Field Entomology (Biology 311 – 3 credit hours at SRU; Biosc 1340 – 3 credit hours at Pitt)
SRU – Summer Session I; PLE session II (6/01/2020 -6/19/2020)

Instructor: Dr. Randy Layne
Location: **VSC 302:** Lecture noon to 5 pm, includes video supplemental field-lab activities. We will use D2L at Slippery Rock University as one delivery platform for course materials. Alternate delivery may be used through the University of Pittsburgh.
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Textbook: Insect Biology and Diversity by James B. Whitfield and Alexander H. Purcell III (978-0-19-538067-5; Oxford University Press).

Important Web Resources About Insects:
Diversity of Living Things http://tolweb.org/tree/
Insect Morphology and Diversity http://sps.k12.ar.us/massengale/insect_notes_b1.htm
Entomological Society of America (includes key entomology journals) www.entsoc.org/
USDA Systematic Entomology Laboratory http://www.ars.usda.gov/Main/site_main.htm?modecode=12-75-41-00
Entomological Society of Canada (includes key entomology journals) www.esc-sec.org/
Biological Survey of Canada (Terrestrial Arthropods): http://www.biology.ualberta.ca/bsc/english/newsletters.htm
PSU Dept. of Entomology (facilities include the Frost Entomological Museum) www.ento.psu.edu/
The Biology of Diptera http://diptera.myspecies.info The Lepidoptera http://www.butterfliesandmoths.org/
Goldenrod Gallfly Ecology http://www.facstaff.bucknell.edu/abrahmsn/solidago/main.html
Ecological Entomology http://www.wiley.com/bw/journal.asp?ref=0307-6946
J. Insect Physiol. www.elsevier.com/wps/find/journaldescription.cws_home/231/description#description
Physiological Entomology www.blackwellpublishing.com/journal.asp?ref=0307-6962&site=1

Objectives: Insects, including their taxonomy, structure, function, ecology, and economic importance. It is important for field biologists to understand the general biology of insects: what they are, how they function, and how they have become the tremendously successful group of organisms that they are today. There are more kinds of insects than any other animal; in fact, insect species outnumber all other species of living organisms combined (both plants and animals). Insects have successfully exploited essentially all of the habitats available on earth except marine waters. Although considerably smaller in size than man, insects have successfully evolved as competitors for many food sources. Insects are also important vectors for many human diseases. Any group of organisms as successful as insects and as capable of affecting human health and economy is worthy of study.

Special Concerns: Animal welfare regulations for the USDA and OLAW do not include insects. Nevertheless, we will conduct class activities in a manner that is both humane and minimally consumptive of living specimens. This information is applicable if you go outdoors to make insect observations. Fieldwork also requires common sense at all times. Key rules:

1. Always follow key guidelines regarding efforts to limit the spread of COVID (social distancing, etc.)
2. Stay with the class during field excursions.
3. Keep insect repellent and drinking water with you during field work.
4. Protect yourself from ticks and biting insects.
5. Proper footwear and clothing at all times.
6. Never approach seemingly friendly mammals – any mammal has the potential to be rabid.
7. Good citizenship at all times – do not litter or make disturbances along the way.
8. All injuries or illness should be immediately reported to me. Proper first aid must be given to injuries.

Course Outcomes: Upon completion of the course the student should:

- know the anatomy of the organ systems of typical insects and know how these organ systems function (dissection is a required activity in this course)
- know the mouthparts of representative insects with different feeding habits and understand the mouthpart homologies
- understand the ecology of insects, the habitat requirements of certain insect groups, the ecological relationships

between insect species, and insect relationships to other organisms (the student will learn microhabitats of many insect orders and/or families)
- know the pattern of insect life cycles, development, and metamorphosis
- know the biology of major groups of social insects
- know the biology of terrestrial arthropods that are associated with the insects
- understand the economic importance of insects, particularly those important to agriculture and human health
- have made a digital insect collection in powerpoint with 5 orders, 10 families, and 20 species being represented
- know how to identify insects by using a key
- know the characteristics of the Arthropoda and Insecta
- know common collecting techniques and devices for insects
- know the general characteristics of all recognized insect orders and be able to identify typical specimens to order
- recognize all major insect orders in our region, in specialized circumstances this may extend to important families and species in our region (e.g. European honey bee – *Apis mellifera*)

Assessment:

The course grade will be computed using quizzes, final exam, digital photograph insect collection, and research paper. Quizzes on a prior day's lecture and lab will be given at the beginning of a laboratory period. Four quizzes will account for 100 pts (25 points each); five quizzes will be given with the lowest score being dropped. A comprehensive final exam will be given at 10 am on the last day of the session (Friday June 19th), and it will count for 100 points. The final exam and quizzes will consist of multiple choice, fill in the blank, and essay questions.

A digital photograph collection will count for 100 points of the course grade. The original digital photographs should be loaded into a power-point file using original (and identifiable) photographs of twenty different insect species. A total of 8 orders and 12 families should be represented in your overall collection. A descriptive slide should be given for each specimen with the following information - life cycle type and its ecological/ economic importance (30 word maximum per entry). Grading of each slide will use the following formula – correct order = 1 point, correct family = 1 point, and description = 3 points so a total of 5 points per specimen/power point slide. Total point value for all 20 specimens = 100 points. Each accurately named species will net a 1 point bonus for that entry. All materials should be your own composition with a list of three or more references given at the end of the file. Late collections will not be accepted.

The insect community diversity project will be written as a formal scientific paper in the format for a research paper in the journal Environmental Entomology. I will be collecting the data during our session and providing the data to you. The following sections should be used in the layout of your paper - title page (1st page), abstract (2nd page), body of the paper (starting on p. 3) with headed subsections - introduction, materials and methods, results, discussion, and literature cited. Use 12 pt font (times), double spacing, and 1-inch margins. Page numbering should be given at the top right-hand corner of each page. All writing must be of your own composition. All writing must be original composition (your words!); long quotations are not acceptable in scientific papers (**10% deduction for a quoted line longer than six words or for use of more than two quotation instances in the paper**). Plagiarism is a more serious infraction, and it will result in a grade of 0% for the assignment. The target length of the total paper, including title page, should be between 8-10 pages, but grading will be based on the quality of composition, thoroughness of analysis, and compliance with the paper guidelines. A well done 7-page paper will be scored substantially higher than a poorly developed 12-page paper. Appropriate use of no fewer than 8 scientific references is an absolute requirement (**nonscientific sources and websites will not be accepted as valid references and graded down 5% for each instance**). Citations should be given with all relevant specific facts that you provide. Put a citation with the sentence where it applies – not just at the end of the paragraph. Give the last name of the author and year – (Smith 1999) or Smith (1999) found … Two author citations give both last names – (Smith and Jones 2001) or Smith and Jones (2001) found … Three or more author citations only give the first author with an indication that others contributed – (Smith et al. 2012) or Smith and coworkers (2012) found …. Common scientific facts do not require a citation. For example, a citation is not required if you mention that water is a polar molecule. Each violation of the approved reference/citation style will be graded down by 2.5% up to a maximum of 20% deduction. Late papers will not be accepted.

Grading summary

Quizzes	100 points total
Final exam	100 points
Collection	100 points
Research paper	100 points

A = 90% and above, B = 80 – 89%, C = 70 – 79%, D 60 – 69%, F below 60%
For those with plus or minus grading, I will use the recommended levels by your home institution.

Date	**Topic**		**Text Chapter**
June 01	Lecture:	A Review of Animal Diversity	----
		Overview of Entomology: Insect Anatomy	1, 2
		Orders of the day (Archaeognatha, Zygentoma)	19
	Lab/Field:	How to collect and identify insects (ch. 17)	47
June 02	Lecture:	Insect Anatomy; Integument	2, 3
		Orders of the day (Odonata, & Ephemeroptera)	20, 21, 34
	Lab/Field:	Collect and identify insects	
June 03	Lecture:	Insect development and reproduction	4
		(Quiz #1 – June 01 material)	
		Orders of the day (Blattodea, Orthoptera)	22, 29
	Lab/Field:	Collect and identify insects	
June 04	Lecture:	Maintenance and Movement	
		(Hemiptera, Siphonaptera, Phthiraptera)	33, 34, 44
	Lab/Field:	Field activities	
June 05	Lecture:	Physiological Ecology	8
		Orders of the day (Lepidoptera, Coleoptera)	39, 45
		(Quiz #2 – June 03 material)	
	Lab/Field:	Collection review	
June 08	Lecture:	Insect sensory systems	6
		Orders of the day (Diptera & Hymenoptera)	41, 43
	Lab/Field:	Ecology Project	
June 09	Lecture:	Social systems	7
		Orders of the day (Mantodea & Dermaptera)	23, 26
		(Quiz #3 – June 05 material)	
	Lab/Field:	Ecology Project	
June 10	Lecture:	Insect, microbes, and disease	11, 12
		Orders of the day (Plecoptera & Phasmatodea)	27, 30
	Lab/Field:	Ecology Project	
June 11	Lecture:	Insect and plant interactions	9
		Orders of the day (Psocoptera, Thysanoptera)	32, 35
		(Quiz #4 – June 09 material)	
	Lab/Field:	Data analysis & Gall ecology	
June 12	Lecture:	Insect Systematics & Evolution	7, 8
	Lab/Field:	Collection and paper review	
June 15	Lecture:	Medical Entomology	
June 16	Lecture:	Invasive species, pest management, and conservation	13, 14
		Orders of the day (Mecoptera & Neuroptera)	38, 42
		(Quiz #5 – June 12 material)	
	Lab/Field:	Temperature regulation in insects	
June 17		FIELD TRIP - virtual	
June 18		Lecture makeup until noon	

PAPER PROJECT AND COLLECTION (both due at 3 pm)

June 19 FINAL EXAM starts at 10 am (comprehensive)

Reference Style (always use double space throughout the paper)

Journal Article (print style)

Hahn, D. A., A. R. Martin, and S. D. Porter. 2008. Body Size, but Not Cooling Rate, Affects Supercooling Points in the Red Imported Fire Ant, *Solenopsis invicta.* Environmental Entomology 37: 1074-1080.

Journal Article (web style)

Sinclair, B. J., A. G. Gibbs, W.-K. Lee, A. Rajamohan, S. P. Roberts, and J. J. Socha. 2009. Synchrotron X-Ray visualisation of ice formation in insects during lethal and non-lethal freezing. PLoS ONE 4(12): e8259. doi:10.1371/journal.pone.0008259.

Book Chapter

Baust, J. G., and M. Nishino. 1991. Freezing tolerance in the goldenrod gall fly, *Eurosta solidaginis*, pp. 260-275. *In* Lee, R. E. Jr. and D. L. Denlinger (eds.), Insects at low temperature. Chapman and Hall, New York.

Book

Zar, J. H. 1984. Biostatistical Analysis, 2nd ed. Prentice Hall, Englewood Cliffs, NJ.

Results Section and Tables/Figures

There are key items to key in mind if you use figures and tables in a Results section. The old adage that a picture is worth a thousand words is only partly applicable here. The narrative of the Results should lead the reader through a table or figure so that the trends in the data are described, but the narrative should not a relisting of the numbers presented in a table or figure. For example, a study reporting on insect abundance in two habitats might present in a table that habitat A had 15 individuals in the family Apidae and habitat B had

150 individuals in the same family. The narrative might say "Random sampling revealed that members of Apidae were 10X more abundant in habitat B vs. habitat A (Table 1)." This helps draw the reader's attention to the disparity.

Tables have specific construction features that need to be followed. The most relevant comparisons should be set up for left to right reading first so the row to column organization should favor this type of reading. This does not preclude making comparisons down columns too. The rows and columns should be labelled and units of measurement should be given where appropriate. Descriptive statistics are the most commonly reported values in tables (mean and standard deviation), but sometimes tables may give individual numbers as seen in population and community surveys of abundance. Above the table will be a heading that starts with naming the table and its identification by number (e.g. Table 1). Any following tables will be numbered consecutively (Table 2, Table 3, etc.). The heading will include a descriptive statement that will indicate what is being presented in the table (see below)

Table 1. Supercooling points (°C) of woolly bears (2011 collection group) with dry and wetted surfaces (100 µl deionized water) and water containing aliquots of hemolymph. The hemolymph was added in volumes of 10 µl and 50 µl to 1 ml of deionized water.

	Caterpillars		Deionized	Hemolymph/Water	
	Dry surface	Wetted surface	Water	10 µl/1ml	50 µl/1 ml
Mean	-6.0 $\pm$ 0.9	-4.7 $\pm$ 1.8	-12.8 $\pm$ 1.1	-5.2 $\pm$ 0.6	-5.2 $\pm$ 0.5
Range	-6.9/-4.5	-7.4/-3.2	-14.6/-11.1	-5.9/-4.5	-6.0/-4.7
N	8	7	16	5	5

The rules for figures have overlapping features with tables but there are differences too. They too commonly present descriptive statistics, but figures sometimes give individual numbers (e.g. scatterplots). Axes should be labelled to identify value levels and units of measure. A unique aspect of a figure is that it uses a caption rather than a heading. The caption is presented below the figure rather than above it. Figures are named and identified in fashion like a table – Figure 1, Figure 2, etc. Additionally, a description follows this sentence like what is given with a table (see below).

Figure 1. A photograph of a woolly bear caterpillar showing the extensive abundance of setae over its body (A) and a photomicrograph of a seta showing numerous barbs on its surface (B).