Your Blog Posts should convey scientific information in a way that a high school student could understand. Your writing should be clear and succinct. As writing space is limited, figures are extremely helpful in extension documents, and students are encouraged to include as many figures as necessary to explain a topic. You must obtain use permission from the owner of any figures you include in your final report if the figure is not original to you. There will be an additional assignment to submit with the Final Blog Posts called "Final Blog Posts Figures and Permissions." For this assignment, you will upload the full-sized jpeg file for each figure and fill in the accompanying word document with the proof of permission for use.

The following are some recent examples of student-lead scientific blog posts that you may use to model your posts after:
Small hive beetle
Varroa rearing
Varroa control with OA

There are four components of the Blog Posts that compose the completed assignment. Due dates for each component are listed in the course schedule.

1) Select Articles Due – The student should identify the articles chosen for their Blog Posts by completing the Canvas assignment "Select Blog Post Articles".

2) 1st Submission – This is not a rough draft, but rather is what the student considers the completed document. It must include both Blog Posts.

3) Peer Review – The 1st submission will be shared with other students in the class who will provide a peer review of the Blog Posts by the due date listed in the course schedule. Each student will peer review two Blog Posts, providing meaningful helpful comments to receive full points.

Sample Syllabus

4) Final Submission – Students are expected to revise their Blog Posts per the "good" comments provided during the peer review process. The final report must be submitted by the due date shown in the course schedule.

A grading rubric will be provided in Canvas to facilitate development and peer review of the Blog Posts. **Five points will be deducted from the final project score every day past the due dates that any of the information requested above is late, regardless of the excuse**. Please do not wait until the last minute to produce your blog posts or meet any of the other deadlines. All points lost will be deducted from the final Blog Posts grade.

4) Extension Project: Students enrolled in ENY 6934 are required to produce an additional extension project which will be in the form of a Featured Creatures article (http://entnemdept.ufl.edu/creatures/). You must choose a honey bee species, a bee pollinator or bee pest of interest and write about it following the standard Featured Creature format. This format is available at the Featured Creatures link above under the "Format for Authors" link. Here are two recent examples of published Featured Creatures articles completed by students that you could use to model your own article.
https://entnemdept.ufl.edu/Creatures/MISC/BEES/Melitta_americana.htm
https://entnemdept.ufl.edu/creatures/misc/bees/Apis_andreniformis.htm#top

Regardless of which topic you choose, it should have the potential for publication through the University of Florida's extension branch (Cooperative Extension Service). You **must** check with the TA before beginning your project so that they can verify that such a document or instructional video does not already exist on your topic. The instructor or TA can provide ideas for selecting a topic. **A grading rubric will be provided to facilitate development of the extension project.**

There are four components of the Extension Project that compose the completed assignment. Due dates for each component are listed in the course schedule.

1) Featured Creature Topic Due – The student should identify and record the topic chosen for the Featured Creature report by completing the Canvas assignment "Extension Report Topic."

2) 1st Submission – This is not a rough draft, but rather is what the student considers the completed report.

3) Peer Review – The 1st submission will be shared with other graduate students in the class who will provide a peer reviews by the due date listed in the course schedule. Each student will peer review the reports of at least two students.

4) Final Submission – Students are expected to revise the reports as per the comments provided during the peer review process. The final version of the reports must be submitted by the due date shown in the course schedule.

A grading rubric will be provided in Canvas to facilitate development and peer review of the Extension Project. **Five points will be deducted from the final project score every day past the due dates that any of the information requested above is late, regardless of the excuse**. Please do not wait until the last minute to produce your fact sheets or meet any of the other deadlines. All points lost will be deducted from the final Extension Project grade.

Absences and Make-Up Work: Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at:
catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/

Sample Syllabus

Online Course Evaluation Process: Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at gatorevals.aa.ufl.edu/public-results/.

Academic Honesty: UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students 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." The Honor Code (sccr.dso.ufl.edu/process/student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Services for Students with Disabilities: Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, dso.ufl.edu/drc) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Campus Resources:

Health and Wellness

U Matter, We Care: If you or someone you know is in distress, please contact mailto:umatter@ufl.edu, 352-392-1575, or visit umatter.ufl.edu/ to refer or report a concern and a team member will reach out to the student in distress.

Counseling and Wellness Center: Visit counseling.ufl.edu/ or call 352-392-1575 for information on crisis services as well as non-crisis services.

Student Health Care Center: Call 352-392-1161 for 24/7 information to help you find the care you need, or visit shcc.ufl.edu/.

University Police Department: Visit police.ufl.edu/ or call 352-392-1111 (or 9-1-1 for emergencies).

UF Health Shands Emergency Room / Trauma Center: For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; ufhealth.org/emergency-room-trauma-center.

Academic Resources

E-learning technical support: Contact the UF Computing Help Desk at 352-392-4357 or via e-mail at helpdesk@ufl.edu.

Career Connections Center: Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services career.ufl.edu/.

Sample Syllabus

Library Support: cms.uflib.ufl.edu/ask various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center: Broward Hall, 352-392-2010 or to make an appointment 352- 392-6420. General study skills and tutoring. teachingcenter.ufl.edu/

Writing Studio: 2215 Turlington Hall, 352-846-1138. Help brainstorming, formatting, and writing papers. writing.ufl.edu/writing-studio/

Student Complaints On-Campus: sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/

On-Line Students Complaints: distance.ufl.edu/student-complaint-process/

Sample Syllabus