

Integrative Biology 427 - Insect Physiology

4 Credit Hours

(<https://learn.illinois.edu/>)

Spring 2020 Syllabus

Teaching Team

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Course Description

In-depth examination of the principal physiological and biochemical functions of insects. The course covers the history of the field of insect physiology, as well as the current status, and future directions. Connections will be made between insect physiology ("how insects work") and insect genomics, insect ecology, integrated pest management, etc. The course includes an inquiry-driven laboratory portion. Students work in groups to generate hypotheses, design experiments, collect and analyze data and write their results.

Offered in alternate years. Prerequisite: IB 202 and IB 401; undergraduates will need consent of instructor to enroll. This is a course designed for graduate students getting their degree in entomology. The focus will be on relatively few model systems.

Class Meeting Times and Location

Lecture (IB 427 AL1) MWF 1 hour: **2083 Natural History Building**

Lab (IB 427 AB1) T 3 hours: **4074 Natural History Building**

Required Materials and Services

- (recommended) Klowden, M.J. (2013 or 2007 or 2002) **Physiological systems in insects**. Elsevier/Academic Press, Amsterdam, The Netherlands. Full 2013 e-book available via the library.illinois.edu and ScienceDirect. Content will also be drawn from books such as "Insect Physiology and Biochemistry" by J.L.Nation (2015), "The insect: Structure and Function" by R.F. Chapman (2013). Ecological and Environmental Physiology of Insects by J. Harrison (2012) and various

websites and peer-reviewed journal articles. Students are not required to purchase these resources.

- Access to e-mail
- Access to the internet (<https://learn.illinois.edu>)
- Twitter account (twitter.com) – can be synonym – just let instructor and course-mates know it is you.

Learning Outcomes

- Become familiar with insect physiological systems such as the endocrine system, the digestive system, the excretory system, the respiratory system, etc.
- Understand how these physiological systems of insects are integrated to maintain homeostasis.
- Understand the history of insect physiology and the current state-of-the-art research being done in the field.
- Develop a sense of how physiology can infuse into major topics in entomology, such as integrated pest management, crop development and food security, disease transmission, etc.

Lectures

Lecture Schedule

(for up to date information make sure to check the calendar on the course's Moodle site <https://learn.illinois.edu/>):

#	Week/Day	Date	Topic	Klowden
	1 M	Jan 20	No Class – MLK Day	
1	1 W	Jan 22	Intro to the course, Homeostasis	Preface
2	1 F	Jan 24	Integument	Ch. 2
3	2 M	Jan 27	Cuticle chemistry	
4	2 W	Jan 29	Molting	
5	2 F	Jan 31	Endocrine system - introduction	Ch. 1
6	3 M	Feb 3	Endocrine system	
7	3 W	Feb 5	Endocrine system	
8	3 F	Feb 7	Endocrine system	
9	4 M	Feb 10	Endocrine system	

10	4 W	Feb 12	Endocrine system	
11	4 F	Feb 14	Reproductive system	Ch. 4
12	5 M	Feb 17	Reproductive system	
13	5 W	Feb 19	Reproductive system	
14	5 F	Feb 21	Digestive system	Ch. 6
15	6 M	Feb 24	Digestive system	
16	6 W	Feb 26	Digestive system	
17	6 F	Feb 28	Nutrition, metabolism	Ch. 6
18	7 M	Mar 2	Intermediary metabolism	
19	7 W	Mar 4	Circulatory system	Ch. 7
	7 F	Mar 6	<i>Review</i>	
	8 M	Mar 9	Midterm Exam through lecture 19	
20	8 W	Mar 11	Immune System	
21	8 F	Mar 13	Trip to the RMBLibrary	
		Mar 16-20	Spring Break	
22	9 M	Mar 23	Immune system	
23	9 W	Mar 25	Respiratory system	Ch. 9
24	9 F	Mar 27	Respiratory system	
25	10 M	Mar 30	Respiratory system	
26	10 W	Apr 1	Excretory system	Ch. 8
27	10 F	Apr 3	Excretory system	
28	11 M	Apr 6	Excretory system	
29	11 W	Apr 8	Muscle	Ch. 10
30	11 F	Apr 10	Muscle	
31	12 M	Apr 13	Nervous system	Ch. 11
32	12 W	Apr 15	Nervous system	
33	12 F	Apr 17	Nervous system	
34	13 M	Apr 20	Biomechanics	
35	13 W	Apr 22	Biomechanics	

36	13 F	Apr 24	Sensory system	
37	14 M	Apr 27	Sensory system	
38	14 W	Apr 29	Communication	Ch. 12
39	14 F	May 1	Chemical communication	
40	15 M	May 4	Topic TBD based on student interests	
41	15 W	May 6	Topic TBD based on student interests	
	Thursday 8:00-11:00 a.m.	May 14	FINAL EXAM – through lecture 41, with a focus on lectures 22-41	

Course Organization

The topic of this course is “how insects work.” The great insect physiologist Sir Vincent B. Wigglesworth opened his 1934 monograph on insect physiology by stating that his goal was to describe the “fundamental processes of vital activity,” but then went on to make it clear that he would begin by dealing with “physiology on the humbler plane: with the grosser functions of the organs and tissues, and with the mechanisms by which these functions are coordinated to serve the purpose of the insect as a whole.” And so, will it be with IB 427.

This course consists of lectures, online content, required readings, content on important classic experiments and the “famous” insect physiologists who performed them, laboratory exercises, student-created content for the online environment and laboratory reports. Three themes will permeate all topics. The first is what one normally thinks of as course content – the answers to the question of how insects work. The second is a historical context of the content (How did we get to this point?). The third is the development of all members of the class as researchers and scientific writers and as scientists learning, working and teaching online to a broader audience (broader than just the instructor and course-mates).

Content is provided by the lectures, by the textbook, by Moodle lessons online, and by assigned, recently published, articles. Historical context is provided by lectures, by the textbook, and by biographies and classic articles of insect physiologists. The laboratory exercises will be developed and performed by the students themselves working in pairs (with support of the TA and the instructor). Practice in scientific writing is provided by the laboratory write-up, blog articles, and by the exams.

It is assumed that the students know the basics of vertebrate physiology, so review will be limited. The following biases of the instructor will be evident. First, the emphasis will be on general solutions to physiological problems rather than on specialists (however, I will try to cover interesting observations on insects that the students are working on for their

research). Second, even though the solutions reflect phylogeny, this aspect of the subject will not be emphasized. Third, physiological adaptations also reflect ecology, but this will not be emphasized. Fourth, understanding of the basics of molecular biology is required, but is not the whole story (the same goes for biochemistry). Fifth, the emphasis will be on a fairly narrow range of “model” insects useful for physiological studies rather than on diversity or on specific beneficials and pests (but again, I will try to also mention some of the insects studied by the student, and welcome any input).

Lectures

It is the instructor’s goal to provide an interactive learning classroom. Sometimes students will be involved in active learning projects in the class. Other times the instructor will use the whiteboard to cover a topic. In the past only Powerpoint presentations were used, they still may make an appearance. Lecture Powerpoint presentations will be posted on Moodle after the class period. These presentations are meant only for the benefit of the students enrolled in the class since not all illustrations will be credited fully. Please do not use any of the material for your own research or presentations (the same goes for any PDFs posted on Moodle).

The content of some topics will be delivered online in the form of a Moodle lesson or links to podcasts, audio, video etc. Most of this content will be an introduction to the next topic to be discussed in class.

Lectures will closely follow the topics in the Klodden textbook. I will also try not to rely on Powerpoint presentations too much, and encourage discussion and questions during class. Please feel free to make suggestions on how lectures may be improved. I especially welcome ideas on how to add different types of content to the lectures: video, audio, etc.

Midterm and Final

You will be tested on the lecture and historical readings material by way of a midterm and a final. The midterms are designed to be completed in 1 hour but everyone will receive 2 hours to complete it. The final is designed to be completed in 2 hours but everyone will receive 3 hours to complete it.

Communicating Insect Physiology

We will use mini-lectures in the form of twitter lectures, podcasts and video to delve into a topic's history and current state of the field. Please see the Communicating Insect Physiology tab on the course’s Moodle page for further details.

Exam Question Crowdsourcing

At the conclusion of every broad topic you will be asked to write an exam question that covers that particular topic. Guidelines for what make up good exam questions will be given in the

"Exam Question Crowdsourcing" tab on the course's Moodle page. You are also required to answer some of your fellow students' questions. A few of these questions will appear on the midterm and final exam.

Laboratory

Laboratory Classroom: 4072 NHB (unless otherwise indicated)

Tuesday 9:00am – 11:50am (unless otherwise indicated)

A separate laboratory syllabus, including more detailed course logistics and grading policies, can be found under the "lab" tab on the course's Moodle website.

Lab Schedule:

Week	Date	Lab #	Topic	Meeting Place	Assignment Due	Quiz Completed/ Due	
1	21-Jan	1	Intro to Physiology Lab / Insect Dissection	4072 NHB			
2	28-Jan	2	SEM Lab	Beckman Institute		Lab 1 & Lab 2 Pre-lab	
3	4-Feb	3	SEM Lab / Rearing <i>M. sexta</i>	4072 NHB		Lab 3 Pre-lab	
4	11-Feb	3	SEM Lab / Rearing <i>M. sexta</i>	Independent work			
5	18-Feb	3	Rearing <i>M. sexta</i>	Independent work	SEM lab report due		
6	25-Feb	3	Rearing <i>M. sexta</i>	Independent work	<i>M. sexta</i> blog due		
7	3-Mar	4	Cuticle Lab	TBD	Cuticle report due	Lab 4 Pre-lab	
8	10-Mar	4	SEM Presentation	4072 NHB			
9	17-Mar	SPRING BREAK NO LAB					
10	24-Mar		Blog peer-review	Independent work	Blog peer-review due		
11	31-Mar	5	Immunolabeling	TBD		Lab 5 Pre-lab	
12	7-Apr	5	Immunolabeling	TBD			
13	14-Apr	6	Ramsay assay	TBD	Immunolabeling lab report due/Ramsay assay report due	Lab 6 Pre-lab	
14	21-Apr	7	Biomechanics	4072 NHB		Lab 7 Pre-lab	

15	28-Apr	8	Insect nervous system	4072 NHB	Nervous system report due	Lab 8 Pre-lab
16	5-May		Finish-up lab work		Biomechanics lab report due	

General information for Insect Physiology Lab

Meeting Times: We are scheduled to meet on Tuesdays 9:00 am to 11:50am. This time will always be available for completing experiments, but because of the nature of many of the projects, you may be required to work outside of this time as well. We will make every attempt to make sure that the lab space and supervision is available at times that work for everyone's schedule. Most of the projects will be done in groups, so everything should work out.

Meeting Place: We are scheduled to meet in 4072 NHB, but a few of the projects will be completed in 317 Morrill Hall (M's Lab) or elsewhere. You will be given plenty of notice about where different activities will take place.

Groups: For most lab projects you will be working in groups of 2 or 3 people. This way, the work can be spread out evenly and we can complete the experiments in a timely manner. However, each person is responsible for understanding all the procedures involved in each project and will be responsible for turning in their own assignments.

SAFETY:

- No mouth pipetting under any circumstances.
- Material Safety Data Sheets (MSDS) are available for all the chemicals we will be using.
- Use the hood for nasty smelling organic compounds. Be sure to avoid skin contact with chemicals especially fixatives, stains, solvents etc. Wear gloves.
- Make sure to dispose of all chemical waste properly (i.e. don't dump anything down the sink unless you're absolutely sure it's safe).
- Report any accidents and incidents as soon as possible to Ed or M, even if they seem trivial to you. Wipe up spills or other messes immediately. Note the locations of fire extinguishers and safety showers.

PRE-LAB QUIZZES:

- Quizzes will be made available immediately following the previous week's lab and will remain open until 9:00am of their associated lab (e.g. Lab 3 Pre-lab will open after lab on 28-Jan and must be completed BEFORE 9:00am on 4-Feb).

- Please read all associated materials listed in the quiz section before attempting.

-You are allowed 3 attempts and will be graded on your highest scoring performance.

LAB REPORT FORMAT AND GRADING:

- Each student must submit individual formal reports for most laboratories. Please discuss your data and results with your group members, but the reports need to be your individual work.

- Reports should be in the format of a manuscript prepared in the style of the Journal of Experimental Biology. They should have the following sections: Introduction, Materials and Methods, Results, Discussion and References. Your lab report's pages should be numbered

- Reports should be double-spaced. There will not be any mandatory page limit, as long as everything is discussed in sufficient details. I expect 5-7 pages will probably be average.

- You must refer to the primary literature in at least your intro and discussion, you need at least 3 references. If you don't know how to find primary research articles, please talk to me.

- You are REQUIRED to put your UIN on your lab report instead of your name. DO NOT include your name your lab report. If your name is used instead of your UIN, I will have to mark points off of your lab.

- Late submissions will lose points

- Points for lab reports:

Item	#	Points
Pre-lab quizzes	8	5
Lab report:	3	45
Introduction		5
Materials and methods		5
Results		10
Discussion		20
References		5
Blog	1	45
Report	3	25
Presentation	1	25

Overall

Course Grading

1. One midterm examination **(20%)** and a final **(25%)**.
2. Communicating Insect Physiology: instruction and participation **(10%)**
3. Exam Question Crowdsourcing: write your own exam question **(10%)**
4. Laboratory (see laboratory tab) **(35%)**

Course Grading Scale

Grade	Percent
A+	98–100
A	93–97.99
A–	90–92.99
B+	88–89.99
B	83–87.99
B–	80–82.99
C+	78–79.99
C	73–77.99
C–	70–72.99
D+	68–69.99
D	63–67.99
D–	60–62.99
F–	0–59.99

Academic Integrity

According to the Student Code, 'It is the responsibility of each student to refrain from infractions of academic integrity, from conduct that may lead to suspicion of such infractions, and from conduct that aids others in such infractions.' Please know that it is my responsibility as an instructor to uphold the academic integrity policy of the University, which can be found here: http://studentcode.illinois.edu/article1_part4_1-401.html

Expectations

Academic dishonesty will not be tolerated. Examples of academic dishonesty include the following:

- Cheating
- Fabrication
- Facilitating infractions of academic integrity
- Plagiarism
- Bribes, favors, and threats
- Academic interference
- Examination by proxy
- Grade tampering
- Non-original works

Guidelines

Should an incident arise in which a student is thought to have violated academic integrity, the student will be processed under the disciplinary policy set forth in the [Illinois Academic Integrity Policy](#).

If you do not understand relevant definitions of academic infractions, contact the instructor for an explanation within the first week of class.

Disability Accommodations

To ensure that disability-related concerns are properly addressed from the beginning of the course, students with disabilities who require assistance to participate in this class are asked to see the instructor as soon as possible. Also, to obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES you may visit 1207 S. Oak St., Champaign, call 333-4603 (V/TTY), or e-mail a message to disability@illinois.edu.