

Entomology 612

Insect Evolution

Basic Course Information

- Instructor:** Dr. John D. Oswald, Professor & Curator, Department of Entomology
Office: 216A Heep Center (inside Heep 216, the main Insect Collection room)
Phone: 979-862-3507
E-Mail: j-oswald@tamu.edu
- Credits:** 3
Offered: Spring semester (alternate years or as requested)
- Lecture/Discussion:** Lecture: TBA
Topic Discussion: TBA
- Web Site:** <http://insevol.tamu.edu>
- Lab:** None
- Textbook:** Grimaldi, D.; Engel, M. S. 2005. *Evolution of the Insects*. Cambridge University Press, Cambridge.
- Reference Texts:** Rasnitsyn, A. P.; Quicke, D. L. J. (eds.). 2002. *History of Insects*. Kluwer Academic Publishers, Dordrecht. xii + 517 pp.
Carpenter, F. M. 1992. *Treatise on Invertebrate Paleontology*. Part R. Arthropoda 4. Volumes 3 & 4: Superclass Hexapoda.
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)
Hennig, W. 1981. *Insect phylogeny*. 514 pp. Wiley: Chichester. (An English translation of Hennig, W. 1969. *Die Stammesgeschichte der Insekten*. Waldermar Kramer: Frankfurt am Main. 436 pp.)
Boudreaux, H. B. 1979. *Arthropod Phylogeny with Special Reference to Insects*. John Wiley & Sons, New York.
Gupta, A. P. 1979. *Arthropod phylogeny*. Van Nostrand Reinhard, New York.
- Prerequisites:** One semester of insect or invertebrate zoology
Corequisites: None
Helpful: Introductory coursework in entomological taxonomy

Grading	%
Lecture Exams (2).....	30
Lecture Final	25
Discussion / Presentations (2).....	15
Term Paper (“Review version” [33%] & “Final version” [67%]).....	30
Total	100

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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 between 1 and 2 weeks to complete each exam (specific assignment and due dates will be announced in class). Expect to do external reading and synthesis for each exam. For each exam, expect to write three 2-3 page essays from a selection of ca. 4-6 essay questions.

“Special Topic” Discussion / Presentations / Panel Debates

Discussion / Presentations: Each student will be responsible for 2 “special topic” discussion / presentation sessions. For each “special topic”, the lead student will (1) identify one or two papers on a special topic in insect evolution for class readings [ca. 15-25 total pages], (2) obtain instructor approval of the topic and readings, (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 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. The lead student is expected to have read more than just the assigned papers in order to prepare, and should have a good general knowledge of the topic that will allow him/her to lead a spirited and informative discussion. Non-lead students will submit to the class and instructor a written list of 5 thought-provoking discussion questions based on the topic. These questions may be related to the assigned reading(s), or address general issues associated with the general topic under discussion.

As appropriate, 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 questions and lead student’s 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 “review version” of the term paper will be submitted near mid term for instructor AND classmate comment. *The “review version” should be complete, i.e. without missing text or illustrations. It should be fully researched and professionally written.* It is not an “idea draft”. Consider the “review version” to be the version of your paper that you would provide to a colleague for review and comment prior to submitting it for publication. The “review version” 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 suggested by the reviewers, will be graded solely by the instructor, and will count for 2/3 of the term paper grade. The “final version” will be due near the end of the semester. The “final version” must be presented in the form of a manuscript to be submitted to a journal identified by the student. A copy of the “instructions to authors” for that journal must be submitted with the “final version”, and this version must fully comply with those instructions for formatting, layout, and other matters contained in the “instructions to authors”.

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. Papers should also identify and discuss areas where additional data, analyses, theoretical or analytical

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developments, etc. would be helpful in advancing future research on the topic. 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 and specializations (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 (cocoons, nests, retreats, food capture, purpose and nature of structures, taxonomic distribution)
- Mechanisms of dispersal (flight, aerial plankton, phorecy, leg-powered)
- Effects of climatic and geological factors on hexapod phylogeny and evolution (glaciation, plate tectonics, mountain building, etc.)

Some Student Paper Topics from Previous Years

- Mimicry in the Hymenoptera
- Origin of parasitism in the Diptera and Hymenoptera
- The evolution of complete metamorphosis in insects
- Evolution and adaptation of insects to the freshwater aquatic environment
- Evolution and advantages of haustellate mouthparts
- Comparative morphology and evolution of the hymenopteran ovipositor
- Origins and functions of bioluminescence in hexapods
- Acoustic evolution in crickets
- Insect life cycle evolution
- Evolution of insect-fungus associations
- Untrastructure of attachment specializations of hexapods
- Loss and recovery of wings in stick insects
- Flightless in insects
- Evolution of maternal care in treehoppers
- Use of caddisfly cases in inferring Trichoptera phylogeny

Course Coverage

Insect Evolution examines hexapod evolution from two historical perspectives. One thread traces the evolution of selected arthropod groups through the fossil record from the Cambrian to the Cretaceous. This thread emphasizes the origin and diversity of important arthropod groups and discusses them within the context of some of the broader environmental processes and events that have influenced their development and diversity over deep time, including plate tectonics, mass extinctions, and their parallel evolution with plants and vertebrates.

The second thread focuses on the phylogeny of the orders of hexapods. This thread emphasizes the relative relationships that are thought to exist among the major groups of insects and related hexapod groups. Long an area of substantial disagreements, multiple hypotheses are examined for many parts of this phylogeny, based on morphological and molecular evidence. Putative morphological synapomorphies are identified for most supra-ordinal clades, and the implications

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of many of these traits are discussed relative to the subsequent diversification and radiation of those groups.

Insect Evolution is designed to provide a solid grounding in the evolutionary history of insects and related hexapod groups and is appropriate for all graduate-level biologists (not just entomologists) who have an interest in the evolution and phylogeny of major animal groups.

Americans with Disabilities Act (ADA) Policy Statement

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.

Academic Integrity Statement

“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>.

Copyright

The handouts used in this course are copyrighted. By “handouts” I mean all materials generated for this class, which include but are not limited to syllabi, quizzes, exams, lab problems, in-class materials, review sheets and additional problem sets. Because these materials are copyrighted, you do not have the right to copy them unless I expressly grant permission.

Plagiarism

As commonly defined, plagiarism consists of passing off as one’s own the ideas, words, writings, etc. which belong to another person. In accordance with this definition, you are committing plagiarism if you copy the work of another person and turn it in as your own, even if you have the permission of that person. Plagiarism is one of the worst academic sins because plagiarists destroy the trust among colleagues that is needed to safely communicate research.

If you have any questions regarding plagiarism, please consult the latest issue of the Texas A&M University Student Rules (<http://student-rules.tamu.edu/>), under the section “Scholastic Dishonesty”.

Teaching Laboratory Safety

The Department of Entomology is committed to the safety of all students and employees participating in teaching laboratories. To ensure that a safe environment is maintained in our teaching laboratories, it is expected that all students will adhere to general safety guidelines and emergency procedures, as well as course-specific and activity-specific safety instructions provided by faculty and teaching assistants. Laboratory safety and emergency procedures will be reviewed during the first class period and you will be asked to sign your acknowledgement of these instructions before attending further classes in this course.

The schedules and procedures in this syllabus are subject to minor changes in the event of extenuating circumstances.

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Lecture Schedule*

JANUARY

week	day	lec	topic
1	14 U	1	Introduction to Course
	16 H	2	History of Life - Cryptozoic
2	21 U	3	History of Life – Cambrian I
	TBA	4	Special Topic #1
	23 H	5	History of Life – Cambrian II
3	28 U	6	History of Life - Ordovician
	TBA	7	Special Topic #2
	30 H	8	History of Life - Silurian

FEBRUARY

4	4 U	9	History of Life - Devonian I	
	TBA	10	Special Topic #3	
	6 H	11	History of Life - Devonian II	
5	11 U	12	History of Life – Carboniferous I	<u>Exam I Assigned</u>
	TBA	13	Special Topic #4	
	13 H	14	History of Life – Carboniferous II	
6	18 U	15	History of Life – Permian I	
	TBA	16	Special Topic #5	
	20 H	17	History of Life – Permian II	<u>Exam I Due</u>
7	25 U	18	History of Life – Mesozoic I	
	TBA	19	Special Topic #6	
	27 H	20	History of Life – Mesozoic II	

MARCH

8	4 U	21	History of Life – Mesozoic III	
	TBA	22	Special Topic #7	
	6 H	23	Hexapod Origins	<i>Term Paper Due (“revision version”)</i>
9	11 U	--	Spring Break – No class	
	TBA	--	Spring Break – No class (contemplate the evolution of insects ... !)	
	13 H	--	Spring Break – No class	
10	18 U	24	Entognathous Hexapod Orders	<u>Exam II Assigned</u>
	TBA	25	Special Topic #8	
	20 H		Reading Day – No class	
11	25 U	26	Apterygote Orders	
	TBA	27	Special Topic #9	
	27 H	28	Pterygota Origins	<u>Exam II Due</u>

APRIL

12	1 U	29	Palaeopterous Insect Orders
	TBA	30	Special Topic #10
	3 H	31	Basic Neopteran Groupings
13	8 U	32	Blattoid Assemblage Orders
	TBA	33	Special Topic #11
	10 H	34	Orthopteroid Assemblage Orders

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14	15 U	35	Hemipteroid Assemblage Orders	
	TBA	36	Special Topic #12	
	17 H	37	Basic Endopterygote Groupings	<i>Term Paper Due ("final version")</i>
15	22 U	38	Endopterygota I	<u>Final Exam Assigned</u>
	TBA	39	Special Topic #13	
	24 H	40	Endopterygota II	
16	29 U	41	Endopterygota III	
MAY				
	1 H	--	Reading Day – No class	
17	6 W	--	Final Exam Due	<u>Final Exam Due</u>

* Changes to this schedule may be required during the semester.