

## GENERAL ZOOLOGY (BIOLOGY 120): COURSE SYLLABUS

Instructor: Dr. Tupper

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See [website](#) for updates on office hours. It's best to make an appointment.



**COURSE DESCRIPTION AND GENERAL PURPOSE:** Presents basic biological principles, emphasizes structure, physiology, and evolutionary relationships of invertebrates and vertebrates. Lecture 3 hours ([in Bisdorf room 462](#)). Recitation and laboratory 3 hours ([in Bisdorf room 395](#)). Total 6 hours per week. This is a one-semester course for science majors, or nonmajors. In it, students are introduced to the evolution of animals from the Paleozoic to the present. Emphasis is placed on evolutionary relationships, anatomical and physiological characteristics of major phyla, and how they fit into their respective environments.

**REQUIRED TEXTS:** (1) Miller SA, Tupper TA. (2019) [Zoology](#), 11<sup>th</sup> Edition. McGraw Hill; Because the 11<sup>th</sup> edition is substantially different from the prior editions, it is required. (2) Alden P, Cassie B. 1999. [National Audubon Society Field Guide to the Mid-Atlantic](#), 1<sup>st</sup> Edition. Knopf. 0-679-44682-6. Available in the NVCC Alexandria bookstore, and on reserve in library.

**COMPETENCIES:** The student should be able to read and express him/herself both orally and in writing on a college freshman level as measured by a college English competency examination (ENG 111 or permission of instructor).

**EVALUATION:** Students will be graded according to the results of four hourly exams (totaling 700 points, three lab quizzes (300 points), labs and lab assignments (totaling 175 points), and lecture attendance (110 points). Your final grade will be based on the percent of points earned out of a possible of 1,285 points. Submission of all assignments is mandatory and must be turned in by the due dates. Lecture attendance is mandatory and is graded (5 points per lecture). You must be on time to receive full credit. Lecture exams will consist of multiple choice and short answer questions. The lab exam focuses on identification of animals by sight and sound, and the ability to identify internal and external features of vertebrates and invertebrates. The lab exam will include species listed in the table at the end of this document, and material covered in the laboratory and on the field trip. Lab attendance is mandatory and is graded. If you miss more than three labs (including the fieldtrip) you will receive a failing grade in the course. There are no make-up exams and there is no extra credit. I do not hand back and discuss exams. If you wish to do so, please make an appointment to see me and I will go over your exam results with you. The final exam is not cumulative.

**STUDENTS WITH SPECIAL NEEDS:** Students with physical disabilities who may require accommodations are encouraged to contact the college center for students with disabilities. Students with learning disabilities should contact [disability services](#). I cannot make accommodations unless I'm presented with the appropriate accommodations form.

**PLAGIARISM, ACADEMIC HONESTY AND CONDUCT:** At Northern Virginia Community College, we expect the highest standards of academic honesty. Academic dishonesty is prohibited in accordance with the Student Conduct, Rights and Responsibilities described in the [student handbook](#). NVCC's policies prohibits cheating on examinations, unauthorized access to examinations or course materials, plagiarism and other proscribed activities. Students that violate plagiarism and academic honesty codes will receive a failing grade and will be expelled from this course. If a student behaves in a hostile or disruptive manner, or presents any indication that he/she is a harm to themselves or others, a formal request for assistance to [NOVACARES](#) will be submitted, and the police may be contacted.

**CANCELLATION DAYS:** In the event of class/lab cancellation, we will resume where we left off during the next meeting. For example, if we were to have an exam scheduled on September 1, and it snowed, the exam would take place on our next scheduled meeting on September 7<sup>th</sup>.

**IMPORTANT DATES, AUDIT POLICY AND INCOMPLETES (EXTENSIONS):** For critical dates regarding refunds, withdraw, holidays, etc. click [here](#). Auditing this course requires instructor permission. Incompletes are only granted if the student's circumstances are dire (e.g. health issues, family issues, documented work conflict). Incompletes will only be granted if students have completed all lab assignments 3 lecture exams and 2 lab exams. Incompletes must be approved by the division dean and provost. Health claims must be documented by medical professionals. Final exam times are different than your normal class meeting time. They are posted below.

**HOW TO SUBMIT ASSIGNMENTS:** To submit assignments in blackboard, scroll to the bottom of the page and click on the, "view/complete assignments" tab that corresponds with the assignment that you want to submit. Attach the appropriate file and click, "submit". If for some reason your blackboard interface is different than mine, please contact me and we will figure out the problem together.

**COMMENTS ON SUBMITTING WORK:** Your work must (1) be free of common spelling errors and typos, and (2) contain one font only, please be consistent. If you cut and paste, clean it up before submitting. Use Times New Roman or similar font. Use only one color, black. When submitting work please label it as the following (as an attachment, use caps lock): LAST NAME\_ASSIGNMENT\_DATE. All written assignments must be proofed by the writing center staff before submission. They will provide you with verification that you were there. For assistance with writing contact staff at academic center for reading and writing:

1. Bisdorf room AA 229; 703-845-6363
2. writinghelp@nvcc.edu
3. [Writing Center Website](#)

**EMAILS AND DISCUSSION BOARD:** Please use proper English when composing emails and posting discussions. Please keep writing somewhat formal, free of slang and as grammatically correct as possible. Please address me in the emails as Dr. or Professor Tupper, not as 'hey.' It's fine to call me by my first name after the semester has ended. I will reply to your emails within 48 business hours from its sent time. There are times when I miss an email, or it gets sent to my junkbox. If you do not hear from me within 48 business hours, please just email me again. That said, I may not reply to your emails unless you ask me a specific question. You don't have to email me if you are going to be late to class, or if you are going to miss a class, or if you have missed class. Please do not email me asking for any logistics/instructions that I have explained in a previous class that you did not attend. For those types of questions, please use the discussion board, or ask your classmates. Additionally, please do not email me asking for extensions or to make up labs on your own time. However, please email me if you have questions about the course content or if you want to set up a time to meet and discuss some of the course content. I am more than happy to help you learn the material. Also, please email me if there are serious circumstances that are beyond your control that may need my attention (i.e. health or job related issues or conflicts that may result in a missed exam or prolonged absence from class). The majority of smaller and less serious questions can be answered by emailing a classmate, or by using the discussion board.

**INTRODUCTORY LETTER, GENERAL COMMENTS ON SUCCESS IN THIS COURSE, AND MISCELLANEOUS RULES:** Please write a brief statement and include something semi-personal about yourself, (e.g. a couple of hobbies/sports/major etc). Also let us know where (if) you work and how many hours you work per week. I am sure your classmates (myself as well) are interested to know a little about you. Also include your name, and what you preferred to be called. Post this on the discussion board and to the gradebook during the first week of the class. It's worth points.

Doing well in this course requires a substantial commitment. This course covers evolutionary hypotheses, systematics, taxonomy, anatomy and physiology. By nature, these topics are challenging. You need to set aside quite a bit of time for reviewing lecture notes, reading, and studying after and before every lecture. The lab material is also difficult and time consuming. You will likely need another couple of hours a week to learn the lab material as well (see Table 1 below). I expect citations in your papers to follow CSE ([Council of Scientific Editors](#)) citation guidelines. If citations do not follow these guidelines, then points will be deducted. There are no exceptions. A few last comments: please make use of the discussion board and become friendly with other students in the class. It helps calm anxieties about the course if you have some peer support. Be on time to class. I will lock the door 10 minutes after the start of lecture (and lab) and will not open the door until we break (or if I see you). Give yourself plenty of time to get to class. We all live in the DC metro area and understand that there is always traffic. Please do not knock while I am lecturing. If you are going to be more than 10 minutes late for lab, you will not be allowed to attend that lab session. Bring goggles with you to every lab, and wear close-toed shoes. Recording devices are not allowed for note taking purposes without my permission. I'd prefer that you take notes via pen and paper. For most people, seeing information, hearing information, and physically writing information is superior to computer use when it comes to getting the information into your short-term memory. So, get a notebook, and be prepared to write. Much of the lab includes dissection. Although the animals are not living, they lost their life so that we could learn. Handling the animals in a disrespectful and unprofessional manner will not be tolerated. If you are caught using the animals for anything other than dissection, you will be removed from the course and receive a failing grade.

## Tentative Lecture Schedule

(We may deviate from the schedule; I will notify you a week before each exam of the date; points per lecture are italicized at end of bullet topic)

### **UNIT I: INTRO MATERIAL & OVERVIEW, ORIGINS THE BASAL PHYLA**

- Course Intro, Overview, & Basal Phyla I (Chapters 1, 8 & 9)—Sept 4
  - \*Read the history of zoology document, and read chapter 1
- Basal Phyla II (Chapter 9) —Sept 9
- Exam I (175 points)— Sept 16

### **UNIT II: LARGER AND LESSER KNOWN LOPHOTROCHOZOA**

- Platyhelminthes & Selected Smaller Lophotrochozoan Phyla (Chapter 10)—Sept 11
- Molluscs (Chapter 11)—Sept 18
- Annelids and Lesser Known Lophotrochozoa (Chapter 12) —Sept 23
- Exam II (175 points)—Sept 30

### **UNIT III: ECDYSOZOA**

- Nematoda and Selected Smaller Ecdysozoan Phyla (Chapter 13)—Sept 25
- Arthropods I (Chapter 14) —Oct 2 and Oct 7
- Arthropods II, Tardigrada, Onychophora (Chapter 15)—Oct 7 and Oct 9
- Exam III (175 points)—Oct 16

### **UNIT IV: THE DEUTEROSTOMES**

- Ambulacraria, Urochordata, and Cephalochorda (Chapters 16 & 17)—Oct 21 and Oct 23
- Fishes (Chapter 18)—Oct 28 and Nov 4
- Amphibians and Reptiles (Chapters 19 and 20)—Nov 6 & Nov 11
- Reptiles and Birds (Chapters 20 and 21)—Nov 13 & Nov 18
- Birds and Mammals (Chapters 21 and 22) —Nov 20 & Nov 25
- Review of Chordate Evolution and Selected Vertebrate Physiology—Nov 27 and December 2
- [Exam IV \(click the link for the final exam schedule\)](#)

## Tentative Lab Schedule (We may deviate from this schedule and I will adjust point totals accordingly)

If you are not able to attend a lab, including field trips, you are not eligible for the points. There are no make-ups and there is no extra credit. We may change the times/dates of the field trips, as they are weather dependent. You have fair warning that the trip dates are tentative. The SERC field trip will take most of the day. Expect to spend about six hours outside. This does not include travel time. During the field trips we encounter things like inclement weather, biting arthropods, mud, water, dirt and thorns. Please show up prepared with the appropriate attire. This includes long sleeves, long pants, boots, a change of clothes, and a snack and water (with hand sanitizer). You must have submitted a signed assumption of risk and code of conduct form before attending the field trip. Before attending the field trip, you must read the links posted on blackboard about chiggers, Lyme disease, poison ivy, west Nile virus and other tick borne diseases, and you agree to the conditions of the course and release the NOVA and SERC of liability.

### **PART I. OFF-CAMPUS FIELD TRIPS**

- [Smithsonian Environmental Research Center](#)—Trip will occur on Sept 14<sup>th</sup> or Sept 15<sup>th</sup>. Clear these dates now if possible. If the weather is good, we will go on the first available date. The trip depends both the weather and the availability of Smithsonian biologist. We will meet in the education building parking lot at 10am. (75 points). Bring AOR and COC forms, signed. Familiarize yourself with species below. The field trip will be confirmed by email on the morning of the trip. To receive points, you must attend the field trip, and submit the report/animal paper. If this trip does not work out due to weather or restricted availability of the SERC biologist, we will aim for a field trip at [Huntley Meadows Park](#) on Sept 21<sup>st</sup>.

### **PART II. ON-CAMPUS LABS AND LAB EXAM WILL MEET IN BIOLOGY LAB ROOM BISDORF 395**

1. Initial lab meeting, intro, requirements & Porifera (**10**)—Sept 9
2. Cnidaria (**10**)—Sept 16
3. Platyhelminthes (**10**)—Sept 23
4. Molluscs (**10**)—Sept 30
5. Annelids (**10**)—Oct 7
6. Ecdysozoa (**10**)—Oct 21
7. Basal Phyla & Protostome lab quiz (**100**)—Oct 28
8. Echinoderms (**10**)—Nov 4
9. Fishes (**10**)—Nov 11
10. Comparative Anatomy & Hominid Lab (**10**)—Nov 18
11. Deuterostome lab quiz (**100**)—Nov 25
12. TBA—Dec 2 (**10**)
13. Field Identification quiz—Dec 9 (**100**)

HERPS	P#	BIRDS	P#	FISH	P#	MAMMALS	P#	INVERTS	P#	INVERTS	P#
American toad**	261	American robin**	323	American eel	250	Bobcat*	363	American copper	224	Snowy tree cricket**	210
Bullfrog*	262	Belted kingfisher	310	Atlantic menhaden	241	House mouse	354	Black widow	199	Sow/pill bugs	197
Gray tree frog*	262	Bald eagle	290	Atlantic needlefish	242	Chipmunk**	351	Bombardier beetle	<a href="#">RC</a>	Springtails	<a href="#">RC</a>
Green frog*	263	Barn swallow	316	Atlantic silverside	242	Coyote**	357	Bottle fly	217	Cicadas** (both)	211
Green tree frog	262	Barred Owl*	308	Brown bullhead	252	meadow vole	354	Carpenter ant	219	Termites	208
Marbled salamander	<a href="#">VHS</a>	Chickadees*	319	Bluegill	255	Downy woodpecker	311	Burrowing crayfish	197	Viceroy	228
E. cricket frog	<a href="#">VHS</a>	Black vulture	288	Brook trout	254	Eastern cottontail	350	Differential grasshopper	209	Water boatman	212
Pickerel frog*	263	Blue jay*	317	Chain pickerel	253	Flying squirrel	353	Dragonflies (various)	203+	Water strider	213
Red-backed salamand	260	Canada goose*	282	Green sunfish	<a href="#">RC</a>	Gray squirrel**	352	Dragonfly nymph	202	Whirligig beetles	214
Red spotted newt	258	Cardinal*	333	Hogchoaker	248	Groundhog	351	E. tiger swallowtail et al.	223	Wolf spider	199
Slimy salamander	260	Carolina wren	320	Bass (both lm/sm)	256	Muskrat	355	Fall field cricket**	210	Wooly bear	233
South leopard frog**	263	Common grackle	341	Mummichog	242	Raccoon**	357	Fishing spider	199	Yellow jacket	220
Spotted salamander	258	Eastern bluebird	321	Naked goby	<a href="#">RC</a>	Red fox**	358	Flat-backed millipede	197	Ticks/chiggers	200
Spring peeper**	262	Eastern-towhee**	335	Norther pipefish	243	Shrews & moles	347	Giant water bug	<a href="#">RC</a>	Garden spider	199
Wood frog	263	European starling	324	Sea lamprey/hagfish	237	Striped skunk	360	Gladiator katydid	<a href="#">RC</a>	Damselflies	203
American alligator**	<a href="#">AO</a>	Fish/American crow	317+	Spiny dogfish shark	239	Bats	349	Caterpillar hunter et al.	214	Earthworm	196
Black racer	268	Gray catbird**	323	Striped bass	244	Virginia opossum	346	Harvestman	200	E. tent caterpillar	231
Black rat snake	268	Goldfinch*	343	Striped blenny	<a href="#">RC</a>	Weasels	361	Honey bee	220	Gypsy moth	234
Snapping turtle	265	Great blue heron	277	White perch	244	White footed mouse	354	Horse fly	217	Mantis	208
E. box turtle	266	Green-winged teal	283	3 spine stickleback	242	White tailed deer	364	House centipede	197	Micrathena	<a href="#">RC</a>
N. cottonmouth	<a href="#">VHS</a>	Hairy woodpecker	311	Summer flounder	249	Beaver/mound *	353	House fly	217	Milkweed beetle	215
E. painted turtle	265	Herring gull	304	Winter founder	249	Mammal tracks	345+	Leech	196	<b>MARINE INVERTS</b>	<b>P#</b>
E. worm snake	<a href="#">VHS</a>	Laughing gull*	303	Pumpkinseed	255	Black bear*	359	Leopard slug	197	Barnacle	191
Five-lined skink	267	Mallard duck	283	Redbreast sunfish	255			Luna moth	231	Blue crab	193
Garter snake	271	Mourning Dove	307	Golden shiner	251			Meadow Katydid*	<a href="#">AO</a>	Comb jelly	185
Hognose snake	269	Northern flicker*	312	Yellow perch	256			Mole cricket*	<a href="#">AO</a>	Common sea star	195
Milk snake	269	Northern mockingbird**	323	Parts of a fish	240			Monarch	229	Grass/sand shrimp	191
E. copperhead	271	Osprey*	290	Parts of a shark	237			Millipedes	197	Moon jelly	184
N. water snake	269	Red-bellied woodpecker*	311					Stink bug	213	WF Mud crab	<a href="#">RC</a>
Red-bellied turtle	266	Red-tailed hawk**	292					Northern true katydid**	210	Clam worm	185
Red-eared slider	<a href="#">VHS</a>	Red-winged blackbird*	339					Painted lady	227	Sea nettle	184
Ribbon snake	271	Song sparrow	337					Diving beetle	<a href="#">RC</a>	Lions Mane	184
Green snakes	<a href="#">VHS</a>	Tree swallow	315					Question mark	226	Parts of a crab	192
Spotted turtle	265	Tufted titmouse*	319					<i>Physa</i>	<a href="#">RC</a>	Mollusc shell parts	186
Timber rattlesnake**	271	Turkey vulture	289					Robber fly	217		
Wood turtle	265	Whip-poor-will**	309					Gastropod shell char's	186		
Parts of a turtle	264	White breasted nuthatch	318					6S Green Tiger Beetle	213		
Parts of a bird →	273→	White throated sparrow*	337					Beetle elytra and wings	213		
		Wood duck	282					Dragonfly parts & naiad	<b>202</b>		

VHS = Virginia Herpetological Society Website; RC = Smithsonian Environmental Research Center Filed Trip. Not in field guide.

Please google image these animals and any other that we may find of the field trip that are not in the field guide.

AO = Audio Only; E. = Eastern; N. = Northern; + = Following Pages; \* = Audio Also \*\* = Audio will show up on final lab exam for sure

Table 1. List of required animal identification for lab. Page numbers are from [A Field Guide to the Mid-Atlantic States](#). Please learn 10 animals per week.

Links to Animal Audio. There's a [book with a CD](#) containing these audio files on reserve in the library.

BIRDS	MAMMALS	REPTILES & AMPHIBIANS	KATYDIDS	CICADAS & CRICKETS
<a href="#">American Goldfinch</a> <a href="#">American Robin</a> <a href="#">Baltimore Oriole</a> <a href="#">Barred Owl</a> <a href="#">Black-Capped Chickadee</a> <a href="#">Blue Jay</a> <a href="#">Brown Thrasher</a> <a href="#">Carolina Chickadee</a> <a href="#">Carolina Wren</a> <a href="#">Chipping Sparrow</a> <a href="#">Common Yellow-throat</a> <a href="#">Common Muskrat</a> <a href="#">Downy Woodpecker</a> <a href="#">Eastern Phoebe</a> <a href="#">Eastern Screech Owl</a> <a href="#">Eastern Towhee</a> <a href="#">Gray Catbird</a> <a href="#">Great Horned Owl</a> <a href="#">House Wren</a> <a href="#">Mourning Dove</a> <a href="#">Northern Cardinal</a> <a href="#">Northern Flicker</a> <a href="#">Northern Mockingbird</a> <a href="#">Pileated Woodpecker</a> <a href="#">Red-Bellied Woodpecker</a> <a href="#">Red-Headed Woodpecker</a> <a href="#">Red-Shouldered Hawk</a> <a href="#">Red-Tailed Hawk</a> <a href="#">Red-Winged Blackbird</a> <a href="#">Song Sparrow</a> <a href="#">Tufted Titmouse</a> <a href="#">Whip-Poor-Will</a> <a href="#">White-Breasted Nuthatch</a> <a href="#">White-Tailed Deer</a> <a href="#">Wood Thrush</a>	<a href="#">American Beaver</a> <a href="#">Black Bear</a> <a href="#">Bobcat</a> <a href="#">Coyote</a> <a href="#">Eastern Chipmunk</a> <a href="#">Eastern Fox Squirrel</a> <a href="#">Eastern Grey Squirrel</a> <a href="#">Flying Squirrel</a> <a href="#">Gray Fox</a> <a href="#">Gray Wolf</a> <a href="#">Meadow Vole</a> <a href="#">Moose</a> <a href="#">North American Porcupine</a> <a href="#">Northern Raccoon</a> <a href="#">Northern River Otter</a> <a href="#">Nutria (Coypu)</a> <a href="#">Red Fox</a> <a href="#">Red Squirrel</a> <a href="#">Striped Skunk</a> <a href="#">Woodchuck (Groundhog)</a>	<a href="#">American Alligator</a> <a href="#">American Toad</a> <a href="#">Bull Frog</a> <a href="#">Cope's Gray Treefrog</a> <a href="#">Eastern Narrowmouth Toad</a> <a href="#">Eastern Spadefoot</a> <a href="#">Fowler's Toad</a> <a href="#">Gray Treefrog</a> <a href="#">Green Frog</a> <a href="#">Green Treefrog</a> <a href="#">Northern Cricket Frog</a> <a href="#">Northern Leopard Frog</a> <a href="#">Pickerel Frog</a> <a href="#">Southern Leopard Frog</a> <a href="#">Southern Toad</a> <a href="#">Spring Peeper</a> <a href="#">Timber Rattlesnake</a> <a href="#">Western Chorus Frog</a> <a href="#">Wood Frog</a>	<b>False Katydids</b> <a href="#">Rattler Round-Winged Katydid</a> <a href="#">Oblong Winged Katydid</a> <a href="#">Greater-Angle Wing</a> <a href="#">Lesser Angle Wing</a> <a href="#">Broad-Winged Bush Katydid</a> <b>True Katydids</b> <a href="#">Northern True Katydid</a> <b>Meadow Katydids</b> <a href="#">Common Meadow Katydid</a> <a href="#">Handsome Meadow Katydid</a> <b>Conehead Katydids</b> <a href="#">Sword-Bearing Conehead</a> <a href="#">Nebraska Conehead</a> <a href="#">Slightly Musical Conehead</a> <a href="#">Round-Tipped Conehead</a>	<b>Cicadas</b> <a href="#">Scissor-Grinder Cicada</a> <a href="#">Swamp Cicada</a> <a href="#">Linne's Cicada</a> <a href="#">Periodical cicada</a> <b>Mole Crickets</b> <a href="#">Northern Mole Cricket</a> <b>Field Crickets</b> <a href="#">Fall Field Cricket</a> <b>Ground Crickets</b> <a href="#">Allard's Ground Cricket</a> <a href="#">Tinkling Ground Cricket</a> <a href="#">Carolina Ground Cricket</a> <a href="#">Striped Ground Cricket</a> <b>Tree Crickets</b> <a href="#">Snowy Tree Cricket</a> <a href="#">Broad-Winged Tree Cricket</a> <a href="#">Black-Horned Tree Cricket</a>

The following taxonomy contains animal orders (in caps). Some of these will show up on your lab exam. We will have exposure to some of these throughout lecture, and on the field trip. Please review the orders relevant to the animals listed above. Please note that animal taxonomy sometimes changes. These groupings may not reflect the latest trends.

### Insects

- ORTHOPTERA (straight wings)—grasshoppers crickets and locusts; formerly mantids (now in Order Mantodea) and roaches (now in Order Blattodea). Most of the noisemakers of the insect world are in this group, and some compete with humans for food; gradual metamorphosis
- ODONATA (toothed)—dragonflies and damselflies. Large compound eyes with many facets; capture insects on the wing with legs as a scoop or basket; mate in air and females lay eggs in water where nymphs develop
- SIPHONAPTERA (tube without wings)—fleas. No wings; body is laterally compressed as adaptation to living as ectoparasites in the fur and hair of mammals and the feathers of birds, The rat flea *Xenopsylla* transmits bubonic or Black Plague to humans. In the 1300's this disease wiped out one quarter of the European population
- ANOPLURA (unarmed tail)—sucking lice. Ectoparasites of mammals from whom they suck blood; 3 species on humans—body lice, head lice, and pubic lice; can transmit diseases like trench and typhus fever.
- COLEOPTERA (sheath wings)—beetles, including fireflies, ladybugs and weevils. The largest order of insects; thickened protective forewings over delicate hindwings; about one animal species in every three is a beetle. The great English biologist, Haldane, was once asked what he had learned about the mind of God from his studies of nature-Haldane replied that God seemed extremely fond of beetles; larvae are often called grubs.
- DIPTERA (two wings)—true flies, including mosquitoes, tse-tse flies, midges, gnats, horseflies and houseflies. Piercing-sucking mouthparts and only one pair of wings; the fruit fly *Drosophila* has been extremely useful in genetic studies.
- LEPIDOPTERA (scale wings)—butterflies and moths. Sucking mouthparts; larvae are caterpillars with chewing mouthparts. Among the most beautiful insects, some migrate very long distances
- HEMIPTERA (half wings)—true bugs including bed bugs, kissing, stink and squash bugs and water striders. Piercing-sucking mouthparts, economically important, some transmit diseases

- HOMOPTERA (same wings)—includes aphids or plant lice, spittle bugs, scale insects and cicadas (This group is recently considered a suborder). Many of these puncture plants and suck their sap so they're among the most important orders of insects
- ISOPTERA (equal wings)—termites (“white ants”). Like ants these are social insects that live in colonies, they eat cellulose substances that are digested in the intestines by symbiotic flagellates. Beneficial in forests by decomposing fallen deadwood, harmful in homes especially in tropics
- HYMENOPTERA (membrane wings)—ants, bees, wasps and hornets. Over 100,000 species; although most members are solitary they are sometimes called the “social insects”, meaning that some species tend to live in colonies where all individuals are offspring of one mother (queen)
- NEUROPTERA (nerve wings) —The insect order Neuroptera, or net-winged insects, includes the lacewings, mantidflies, antlions and their relatives. The adults of this order possess four membranous wings, with the forewings and hindwings about the same size, and with many veins. They have chewing mouthparts, and undergo complete metamorphosis.
- COLLEMBOLA (glue wedge) —These are not insects, but are related entognathans. Known as the springtails, their abdomen is equipped with a forked springing appendage that allows them to jump great distances. The abdomen also bears a tube called the collophore, which may be used for righting themselves after jumping. Collembola are named after their collophores, which were once thought to be sticky structures used for stabilization. First fossil hexapods were collembola.

### Fishes

- MYXINIFORMES—Hagfishes
- PETROMYZONIFORMES—Lampreys
- SELACHIFORMES—Living sharks and rays
- ANTHRIFORMES—The silversides
- BELONIFORMES—The needlefishes
- CLUPEIFORMES —Herring-like fishes, tarpons, salmonids (salmon, trout) and relatives
- ESOCIFORMES—Pike, pickerel
- CYPRINIFORMES—Goldfish, carp, minnows, suckers
- ANGUILLIFORMES—Eels
- CYPRINODONTIFORMES—Livebearers, the killifishes and guppies
- PERCIFORMES—Perchlike fishes, perch, sunfish, bluegill, bass, etc
- PLEURONECTIFORMES—Flatfishes
- SILURIFORMES—The catfishes
- SYGNATHIFORMES—The pipefishes

### Amphibians

- CAUDATA—Salamanders and newts
- ANURA—Frogs and toads

### Non-Avian Reptiles

- SQUAMATA—Snakes and lizards
- CHELONIA or TESTUDINES—Turtles and Tortoises

### Avian Reptiles (Birds)

- CICONIFORMES—Herons, bitterns, storks, ibises, flamingoes (herons sometimes in Pelecaniformes)
- ANSERIFORMES—Waterfowl, ducks, geese, etc
- FALCONIFORMES—Vultures, hawks, ospreys, falcons
- COLUMBIFORMES—Pigeons, doves
- STRIGIFORMES—Owls
- CAPRIMULGIFORMES—The goatsuckers, nightbirds, whip-poor-will, chuck will's widow, nighthawks
- PICIFORMES—Woodpeckers, flickers
- PASSERIFORMES—The songbirds: flycatchers, larks, swallows, jays, crows, titmice, nuthatches, creepers, bulbuls, wrens, mimic thrushes (mocking and catbirds), thrushes, kinglets, pipits, waxwings, shrikes, starlings, vireos, wood warblers, weaver finches (house sparrow, European tree sparrow), blackbirds, tanagers, finches

## Mammals

- **ARTIODACTYLA** (even-toed hoofed animals)—Hoofed animals with an even number of toes include those that ruminates, or digest their food in four-chamber stomachs and chew cuds, and those that do not ruminates. Those that ruminates are the families Girrafidæ (giraffes), Cervidæ (deer, moose, reindeer, elk), Antilocapridæ (pronghorn antelope), and Bovidæ (cattle, bison, yaks, waterbucks, wildebeest, gazelles, springboks, sheep, musk oxen, goats). Non-ruminators include the families Suidæ (pigs), Tayassuidæ (peccaries), Hippopotamidæ (hippopotamuses), and Camelidæ (camels, llamas).
- **CARNIVORA** (meat-eaters)—There are two suborders of these toe-footed creatures. They include the Canidæ (wolves, dogs, jackals, foxes), Ursidæ (bears, giant pandas), Procyonidæ (coatis, raccoons, lesser pandas), and Mustelidæ (martens, weasels, skunks, otters), all part of one superfamily that is characterized by long snouts and unretractable claws; and Felidæ (cats, lions, cheetahs, leopards) Hyaenidæ (hyenas), and Viverridæ (mongooses, civets), all of which have retractable claws.
- **CHIROPTERA**—(bats) There are two suborders of bats, the only mammals that can fly. Suborder Megachiroptera contains one family, the Pteropodidæ (flying foxes, Old World fruit bats). Suborder Microchiroptera contains 17 families, including: Rhinopomatidæ (mouse-tailed bats), Emballonuridæ (sheath tailed bats), Craseonycteridæ (hog-nosed or butterfly bats), Noctilionidæ (bulldog or fisherman bats), Nycteridæ (slit-faced bats), Megadermatidæ (false vampire bats), and Rhinolophidæ (horseshoe bats).
- **LAGOMORPHA**— (pikas, hares, and rabbits). Two families make up this order: Ochotonidæ (pikas) and Leporidae (hares and rabbits of all sorts).
- **MARSUPIALIA**—(pouched mammals). Included among these are the families Caenolestidæ (rat opossums), Didelphidæ (true opossums), Dasyuridæ (native cats, native mice), Notoryctidæ (marsupial moles), Myrmecobiidæ (numbats), Peramelidæ (bandicoots), Phalangeridæ (koalas), Vombatidæ (wombats), and Macropodidæ (kangaroos and wallabies).
- **RODENTIA**—(gnawing mammals). The most prolific mammals, Order Rodentia includes three suborders. It takes in the families Aplodontidæ (mountain beavers), Sciuridæ (chipmunks, squirrels, marmots), Cricetidæ (field mice, lemmings, muskrats, hamsters, gerbils), Muridæ (Old World mice, rats), Heteromyidæ (New World mice), Geomyidæ (gophers), and Dipodidæ (jerboas).