

# Entomology 689

## Insect Phylogeny and Evolution

### Basic Course Information

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**Instructor:** John D. Oswald  
**Office:** 216A Heep Center  
**Phone:** 979-862-3507  
**E-Mail:** j-oswald@tamu.edu

**Credits:** 3

**Offered:** Alternate Spring semesters [offered Spring 2005]

**Lecture/Discussion:** (preliminary) Lecture: Mon. & Fri. 11:30 – 12:20 AM (Heep 205)  
(preliminary) Topic Discussion: Wed. 11:30 – 12:20 AM (Heep 205)

**Web Site:** (in preparation)

**Lab:** None

**Textbook:** None. Readings will be assigned.

**Reference Texts:** Boudreaux, H. B. 1979. *Arthropod Phylogeny with Special Reference to Insects*. John Wiley & Sons, New York.  
Carpenter, F. M. 1992. *Reatise on Invertebrate Paleontology. Part R. Arthropoda 4. Volumes 3 & 4: Superclass Hexapoda*.  
Gupta, A. P. 1979. *Arthropod phylogeny*. Van Nostrand Reinhard, New York.  
Hennig, W. 1981. *Insect phylogeny*. 514 pp. Wiley: Chichester. (An English translation of Hennig, W. 1969. *Die Stammesgeschichte der Insekten*. Waldemar Kramer: Frankfurt am Main. 436 pp.)  
Kristensen, N. P. 1991. *Phylogeny of Extant Hexapods*. Pp. 125-140 in *The Insects of Australia*, I. D. Naumann, chief ed. 2nd edition. Melbourne University Press. Vol. 1.  
Kukalova-Peck, J. 1991. *Fossil History and the Evolution of Hexapod Structures*. Pp. 141-179 in *The Insects of Australia*, I. D. Naumann, chief ed. 2nd edition. Melbourne University Press. Vol. 1.  
Rohdendorf, B. B. 1991. *Fundamentals of Paleontology. Volume 9: Arthropoda, Tracheata, Chelicerata*. Smithsonian Institution, Washington, DC. (an English translation of the Russian work: Rohdendorf, B. B. 1962. *Osnovy Paleontologii*. Volume 9)

**Prerequisites:** One semester of insect or invertebrate zoology

**Corequisites:** None

**Helpful:** Introductory coursework in entomological taxonomy

<b>Grading</b>	<b>%</b>
Lecture Exams (2) .....	30
Lecture Final.....	25
Discussion / Presentations (2) .....	15
Term Paper (preliminary [33%] & final [67%]) .....	30
<b>Total</b>	<b>100</b>

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### **Midterm and Final Exams**

The two "midterm" exams and the final exam will be take-home, essay-style exams. You will have 2 weeks to complete each exam. Expect to do some reading and synthesis for each exam. For each exam, expect to write three two-page essays from a selection of 5-6 essay questions.

### **Discussion / Presentations / Panel Debates**

Discussion / Presentations: Each student will be responsible for 2 discussion / presentations. Each will be the focus of one "special topic" period. For single-student-led presentations, the lead student will (1) select and sign-up for a particular topic with the instructor, (2) with the instructor, select one or two appropriate papers as class readings on the topic, (3) on the day assigned to that topic, make a 10-15 minute oral presentation on the topic based on the class readings and other materials consulted, (4) submit to the class and the instructor a written list of 8-10 thought-provoking questions about the topic and readings, and (5) lead a discussion of the topic based on the class readings and prepared question lists. Non-lead students will submit to the class and instructor a written list of 3-5 discussion questions based on the topic.

Some topics may be organized as "panel debates" in which alternate viewpoints are presented by different groups, followed by group discussion. If you have a topic that you think would be amenable to this format, please let me know.

Grading will be based on the content of the oral presentation, evidence of synthesis and thought in preparing the question list and ability to stimulate and maintain the discussion.

### **Term Paper**

The term paper will be 10-15 pages long and will present a topic of entomological interest in a phylogenetic/evolutionary context. Students may choose to expand and develop one of their Discussion / Presentation topics into a term paper, or may select an entirely different topic. A preliminary version of the term paper will be submitted near mid term for instructor and fellow-student comments. The draft will be graded by the instructor based on student and instructor comments, and will count for 1/3 of the term paper grade. The final version of the paper, with additions, corrections and modifications, will be graded solely by the instructor, will count for 2/3 of the term paper grade, and will be due near the end of the semester. The final draft of the version must be presented in the form of a manuscript to be submitted to a journal identified by the student, and accompanied by a copy of the "instructions to authors" for that journal.

Grading will be based primarily on evidence that the student has reviewed the major literature relevant to the topic, has synthesized the facts and ideas relevant to the topic, and has shown evidence of critical thinking and the extension of published ideas and/or data. The presentation of the paper in terms of format, spelling, referencing, adherence to journal requirements and other "mechanical" elements of writing will count for a portion of the grade.

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### A List of Some Possible Discussion, Lecture and Term Paper Topics

#### **Evolution of Individual Character Systems (character view)**

Investigate the origins, functions, variation, evolutionary significance and phylogenetic/taxonomic distribution of specific characters or character systems

- Sound production (stridulation, tremulation)
- Sound reception (tympana, subgenual receptors)
- Modes of locomotion (gressorial, cursorial, saltatorial, natatorial, aerial, "jet" propulsion)
- Hexapod leg configuration (evolution, function and significance)
- Insemination mechanisms (indirect and direct spermatophore transfer, direct insemination)
- Fertilization mechanisms (sperm storage, fertilization "plumbing", fertilization choice)
- Oviposition (form and function of ovipositors)
- Mouthpart specializations (chewing, sucking, "lapping")
- Gills (flattened plates, tubes, plastrons)
- Antennae (morphological forms, sensory types)
- Gland systems (reproductive, communication, defensive, physiological)
- Eggs (kinds and taxonomic distribution of specializations, origin)
- Cephalization (competing theories)
- Silk production (uses, differences in production)

#### **Microhabitat Specializations (microhabitat view)**

Investigate the origins, evolutionary significance and phylogenetic/taxonomic distribution of taxa characteristic of a specialized microhabitat, and the function and variation of characters that adapt them to that microhabitat

- Leaf rollers
- Leaf miners
- Leaf skeletonizers
- Wood borers
- Internal parasites
- Internal parasitoids
- External parasites
- Freshwater aquatics
- Marine & intertidal
- Water surface insects
- Aerial predators
- Subterranean taxa
- Myrmecophiles & termitophiles
- Cavernicolous
- Specialized predators

#### **Evolution of Life History Attributes (life history view)**

Investigate the phylogenetic/taxonomic distribution of taxa characterized by a particular life history attribute, and the origins, consequences and evolutionary significance of the attribute

- Predation
- Herbivory
- Parasitism
- Voltinism
- Number of instars
- Relative instar length
- Diapause
- Subsocial behavior
- Eusocial behavior
- Migratory behavior
- Oviposition type
- Allometry
- Mimicry

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### Miscellaneous Topics

- Plant / insect co-evolution (general, specific examples, taxonomic distribution, pollinators, sequestering of plant chemicals)
- Aquatic  $\leftrightarrow$  terrestrial transitions (number of independent origins, phylogenetic positions, "driving" forces)
- Extreme size (large or small, consequences)
- Parallel evolution of functionally similar morphological structures (raptorial legs, elongate slender legs, sucking mouthparts, loss or reduction of wings or other structures)
- Insects as architects (cocoon, nests, retreats, food capture, purpose and nature of structures, taxonomic distribution)
- Mechanisms of dispersal (flight, aerial plankton, phoresy, leg-powered)
- Effects of climatic and geological factors on hexapod phylogeny and evolution (glaciation, plate tectonics, mountain building, etc.)

### Student Topics from Earlier Years

- Mimicry in the Hymenoptera, in particular its asocial and phylogenetic aspects.
- The evolution of complete metamorphosis in insects.
- Origins of parasitism in the orders Diptera and Hymenoptera.
- Evolution and adaptation of insects to the freshwater aquatic environment.

### Course Coverage

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This course will review current and historical ideas about the **phylogeny and evolution of the major groups of hexapods** (in general to ordinal or subordinal level). The evidential basis for **hypotheses of monophyly** of individual clades will be a major theme. Competing phylogenetic hypotheses will be presented where substantial disagreement exists. Overlain on this taxonomic organization will be a specific focus on the **major innovations** and "trends" that appear to have significantly affected the adaptive radiations of specific taxa. **Morphological character** systems will be emphasized; however, other characters, such as physiological, life history and behavioral traits will be treated where relevant. The **fossil record** of insects will be treated and an attempt will be made to place extant taxa within the broader context of their presumed fossil ancestors. The history of **insect classification** and the major **character systems** that have been employed will be reviewed. The materials presented in this class will be of particular interest to students of systematic entomology, but should also be of interest to a broader cross section of students interested in the evolutionary history of the major groups of animals.

### Americans with Disabilities Act (ADA) Policy Statement

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The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Department of Student Life, Services for Students with Disabilities, in Room 126 of the Koldus Building or call 845-1637.

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**Academic Integrity Statement**

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“An Aggie does not lie, cheat, or steal or tolerate those who do.” For more on the Aggie Honor Code, link to: <http://www.tamu.edu/aggiehonor>.

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### Lecture Schedule\*

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#### JANUARY

week	days	lects	topics
1	19-21	1-2	(WF) Introduction (1); Hexapod Origins (1)
2	24-26	3-4	(MF) Hexapod Origins
	26		(W) <b>Special Topic #1</b>
3	31	5	(M) Entognathous Hexapod Orders (1)

#### FEBRUARY

3	4	6	(F) Apterygote Insect Orders (1)
	2		(W) <b>Special Topic #2</b>
4	7-11	7-8	(MF) Apterygote Insect Orders
	9		(W) <b>Special Topic #3</b>
5	14-18	9-10	(MF) Pterygota Origins; Palaeopterous Insect Orders (1)
	14		(M) <b>Lecture Exam I Assigned</b>
	16		(W) <b>Special Topic #4</b>
6	21-25	11-13	(MWF) Palaeopterous Insect Orders
	25		(F) <b>Lecture Exam I Due</b>
7	28	14	(M) Basic Neopteran Groupings

#### MARCH

7	4	15	(F) Blattoid assemblage orders
	2		(W) <b>Special Topic #5</b>
8	7-11	16-18	(MWF) Orthopteroide assemblage orders (2); Hemipteroide assemblage orders
	11		(F) <b><u>Term Paper Due (Preliminary Draft)</u></b>
9	14-18		(MWF) <b>Spring Break – No class</b>
10	21-25	19-20	(MF) Basic Endopterygote Groupings
	21		(M) <b>Lecture Exam II Assigned</b>
	23		(W) <b>Special Topic #6</b>
11	28	21	(M) Coleoptera
	20		(W) <b>Special Topic #7</b>

#### APRIL

11	1	22	(F) Neuroptera
	1		(F) <b>Lecture Exam II Due</b>
12	4-8	23-24	(M) Hymenoptera (HYME)
	6		(W) <b>Special Topic #8</b>
13	11-15	25-26	(MF) Mecoptera
	13		(W) <b>Special Topic #9</b>
14	18-22	27-28	(MF) Antliophora (MECO, SIPH, DIPT)
	18		(M) <b>Final Exam Assigned; <u>Term Paper Due (Final Draft)</u></b>
	20		(W) <b>Special Topic #10</b>
15	25-29	29-31	(MWF) Amphiesmenoptera (TRIC, LEPI)

#### MAY

	2	32	(U) Amphiesmenoptera (TRIC, LEPI); <b>Last Day of Lecture</b>
	6		(F) <b>Final Exam Due</b>