

Entomology 602

Insect Biodiversity and Biology

Basic Course Information

Instructor: Dr. John D. Oswald, Professor & Curator, Department of Entomology

Office: 216A Heep Center (inside Heep 216, the Insect Collection room)

Contacts: j-oswald@tamu.edu; 979-862-3507 (office phone); 979-845-6305 (fax)

Office Hours: None specifically scheduled, feel free to come see me anytime.

602 Lecture: MWF 11:30 to 12:20 (205 Heep Center) (computers: user: _____; pass: _____)

602 Lab: W 1:50 to 4:40 (205/210 Heep Center)

Lab TA: Ana Dal Molin

Required Text: Triplehorn, C. A.; Johnson, N. F. 2005. *An Introduction to the Study of Insects*. 7th Edition. Thomson Brooks/Cole, Belmont, CA. (earlier editions are not acceptable because the keys have been updated for the 7th edition)

Web Site: <http://biodivgrad.tamu.edu>

Optional: **Lecture Outlines** (Synoptic outlines of many of the course lectures are available. I recommend that you take a look at these outlines to see if they might help you organize your lecture notes. The outlines can be downloaded from the course web site and printed as needed.)

Habitat Guide (This guide contains a list of all of the insect families that are known to occur in America north of Mexico, with indications of which ones are found in Texas, and general information on where to find them and how to collect them. This document contains some subtle shading in a large table, so it doesn't photocopy well. You should download a copy of the pdf version of this file from the course website if you think it would be useful for you.)

Prerequisites: 6 hours of biological sciences

Corequisites: None

Course Objectives

Insect Biodiversity and Biology provides an introduction to the orders and most important families of insects. Lectures cover the morphology unique to each order and the biology, natural history, and synoptic features of selected families. Laboratories emphasize identification of orders and selected families. A collection of insects identified to the family level provides an introduction to the methods of collecting and preparing insect specimens, additional practice in insect identification, and opportunities to associate insect groups with their habitats in the field.

After completing this class you should ...

- be able to sight identify all 31 insect orders and approximately 175 of the 700 families of North American insects (most of these families are worldwide in distribution)
- be able to key to family level almost any North American insect
- know the basic biologies of approximately 150 North American insect families
- know in general where to find these families in the field, and the most appropriate method(s) to use to collect them
- be able to properly preserve and prepare insects for scientific study and research vouchering

Course Emphases

LECTURE

- Morphological fundamentals of insect orders
- Insect biologies, life histories, behaviors, habitats, etc.
- Insect classification, diagnostic characters and taxon names

LAB

- Insect identification (“by sight” and “by key”)
- Diagnostic traits of selected insect families
- Insect collecting methods and techniques
- Insect preservation, mounting, and labeling methods and techniques

Grading Point System

	points	points	%	%
Lecture Exams	450		53	
Exams (3 @ 100 points each)		300		35
Lecture Final (comprehensive)		150		18
Lab Exams	255		28	
Quizzes (11 @ 5 points each)		55		4
Exams (2 @ 50 points each)		100		12
Lab Final (comprehensive)		100		12
Insect Collection	154		18	
Insect Collection Preview		14		2
Insect Collection		*140		16
	859=	859	100 =	100

* The Insect Collection is open-ended – it has no fixed maximum point value. An “A” collection will typically contain 126-140 (or more) points. For detailed information on how collection points are calculated see the Insect Collection Grading Sheet in the Collection Guide.

Letter Grades*

A (90-100%); B (80-<90%); C (70-<80%); D (60-<70%); F (<60%)

* Students meeting these percentiles are guaranteed the indicated grade. The instructor reserves the right to lower the percentiles required to achieve each grade.

Exams

- Regular semester lecture exams will emphasize previously untested material – that is, although they are not intended to be fully comprehensive, they may contain minor elements from previously tested material; lab exams will be at least partially comprehensive.
- Finals will be comprehensive.
- Lab material may, but will not typically, be tested in lecture exams, and vice versa (though there is quite a bit of natural overlap...).
- Make-up exams will be possible only under very exceptional circumstances.
- Lecture and lab exams cover, almost exclusively, information actually covered in lectures and labs (as opposed to readings from assigned texts...), so attend all lectures and labs.

- Several sample lecture exams are posted on the course web site. Use these to see the kinds of questions that will be on the exams. Typical question types include: fill-in-the-blank, short answer, essay, essay correction, labeling, and diagramming.
- Lab exam emphasis will be on sight identification, keying and structure and function recognition.
- Lab quizzes will consist of several (ca. 5) questions, typically emphasizing identification and structure and function recognition.

Attendance Policy

- I may call roll until I learn the names of all the students in the class. I expect all students to attend all lectures and labs. The course moves at a rapid pace and failure to attend lectures and labs will cause one to fall behind very rapidly.
- There is no assigned seating.
- Student rules governing class attendance can be found on the Texas A&M University web site under Student Rules at <http://student-rules.tamu.edu/>. **Make-up exams in Entomology 602 lab and lecture will only be given under EXCEPTIONAL circumstances.** If you think your circumstances are exceptional, please discuss them with me.

Only the following absences are considered excused by Texas A&M University:

- Participation in an activity appearing on the university authorized activity list (see <http://studentactivities.tamu.edu/stuactweb/submainpages/authsponmain.htm>).
- Death or major illness in a student's immediate family. Immediate family may include: mother, father, sister, brother, grandparents, spouse, child, spouse's child, spouse's parents, spouse's grandparents, stepmother, step-father, step-sister, step-brother, step-grandparents, grandchild, step-grandchild, legal guardian, and others as deemed appropriate by faculty member or student's academic dean.
- Illness of a dependent family member.
- Participation in legal proceedings or administrative procedures that require a student's presence.
- Religious holy days (see <http://student-rules.tamu.edu/append4.htm>).
- Illness that is too severe or contagious for the student to attend class (to be determined by Health Center or off-campus physician).
- Required participation in military duties.
- Mandatory admission interviews for professional or graduate school, which cannot be rescheduled.

Class Etiquette

- Students are expected to be in their seats and prepared for lecture at the time scheduled for the start of class. Personal conversations should cease at this time.
- If a student must be late, please enter quietly and be seated as close to the door as possible.
- If you have reason to be late consistently, please discuss the reasons with the instructor and obtain approval.
- If a student is absent, the student remains responsible for all lecture or laboratory subjects discussed and materials provided during the period(s) of absence.
- Please turn off all cell phones or pagers before class starts.
- You are expected to be in laboratory classes for the entire lab period (2 hours and 50 minutes), except after lab exams.

Americans with Disabilities Act (ADA) Policy

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 118B of the Cain Hall or call 845-1637.

Academic Integrity

"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/>).

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 above schedules and procedures are subject to change in the event of extenuating circumstances.

Entomology 602

Insect Biodiversity and Biology

Lecture Schedule*

JANUARY

week	day	lec	topic
1	13 M	1	Introduction to Course
	15 W	1	Introduction to Hexapoda; Protura, Collembola
	17 F	2	Diplura, Microcoryphia, Thysanura
2	20 M	3	Martin Luther King Day, No class
	22 W	4	Ephemeroptera
	24 F	5	Odonata (I)
3	27 M	6	Odonata (II), Orthoptera (I)
	29 W	7	Orthoptera (II), Grylloblattodea
	31 F	8	Phasmatodea, Mantodea, Mantophasmatodea

FEBRUARY

4	3 M	9	Isoptera
	5 W	10	Lecture Exam I
	7 F	11	Blattodea, Dermaptera, Embiidina
5	10 M	12	Plecoptera, Zoraptera, Psocoptera
	12 W	13	Phthiraptera (Lab Exam I)
	14 F	14	Thysanoptera
6	17 M	16	Hemiptera I
	19 W	16	Hemiptera II
	21 F	17	Hemiptera III
7	24 M	18	Hemiptera IV
	26 W	19	Neuroptera I
	28 F	20	Neuroptera II

MARCH

8	3 M	21	Lecture Exam II
	5 W	22	Coleoptera I
	7 F	23	Coleoptera II
9	10 M	--	Spring Break – No class
	12 W	--	Spring Break – No class (!! Collect Lots of Insects !!)
	14 F	--	Spring Break – No class
10	17 M	24	Coleoptera III
	19 W	25	Coleoptera IV
	21 F	26	Coleoptera V
11	24 M	27	Strepsiptera
	26 W	28	Diptera I (Lab Exam II)
	28 F	29	Diptera II
12	31 M	30	Diptera III

APRIL

	2 W	31	Diptera IV
	4 F		Siphonaptera, Mecoptera
13	7 M	32	Hymenoptera I
	9 W	33	Lecture Exam III

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	11 F	34	Hymenoptera II
14	14 M	35	Hymenoptera III
	16 W	36	Hymenoptera IV
	18 F	37	Reading Day – No class
15	21 M	38	Trichoptera
	23 W	39	Lepidoptera I (Lab Final)
	25 F	40	Lepidoptera II
16	28 M	41	Lepidoptera III (Prep Day)
	29 U	42	Lepidoptera IV; Redefined day, attend Friday classes; Last day of lecture
	30 W	--	Reading Day – No class

MAY

17 7 W -- **Final Exam (10:30-12:30 Heep 205)**

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

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Insect Biodiversity and Biology

Laboratory Schedule*

January

- 15 W Lab 1 *Topics:* Introduction, Lab Equipment, Morphology Review, Keys and Keying
Taxa: Protura, Collembola, Diplura, Microcoryphia, Thysanura, Ephemeroptera
- 22 W Lab 2 *Topics:* Lab Kits, Collecting Methods, Pinning and Pointing
Taxa: Odonata, Orthoptera, Embiidina
- 29 W Lab 3 *Taxa:* Phasmatodea, Grylloblattodea, Dermaptera, Plecoptera, Zoraptera, Mantodea, Blattodea

February

- 5 W Lab 4 *Topics:* Spreading, Label Making
Taxa: Isoptera, Thysanoptera, Psocoptera, Phthiraptera
- 12 W Lab 5 **Lab Exam I** (covers Labs 1-4)
- 19 W Lab 6 *Taxa:* Hemiptera (I)
- 26 W Lab 7 *Taxa:* Hemiptera (II), Neuroptera

March

- 5 W Lab 8 *Taxa:* Strepsiptera, Coleoptera (I)
- 12 W ----- **Spring Break – No class**
- 19 W Lab 9 *Taxa:* Coleoptera (II), Siphonaptera, Mecoptera, Diptera (I)
- 26 W Lab 10 **Lab Exam II** (covers Labs 6-9, a few from Labs 1-4)

April

- 2 W Lab 11 *Taxa:* Diptera (II), Hymenoptera (I): **Insect Collection Preview due**
- 9 W Lab 12 *Taxa:* Hymenoptera (II)
- 16 W Lab 13 *Taxa:* Trichoptera, Lepidoptera
- 23 W Lab 14 **Final Lab Exam** (Comprehensive; ca. 50% labs 1-8, ca. 50% labs 10-13)
- 30 W **Insect Collections Due (5:00 PM in 205 Heep Center)**
(A penalty of up to 10% will be assessed for turning in your collection late.)
Lab Kit Returns Due (5:00 PM in 205 Heep Center)
(NOTE: Failure to clear the return of your Lab Kit materials with the Ento 602 TA before final grades are due at the registrar's office will result in an Incomplete for the course.)

May

* Minor changes to this schedule may be required during the semester.

List of Orders & Families to be Covered in Lab*

Lab #1 (12 families)

Protura

Eosentomidae [grad only]

Collembola

Hypogastruridae

Isotomidae

Sminthuridae

Diplura

Japygidae

Microcoryphia (=Archaeognatha)

Machilidae

Thysanura

Lepismatidae

Ephemeroptera

Baetidae [grad only]

Caenidae

Ephemeridae

Heptageniidae

Polymitarcyidae [grad only]

Lab #2 (15 families)

Odonata

Gomphidae

Aeshnidae

Libellulidae

Calopterygidae [grad only]

Lestidae [grad only]

Coenagrionidae

Orthoptera

Acrididae

Tetrigidae

Tridactylidae [grad only]

Stenopelmatidae [grad only]

Tettigoniidae

Gryllidae

Gryllotalpidae

Rhaphidophoridae

Embiidina

Anisembiidae

Lab #3 (13 families)

Phasmatodea

Pseudophasmatidae

Heteronemiidae [grad only]

Grylloblattodea

Grylloblattidae [grad only]

Dermaptera

Anisolabididae

Labiduridae

Forficulidae

Plecoptera

Perlidae

Nemouridae

Zoraptera

Zorotypidae [grad only]

Mantodea

Mantidae

Blattodea

Blattidae

Polyphagidae

Blattellidae

Lab #4 (13 families)

Isoptera

Rhinotermitidae

Termitidae

Psocoptera

Liposcelididae

Psocidae

Phthiraptera

Menoponidae

Phlopteridae [grad only]

Trichodectidae

Linognathidae [grad only]

Pediculidae

Phthiridae

Thysanoptera

Phlaeothripidae

Aeolothripidae [grad only]

Thripidae

Lab #5

First Lab Exam (Labs 1-4)

Lab #6 (18 families)

Preview Collection I Due

Hemiptera

Veliidae

Gerridae

Belostomatidae

Corixidae

Notonectidae [grad only]

Reduviidae

Miridae

Tingidae

Anthocoridae [grad only]

Cimicidae [grad only]

Pentatomidae

Scutelleridae

Berytidae [grad only]

Rhyparochromidae

Lygaeidae

Alydidae [grad only]

Coreidae

Cicadidae

List of Orders & Families to be Covered in Lab*

Lab #7 (17 families)

Hemiptera

Membracidae
Cicadellidae
Cercopidae
Delphacidae
Flatidae [grad only]
Psyllidae
Aleyrodidae
Aphididae
Pseudococcidae
various scale families [demo only]

Neuroptera

Corydalidae
Raphidiidae
Coniopterygidae [grad only]
Mantispidae
Hemerobiidae
Chrysopidae
Myrmeleontidae
Ascalaphidae [grad only]

Lab #8 (17 families)

Strepsiptera

Myrmecolacidae [g only]

Coleoptera

Carabidae
Gyrinidae
Dytiscidae
Hydrophilidae
Histeridae [grad only]
Silphidae [grad only]
Staphylinidae
Scarabaeidae
Buprestidae
Elateridae
Lampyridae
Cantharidae
Dermestidae
Cleridae
Coccinellidae
Mordellidae [grad only]

!! Spring Break !!

Lab #9 (16 families)

Preview Collection II Due

Coleoptera

Tenebrionidae
Meloidae
Cerambycidae
Chrysomelidae
Curculionidae

Siphonoptera

Pulicidae

Mecoptera

Panorpidae
Bittacidae [grad only]

Diptera

Tipulidae
Chironomidae
Culicidae
Simuliidae
Bibionidae [grad only]
Cecidomyiidae
Stratiomyidae [grad only]
Tabanidae

Lab #10

Second Lab Exam (mostly over Labs 6-9)

Lab #11 (18 families)

Diptera

Asilidae
Bombyliidae
Dolichopodidae
Syrphidae
Anthomyiidae [grad only]
Calliphoridae
Hippoboscidae
Muscidae
Sarcophagidae
Tachinidae
Tephritidae
Ulidiidae [grad only]
Sciomyzidae [grad only]
Chloropidae
Drosophilidae

Hymenoptera

Argidae [grad only]
Tenthredinidae
Siricidae [grad only]

List of Orders & Families to be Covered in Lab*

Lab #12 (17 families)

Hymenoptera

Evaniidae [grad only]
Braconidae
Ichneumonidae
Chalcididae
Cynipidae
Diapriidae
Chrysididae
Sphecidae
Halictidae
Megachilidae
Apidae
Tiphidae [grad only]
Mutillidae
Pompilidae
Scoliidae [grad only]
Vespidae
Formicidae

Lab #13 (17 families)

Preview Collection III Due

Trichoptera

Hydropsychidae
Leptoceridae

Lepidoptera

Yponomeutidae [grad only]
Sesiidae [grad only]
Tortricidae
Pterophoridae [grad only]
Pyralidae
Hesperiidae
Papilionidae
Pieridae
Lycaenidae
Nymphalidae
Geometridae
Saturniidae
Sphingidae
Noctuidae
Arctiidae

Lab #14

Final Lab Exam (comprehensive)

* Minor changes to this schedule may be required during the semester.

Entomology 602

Insect Biodiversity and Biology

You are responsible for knowing all of the scientific and “common” names on the following taxon list, together with any others discussed in lecture. Use the following list as a study guide to help learn the names of most of the taxa that will be treated in lecture and lab. The stressed syllable of scientific names is accented (after Borrer et al. 1989). Acute accents (á, é, í, ó, ú, ý) indicate soft vowels, grave accents (à, è, ì, ò, ù) indicate hard vowels.

Scientific & “Common” Names List

Order (approx. # Nearctic species)		Textbook
Suborder / Superfamily		Chapter page
Family	“Common” name	
Protùra (73)	proturans	7 169
Eosentómidae	“ (or eosentomids)	“ 170
Collémbola (820)	springtails	7 169
Hypogastrùridae	elongate-bodied springtails	“ 172
Isotómidae	smooth springtails	“ 172
Entomobryidae	slender springtails	“ 172
Sminthùridae	globular-bodied springtails	“ 172
Diplùra (125)	diplurans	7 169
Japýgidae	earwig-like diplurans	“ 175
Microcorýphia (24)	jumping bristletails	8 177
Machílidae	rock bristletails	“ 179
Thysanùra (20)	thysanurans	8 177
Nicoletiidae	nicoletiids	“ 190
Lepismátidae	silverfish and firebrats	“ 179
Ephemeróptera (600)	mayflies	9 181
Baètidae	small minnow mayflies	“ 190
Caènidae	small squaregill mayflies	“ 190
Epheméridae	common burrowing mayflies	“ 190
Heptageniidae	flatheaded mayflies	“ 190
Polymitarcyidae	pale burrowing mayflies	“ 191
Odonàta (440)	-----	10 193
Gómphidae	clubtails	“ 202
Aéshnidae	darners	“ 203
Libellùlidae	common skimmers	“ 203
Calopterygidae	broad-winged damselflies	“ 205
Léstidae	spread-winged damselflies	“ 205
Coenagriónidae	narrow-winged damselflies or pond damsels	“ 205
Orthóptera (1210)	orthopterans	11 209
Acrídidae	short-horned grasshoppers	“ 215
Tetrígidae	pygmy grasshoppers	“ 218
Tridactylidae	pygmy mole crickets	“ 218
Stenopelmatidae	Jerusalem crickets	“ 218
Rhaphidophoridae	cave and camel crickets	“ 218
Tettigoniidae	long-horned grasshoppers	“ 219
Gryllidae	crickets	“ 223
Gryllotalpidae	mole crickets	“ 225
Phásmatodea (33)	walkingsticks, leaf insects	12 227
Pseudophasmatidae	striped walkingsticks	“ 228
Heteronemiidae	common walkingsticks	“ 228
Grylloblattodea (10)	rock crawlers	13 230
Gryllobláttidae	rock crawlers	“ 230
Mantophasmatodea (0)	mantophasmatids	14 232
Mantophasmatidae	mantophasmatids	“ 232

Family List (continued)

Order (# Nearctic species)	Suborder / Superfamily	Family	“Common” name	Textbook Chapter page
Dermáptera (23)			earwigs	15 234
		Anisolabididae	seaside & ring-legged earwigs	“ 236
		Labidùridae	striped earwigs	“ 237
		Forficùlidae	European and spine-tailed earwigs	“ 237
Plecóptera (630)			stoneflies	16 239
		Nemoùridae	spring stoneflies	“ 244
		Pérlidae	common stoneflies	“ 245
Embiidìna (11)			web-spinners	17 247
		Anisembiidae	web-spinners	“ 248
Zoráptera (2)			angel insects	18 250
		Zorotýpidae	angel insects	“ 250
Isóptera (44)			termites	19 252
		Rhinotermítidae	subterranean termites	“ 256
		Termítidae	desert termites	“ 257
Mantòdea (30)			mantids	20 260
		Mántidae	mantids	“ 260
Blattodea (67)			cockroaches	21 263
		Bláttidae	American cockroaches	“ 265
		Polyphágidae	desert cockroaches	“ 265
		Blattéllidae	German cockroaches	“ 266
Hemiptera (11,300)			-----	22 268
		Heteroptera	[true] bugs	
		Veliidae	riffle bugs	“ 293
		Gérridae	water striders	“ 293
		Belostomátidae	giant water bugs	“ 289
		Coríxidae	water boatmen	“ 290
		Notonéctidae	backswimmers	“ 291
		Reduviidae	assassin & ambush bugs, etc.	“ 296
		Míridae	plant bugs	“ 294
		Tíngidae	lace bugs	“ 293
		Nàbidae	damsel bugs	“ 294
		Anthocòridae	minute pirate bugs	“ 296
		Cimícidae	bed bugs	“ 296
		Aradidae	flat bugs	“ 298
		Pentatómidae	stink bugs	“ 302
		Scutelléridae	shield-backed bugs	“ 302
		Berýtidae	stilt bugs	“ 298
		Lygaèidae	seed bugs	“ 299
		Alydidae	broad-headed bugs	“ 301
		Corèidae	squash & leaf-footed bugs	“ 301
		Auchenorrhýncha	-----	
		Cicàdidae	cicadas	“ 305
		Membràcidae	treehoppers	“ 305
		Cercópidae	frohoppers, spittlebugs	“ 309
		Cicadéllidae	leafhoppers	“ 310
		Delphácidae	delphacid planthoppers	“ 315
		Cixiidae	cixiid planthoppers	“ 316
		Flatidae	flatid planthoppers	“ 317
		Sternorrhýncha	-----	
		Psýllidae	psyllids or jumping plantlice	“ 317
		Aleyròdidae	whiteflies	“ 318
		Aphídidae	aphids or plantlice	“ 319
		Coccoidea	scales	“ 324
		Pseudocóccidae	mealybugs	“ 325

Family List (continued)

Order (# Nearctic species)

Suborder / Superfamily	Family	"Common" name	Lecture Covered?	Laboratory Covered? #	Textbook Chapter page	
Thysanóptera (700)		thrips (one or many!)			23 333	
	Phlaeothrípidae	tube-tailed thrips			" 339	
	Aeolothripidae	aeolothripid thrips			" 338	
	Thrípidae	common thrips			" 338	
Psocóptera (270)		booklice & barklice			24 341	
	Liposcèlididae	booklice			" 351	
	Psòcidae	common barklice			" 354	
Phthiráptera (950)		lice			25 356	
	Amblýcera	chewing lice				
	Menopónidae	poultry lice			" 361	
	Ischnócera	-----				
	Philopteridae	bird lice			" 361	
	Trichodéctidae	mammal-chewing lice			" 362	
	Anoplùra	sucking lice				
	Haematopinidae	haematopinids			" 362	
	Pedicùlidae	body lice			" 362	
	Pthíridae	pubic lice			" 363	
	Coleóptera (25,200)		beetles			26 365
		Adephaga	-----			
		Carabidae	ground beetles			" 401
Gyrinidae		whirligig beetles			" 403	
Dytiscidae		predaceous diving beetles			" 405	
Polyphaga		-----				
Hydrophilidae		water scavenger beetles			" 406	
Histeridae		clown beetles			" 407	
Silphidae		carrion beetles			" 408	
Staphylinidae		rove beetles			" 409	
Scarabaeidae		scarab beetles			" 412	
Buprestidae		metallic wood-boring beetles			" 417	
Elateridae		click beetles			" 422	
Lampyridae		lightningbugs, fireflies			" 423	
Cantharidae		soldier beetles			" 424	
Dermestidae		dermestid or skin beetles			" 424	
Anobiidae		death watch & spider beetles			" 427	
Trogossitidae		bark-gnawing beetles			" 428	
Cleridae		checkered beetles			" 428	
Nitidulidae		sap beetles			" 430	
Coccinellidae		ladybird beetles			" 433	
Tenebrionidae		darkling beetles			" 436	
Meloidae		blister beetles			" 438	
Cerambycidae		long-horned beetles			" 441	
Chrysomelidae		leaf beetles			" 445	
Curculionidae		snout beetles, true weevils			" 453	

Family List (continued)

Order (# Nearctic species)

Suborder / Superfamily	Family	"Common" name	Textbook	
			Chapter	page
Neuróptera (400)		----	27	469
	Megaloptera	----		
	Sialidae	alderflies	“	474
	Corydalidae	dobsonflies & fishflies	“	475
	Raphidioptera	snakeflies		
	Raphidiidae	snakeflies	“	476
	Planipennia	lacewings, antlions & owlflies		
	Coniopterygidae	dustywings	“	476
	Mantispidae	mantisflies	“	477
	Hemerobiidae	brown lacewings	“	477
	Chrysopidae	green lacewings	“	477
	Myrmeleontidae	antlions	“	478
	Ascalaphidae	owlflies	“	479
Hymenóptera (20,400)		ants, bees & wasps	28	481
	Symphyla	----		
	Argidae	argid sawflies	“	517
	Tenthredinidae	common sawflies	“	517
	Siricidae	horntails	“	518
	Apocrita	----		
	Evaniidae	ensign wasps	“	522
	Braconidae	braconid wasps	“	522
	Ichneumonidae	ichneumonid wasps	“	523
	Chalcididae	chalcidid wasps	“	533
	Cynipidae	gall wasps	“	534
	Diapriidae	diapriid wasps	“	536
	Scelionidae	scelionid wasps	“	537
	Chrysididae	cuckoo wasps	“	537
	Sphecidae	sphecid wasps	“	539
	Halictidae	halictid bees	“	543
	Megachilidae	leaf-cutting bees	“	544
	Apidae	apid bees	“	545
	Tiphidae	tiphiid wasps	“	547
	Mutillidae	velvetants	“	548
	Pompilidae	spider wasps	“	549
	Vespidae	paper wasps, yellow jackets, hornets, etc.	“	549
	Formicidae	ants	“	552
Trichóptera (1450)		caddisflies	29	558
	Hydropsychidae	net-spinning caddisflies	“	566
	Hydroptilidae	microcaddisflies	“	567
	Leptoceridae	long-horned caddisflies	“	569
Lepidóptera (11,700)		butterflies & moths	30	571
	Yponomeutidae	yponomeutid moths	“	607
	Gelechiidae	gelechiid moths	“	610
	Sesiidae	clearwing moths	“	612
	Cossidae	carpenter and leopard moths	“	613
	Tortricidae	tortricid moths	“	613
	Pterophoridae	plume moths	“	616
	Pyralidae	pyralid moths	“	617
	Hesperiidae	skippers	“	619
	Papilionidae	swallowtails & parnassians	“	620
	Pieridae	whites, sulphurs & orange-tips	“	621
	Lycaenidae	coppers, hairstreaks, blues & metalmarks	“	622
	Nymphalidae	brush-footed butterflies	“	623

Family List (continued)

Order (# Nearctic species)

Suborder / Superfamily	Family	"Common" name	Textbook Chapter page
Lepidóptera (continued)		butterflies & moths	30 571
	Geometridae	measuringworms, loopers	" 628
	Saturniidae	giant silkworm moths	" 631
	Sphingidae	sphinx or hawk moths	" 634
	Noctuidae	noctuid moths	" 636
	Arctiidae	arctiid moths	" 640
Siphonáptera (320)		fleas	31 648
	Pulicidae	pulcid fleas	" 659
Mecóptera (83)		scorpionflies	32 662
	Panorpidae	common scorpionflies	" 666
	Bittacidae	hangingflies	" 666
Strepsíptera (91)		twisted-wing parasites	33 669
	Halictophagidae		"
Díptera (19,800)		flies	34 672
	Nematocera	long-horned flies	" 707
	Tipulidae	crane flies	" 707
	Chironomidae	midges	" 709
	Culicidae	mosquitoes	" 710
	Simuliidae	black flies	" 714
	Bibionidae	march flies	" 715
	Cecidomyiidae	gall midges or gall gnats	" 716
	Brachycera	short-horned flies	" 719
	Stratiomyidae	soldier flies	" 719
	Tabanidae	horse & deer flies	" 720
	Asilidae	robber & grass flies	" 723
	Bombyliidae	bee flies	" 724
	Empididae	dance flies	" 725
	Dolichopodidae	long-legged flies	" 726
	Syrphidae	hover or flower flies	" 728
	Calypterae	calypterate muscoid flies	" 728
	Anthomyiidae	anthomyiid flies	" 729
	Calliphoridae	blow flies	" 729
	Hippoboscidae	louse and bat flies	" 731
	Muscidae	muscid flies	" 731
	Sarcophagidae	flesh flies	" 733
	Scathophagidae	dung flies	" 733
	Tachinidae	tachinid flies	" 734
	Acalypterae	acalypterate muscoid flies	" 734
	Tephritidae	fruit flies	" 737
	Sciomyzidae	marsh flies	" 739
	Drosophilidae	potato or small fruit flies	" 741
	Chloropidae	grass flies	" 741

There are approximately 96,000 known species of living insects and entognathous hexapods in America north of Mexico.