I. Locator information
4.0 semester hrs of credit
Class times:

<table>
<thead>
<tr>
<th>Section 01: Lecture:</th>
<th>TR 12:30 – 1:45 p.m.</th>
<th>Room: LSA 121</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab:</td>
<td>T 10:00 - 11:50 a.m.</td>
<td>Room: LSA 245</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section 02: Lecture:</th>
<th>TR 12:30 – 1:45 p.m.</th>
<th>Room: LSA 121</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab:</td>
<td>R 10:00 - 11:50 a.m.</td>
<td>Room: LSA 245</td>
</tr>
</tbody>
</table>

Instructor: Philip Senter, Ph.D.
Office location: LS 126  Office phone: 672-1304  Email: psenter@uncfsu.edu
Office hrs: M 10:00 – 12:00, TR 9:00 – 10:00 & 12:00 – 12:30, W 12:00 – 2:00, and by appointment

FSU Policy on Electronic Mail: Fayetteville State University provides to each student, free of charge, an electronic mail (username@uncfsu.edu) that is easily accessible via the Internet. The university has established FSU email as the primary mode of correspondence between university officials and enrolled students. Inquiries and requests from students pertaining to academic grades, bills, financial aid, and other matters of a confidential nature must be submitted via FSU email. Inquiries or requests sent to personal email accounts are not assured a response. The university maintains open-use computer laboratories throughout the university that can be used to access electronic mail. Rules and regulations governing the use of FSU email may be found at http://www.uncfsu.edu/PDFs/EmailPolicyFinal.pdf

II. Course description:
A study of concepts of animal biology relative to structure, function, ecology, heredity, and embryogenesis, with emphasis on the evolution and characteristics of major animal phyla, and with two (2) hours of laboratory studies relative to basic concepts of animal biology. Prerequisite: BIOL 150

III. Disabled Student Services: In accordance with Section 504 of the 1973 Rehabilitation Act and the Americans with Disabilities Act (ACA) of 1990, if you have a disability or think you have a disability to please contact the Center for Personal Development in the Spaulding Building, Room 155 (1st Floor); 910-672-1203.

IV. Textbooks:
Main text:

Lab manual:

V. Course objectives and student learning outcomes:
Upon completion of this course, students will be able to:
A. Correctly apply the spelling conventions of animal taxonomy.
B. Correctly use terms relating to animal anatomy, taxonomy, and development.
C. Demonstrate familiarity with the scientific method.
D. Demonstrate familiarity with evidence of macroevolution (e.g. vestigial structures; lack of irreducible complexity; evidence for endosymbiotic origins of certain organelles)
E. Correctly use a light microscope and dissection tools.

Disclaimer: Policies outlined below are subject to change if the instructor deems necessary.
VI. Evaluation criteria and grading scale

Four exams (including the midterm and final), 80 pts apiece.  
note: each exam covers both lecture and lab  
Total: 320 pts

Lab participation: 12 lab periods, 5 pts apiece*  
Total: 60 pts

Lab reports: 13 lab periods: first report 10 pts, the next twelve 20 pts apiece**  
Total: 250 pts

Animal observation field log (3 hours of observation)***  
Total: 35 pts

5-point in-class assignment on last class day****  
Total: 5 pts

Grand total: 670 pts

*Student must be no more than 5 min. late in order to get these points.

**See p. 3 for when lab reports are due and for policy on late lab reports. The student must have been present in the lab period for a lab report to be accepted. See Appendix 2 for lab report format and Appendix 3 for instructions.

***See page 4 for due date and Appendix 4 for format. This assignment may be done singly or by a group of two or three, but not by more than three. Recommended: take a notebook to record observations and/or film the animals and write observations afterward. Observed animals must be wild or captive (e.g. in a zoo) but must not be pets and must not be human. They do not have to be vertebrates; for example, observation of a fly indoors, bees around a flower bed, or a crawling snail, etc., are acceptable. Each observation must be at least 20 minutes long, and together they must total 3 hours; a single 3-hour observation is also acceptable. Within each observation a single animal may be observed, or a group of animals (e.g. a flock of birds), or a series of animals at a location (e.g. birds at a bird feeder); for a series of animals at a location, the observation will be acceptable only if it does not include any periods of more than 5 minutes without an observed animal’s presence. For the field log, hard-copy is preferred but an emailed electronic copy is acceptable. No late turn-ins will be accepted. Early turn-ins are encouraged; 5 bonus points will be awarded for field logs turned in at least two weeks before the due date, and 3 bonus points will be awarded for field logs turned in during the last two weeks before the due date.

****Graduating seniors are exempt from this assignment, and their semester scores will be based on a total of 670 instead of 675 possible points.

A semester grade of A is awarded if the student earns > 90% of 675 pts

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>80-89%</td>
</tr>
<tr>
<td>B</td>
<td>70-79%</td>
</tr>
<tr>
<td>C</td>
<td>60-69%</td>
</tr>
<tr>
<td>D</td>
<td>&lt; 60%</td>
</tr>
</tbody>
</table>

There is no extra credit except for bonus points for early turn-in of the field log. Grades are not curved.

New FSU attendance and grading policy

Grades of “WN” are no longer given.

A grade of “FN” (F due to non-attendance) is given to a student who attends zero, one, or two class periods in a semester and does not withdraw but instead remains on the roster. Lab periods are considered class periods.

New type of grade: Interim Grade. An Interim Grade of “X” (no show) or “EA” (excessive absences) may be given early in the semester as a warning to the student. Interim Grades do not influence GPA. They are reminders to the student to decide whether to withdraw or to increase attendance.

Classroom policies:

**Food:** Food is forbidden in the lecture room, and OSHA regulations forbid both food and drink in the lab.

**Bringing children to the class or lab:** This is against FSU policy.

**Disruptive behavior:** The professor will use his own judgment as to whether, in response to disruptive behavior, he will merely ask the student to stop, ask the student to leave for the rest of the class period, or take other action. In extreme or repeated cases, the instructor may report the student to the Dean of Students for disciplinary action according to the FSU Code of Student Conduct. Disruptive behavior includes food consumption, playing
music with headphones, popping gum, texting, answering a phone, holding a private conversation, or any other behavior that the professor or students find distracting or rude.

Exam and lab policies:
A. Bring to every exam: (1) a pencil, (2) white-out.
B. Make-up exams:
   (1) A make-up exam is arranged only if the student requests one.
   (2) A make-up exam must be taken within one week after the scheduled exam.
   (3) To discourage habitual absence on exam days, each student is allowed only two make-up exams per semester without penalty. The third time the student misses an exam, he or she will at first receive a zero for that exam.
      If a make-up exam is arranged, the score of the make-up exam replaces the zero only if the student provides documentation for a legitimate reason (e.g. medical situation, family emergency, auto trouble, participation in a school event) for having missed the scheduled exam. Legitimate reasons do not include forgetfulness, oversleeping, or not being ready to take the exam.
C. Prearrangements to take an exam at an alternate time/date are not the same as make-up exams and do not necessarily require extraordinary circumstances or documentation. Please let the prof. know far enough ahead of time if a prearrangement is needed. There is no penalty for prearrangements.
D. Location: If a prearranged or make-up exam cannot be taken in the professor’s office during office hours, it will be taken in the University Testing office (Collins 109). The University Testing office requires that the student make an appointment with at least one day’s notice (call 672-1815); appointments cannot be changed.
E. Tardiness: Arrival more than 15 minutes late to an exam more than once results in a reduction of the student’s exam score by 10 points, unless the student provides documentation for a legitimate reason (see B3 above) for the lateness. The 10-point penalty occurs only if the late student arrives after another student has already left.
F. Cheating: The instructor will adhere to University policy concerning cheating.
G. If you leave the room after having started an exam, your exam is over. The portion that has been completed will be graded, and the uncompleted portion will be treated as a series of wrong answers.
H. Lab exercises cannot be made up, but the points may be waived if the student provides documentation for a legitimate reason (see B3 above) for the absence.
I. Bring the lab manual to every lab period.
J. Turning in lab reports: For students with a Tuesday lab (section 01), the lab report is due in class that Thursday. For students with a Thursday lab (section 02), the lab report is due by noon the following Monday. No late lab reports will be accepted.
   Hard-copy is preferred for lab report turn-in. Do not turn anything in by putting it in the black wire box on Dr. Senter’s door; instead, slip it under the office door if he’s not in the office at the time. Although it is not preferred, it is permissible to email the report to the professor (psenter@uncfsu.edu), and to use email to send a scanned copy or cell phone photo of the page with the drawings on it. To be considered on time, an emailed lab report must arrive in the professor’s email inbox by the end of class on Thursday (for section 01) or by noon on Monday (for section 02).
   Students may turn in lab reports individually or in pairs, but not in groups of three or more. For pairs, the names of both members of the pair must be on each page (including pages with drawings) of the lab report. On any given lab report, a student can be listed as part of the pair only if he or she was actually present during the lab period.
K. Absence on a lab day: If the student misses a lab day and provides documentation for a legitimate reason (see B3 above) for the absence, the points for that week’s lab report and lab participation will be waived.
L. The last day to turn in documentation for items E or K above, is the day before the original date of the final exam for the student’s course section.

VII. Academic support resources
University College Learning Center: Chick 216C, ph: 910-672-1864. Tutoring, proofreading, etc.
ZOOL 110 study guides: on Blackboard at http://blackboard.uncfsu.edu
### VIII. Course outline and assignments
(dates subject to change):

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture topic</th>
<th>Lab topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thurs., Aug 22</td>
<td>Introduction; Ch. 10: taxonomy</td>
<td>Section 01: No lab this week</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Section 02: Lab A (anatomy): the microscope, animal development</td>
</tr>
<tr>
<td>Tues., Aug 27</td>
<td>Ch. 10: taxonomy and phylogeny</td>
<td>Section 01: Lab A (anatomy): the microscope, animal development</td>
</tr>
<tr>
<td>Thurs., Aug 29</td>
<td>Ch. 7, 8: reproduction, development</td>
<td>Section 02: Lab B (anatomy): vertebrales*</td>
</tr>
<tr>
<td>Tues., Sep 3</td>
<td>Ch. 9, 6: animal architecture, evolution</td>
<td>Section 01: Lab B (anatomy): vertebrales*</td>
</tr>
<tr>
<td>Thurs., Sep 5</td>
<td>Ch. 28: Mammalia</td>
<td>Section 02: No lab this week</td>
</tr>
<tr>
<td>Tues., Sep 10</td>
<td>Ch. 26: Reptilia</td>
<td>Lab C (taxonomy): mammals</td>
</tr>
<tr>
<td>Thurs., Sep 12</td>
<td>Ch. 27: Aves</td>
<td></td>
</tr>
<tr>
<td>Tues., Sep 17</td>
<td><strong>Exam 1</strong></td>
<td>Lab D (taxonomy): reptiles, amphibians, fishes</td>
</tr>
<tr>
<td>Thurs., Sep 19</td>
<td>Ch. 25: early tetrapods and amphibians</td>
<td></td>
</tr>
<tr>
<td>Tues., Sep 24</td>
<td>Ch. 24: fishes</td>
<td>Lab E (anatomy): lower chordates, Echinodermata*</td>
</tr>
<tr>
<td>Thurs., Sep 26</td>
<td>Ch. 23: lower chordates</td>
<td></td>
</tr>
<tr>
<td>Tues., Oct 1</td>
<td>Ch. 22: Chaetognatha, Echinodermata, Hemichordata</td>
<td>Lab F (anatomy): Arthropoda*</td>
</tr>
<tr>
<td>Thurs., Oct 3</td>
<td>Ch. 19, 20: Arthropoda</td>
<td></td>
</tr>
<tr>
<td>Tues., Oct 8</td>
<td>Ch. 21: more Arthropoda</td>
<td>Lab G (taxonomy): Arthropoda</td>
</tr>
<tr>
<td>Thurs., Oct 10</td>
<td><strong>Exam 2</strong></td>
<td></td>
</tr>
<tr>
<td>Tues., Oct 15</td>
<td>Ch. 18: Nematoda, other Ecdysozoa</td>
<td>No lab this week</td>
</tr>
<tr>
<td>Thurs., Oct 17</td>
<td><strong>Midterm break: no class Thursday</strong></td>
<td></td>
</tr>
<tr>
<td>Tues., Oct 22</td>
<td>Ch. 17: Annelida</td>
<td>Lab H (anatomy): Annelida, Mollusca</td>
</tr>
<tr>
<td>Thurs., Oct 24</td>
<td>Ch. 16: Mollusca</td>
<td></td>
</tr>
<tr>
<td>Tues., Oct 29</td>
<td><strong>No lecture or lab periods this week. Instead, time is granted for the field log assignment.</strong></td>
<td></td>
</tr>
<tr>
<td>Thurs., Oct 31</td>
<td><strong>No lecture or lab periods this week. Instead, time is granted for the field log assignment.</strong></td>
<td></td>
</tr>
<tr>
<td>Tues., Nov 5</td>
<td>Ch. 15: other Lophotrochozoa</td>
<td>Lab I (anatomy): Platyhelminthes</td>
</tr>
<tr>
<td>Thurs., Nov 7</td>
<td>Ch. 14: Platyhelminthes, Nemertea, Acoelomorpha</td>
<td></td>
</tr>
<tr>
<td>Tues., Nov 12</td>
<td><strong>Exam 3</strong></td>
<td>Lab J (anatomy): Cnidaria, Porifera</td>
</tr>
<tr>
<td>Thurs., Nov 14</td>
<td>Ch. 13: Cnidaria, Ctenophora</td>
<td></td>
</tr>
<tr>
<td>Tues., Nov 19</td>
<td>Ch. 12: Porifera, Placozoa</td>
<td>Lab K (anatomy): protozoans</td>
</tr>
<tr>
<td>Thurs., Nov 21</td>
<td>Ch. 11: protozoan groups</td>
<td></td>
</tr>
<tr>
<td>Tues., Nov 26</td>
<td><strong>Field log due Tuesday</strong></td>
<td>No lab this week</td>
</tr>
<tr>
<td></td>
<td>Ch. 11, 2 (in part): protozoan groups, endosymbiotic theory</td>
<td></td>
</tr>
<tr>
<td>Thurs., Dec. 3</td>
<td><strong>Thanksgiving Break</strong></td>
<td></td>
</tr>
<tr>
<td>Tues., Dec. 5</td>
<td>Ch. 1 &amp; 6: scientific method and the predictions of evolutionary theory</td>
<td>Lab L (live animals): live animals under the microscope</td>
</tr>
<tr>
<td>Finals week, during scheduled Final Exam time:</td>
<td><strong>Final exam</strong></td>
<td>No lab this week</td>
</tr>
<tr>
<td>5-point in-class assignment (Tues., Dec. 10, 12:00 noon)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### IX. Instructional style:
ZOOL 200 is a lecture-based course designed to present the basic concepts of zoology. ZOOL 200 also contains a laboratory component that provides hands-on implementation of the theories and concepts covered in lecture. Visual aids such as transparencies will be utilized to bring clarity to concepts/theories and structural components discussed in lecture. For the laboratory, students will work in teams, one team per lab table. The instructor will provide the specimens to be studied, the list of body parts to be identified, and assistance as needed.

### X. Bibliography:
All ZOOL 110 students are encouraged to use the library for supplemental reading in the biological sciences. The following science periodicals provide a source of current information in a format appropriate for both the major and non-major biology student: Discover, Nature, Science, Science News, Science Digest, Scientific American
Appendix 1: Exam study Guide

Exam 1

Lecture part:
1. For each bold-faced term in the lecture notes, know the meaning of the term. If the term is the name of an anatomical structure, know what the structure is for.
2. Correctly apply the traits that are highlighted in yellow in the lecture notes, to the taxa highlighted in blue.
3. For other sections highlighted in yellow in the lecture notes, know the information in the yellow highlighting.

Lab part:
Be able to do the following with pictures of specimens used in the anatomy labs:
   Lab A: Identify parts of the light microscope. Identify the stages of development listed under “terms with which to label figure(s)” in the instructions for Lab A in Appendix 3 of the syllabus.
   Lab B: Identify whether a skeleton is that of a mammal or that of a reptile, by looking at the ribcage.

Exam 2

Lecture part:
Know the material in the bold-faced and highlighted parts of the lecture notes, as described above for Exam 1.

Lab part:
Be able to do the following with pictures of specimens used in the anatomy labs:
   Labs E and F: Identify the body parts listed under “terms with which to label figure(s)” in the instructions for these lab periods in Appendix 3 of the syllabus.
   Lab E: Apply the correct phylum name to the animals.
   Lab F: Apply the correct phylum and subphylum name to the animals.

Exam 3

Lecture part:
Know the material in the bold-faced and highlighted parts of the lecture notes, as described above for Exam 1.

Lab part:
Be able to do the following with pictures of specimens used in the anatomy labs:
   Labs H and I: Identify the body parts listed under “terms with which to label figure(s)” in the instructions for these lab periods in Appendix 3 of the syllabus.
   Labs H and I: Apply the correct phylum and class name to the animals.

Exam 4

Lecture part:
Know the material in the bold-faced and highlighted parts of the lecture notes, as described above for Exam 1.

Lab part:
1. Be able to do the following with pictures of specimens used in the anatomy labs:
   Labs J and K: Identify the body parts listed under “terms with which to label figure(s)” in the instructions for these lab periods in Appendix 3 of the syllabus.
   Labs J and K: Apply the correct phylum name to the organisms.
2. Focus a light microscope.
## Appendix 2: Lab Reports

**Rubric for grading anatomy lab reports**

<table>
<thead>
<tr>
<th>Point value</th>
<th>Points earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
</tr>
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<td>2</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

See next page for an example to follow, for writing an anatomy lab report.
Date of lab period: September 32, 1925

Name: Student Passworthington

Title: A Test of Whether Pig Lungs Are Made of Diamonds, and a Study of the Number of Appendages in Larval Martian Frogs

Hypotheses: We tested the following hypotheses:

Set 1:  
1. Pig lungs are made of diamonds.
2. Pig lungs are not made of diamonds.

Set 2:  
3. Larval Martian frogs have \( n \) appendages, where \( n = \) any given number.

Materials:  
- preserved pig
- scissors
- microscope slide with larval Martian frogs
- microscope

Methods:  
We used scissors to dissect a preserved pig (Fig. 1). We then observed its lungs to look for properties that are present in diamonds: lack of pigmentation, hardness at room temperature, and a tendency to look good when embedded in a gold band on a human finger. To test for the third characteristic above, we embedded the lungs in a gold band and placed it on the finger of Student Passworthington.

We observed nine larval Martian frogs under a microscope (Fig. 2) and counted the number of appendages of each.

Results:  
The lungs of the pig are pigmented and are squishy at room temperature. On the gold band on the finger of Student Passworthington, the pig lungs do not look good but instead look nauseating and ridiculous (Fig. 3).

Each of the nine Martian frog larvae has five appendages (Fig. 2).

Conclusions:  
The hypothesis that pig lungs are made of diamonds is falsified. The hypothesis that pig lungs are not made of diamonds is supported.

The hypothesis that larval Martian frogs have nine appendages is supported. All other hypotheses as to the number of appendages in larval Martian frogs are falsified.
Rubric for grading taxonomy lab reports

<table>
<thead>
<tr>
<th>Point value</th>
<th>Points earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>The report is typed, is single-spaced, and is in 10, 11, or 12-point font.</td>
<td>3</td>
</tr>
<tr>
<td>The date of the lab period is present.</td>
<td>1</td>
</tr>
<tr>
<td>The student’s name is on all pages, including page(s) with drawings.</td>
<td>1</td>
</tr>
<tr>
<td>The student has included a title that is relevant to the material covered in the lab (see Appendix 3)</td>
<td>1</td>
</tr>
<tr>
<td>The number of specimens used in the report is ten, and at least one specimen from each table is used.</td>
<td>2</td>
</tr>
<tr>
<td>For each specimen, the student has correctly listed the taxonomic ranks specified in the lab instructions.</td>
<td>2</td>
</tr>
<tr>
<td>For each specimen, the student has listed the taxonomic ranks vertically, as in the example on the following page, and not horizontally.</td>
<td>1</td>
</tr>
<tr>
<td>The student has correctly used capitalization in the taxonomic names (all ranks but species are capitalized).</td>
<td>2</td>
</tr>
<tr>
<td>The student has correctly applied italics in the taxonomic names (only genus and species are italicized).</td>
<td>2</td>
</tr>
<tr>
<td>Figures are hand-drawn (note: artistic ability is not part of the grade).</td>
<td>1</td>
</tr>
<tr>
<td>Each figure is labeled as “Fig. 1,” “Fig. 2,” etc.</td>
<td>1</td>
</tr>
<tr>
<td>Each figure is cited in the report, at the spot specified in the lab instructions.</td>
<td>1</td>
</tr>
<tr>
<td>The student has included a drawing of each of the specimens used in the report.</td>
<td>2</td>
</tr>
<tr>
<td>Total:</td>
<td>20</td>
</tr>
</tbody>
</table>

See next page for an example to follow, for writing a taxonomy lab report.
**Date of lab period:** September 32, 1925

**Name:** Student Passworthington

**Title:** Taxonomy of turtles

<table>
<thead>
<tr>
<th>Phylum Chordata</th>
<th>Phylum Chordata</th>
<th>Phylum Chordata</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subphylum Vertebrata</td>
<td>Subphylum Vertebrata</td>
<td>Subphylum Vertebrata</td>
</tr>
<tr>
<td>Class Reptilia</td>
<td>Class Reptilia</td>
<td>Class Reptilia</td>
</tr>
<tr>
<td>Order Testudines</td>
<td>Order Testudines</td>
<td>Order Testudines</td>
</tr>
<tr>
<td>Family Cheloniidae</td>
<td>Family Trionychidae</td>
<td>Family Dermochelyidae</td>
</tr>
<tr>
<td>Genus <em>Kinosternon</em></td>
<td>Genus <em>Trionyx</em></td>
<td>Genus <em>Dermochelys</em></td>
</tr>
<tr>
<td>Species <em>K. subrubrum</em></td>
<td>Species <em>T. spiniferus</em></td>
<td>Species <em>D. coriacea</em></td>
</tr>
<tr>
<td>Common name: eastern mud turtle</td>
<td>Common name: spiny softshell</td>
<td>Common name: leatherback</td>
</tr>
</tbody>
</table>

(Fig. 1)

<table>
<thead>
<tr>
<th>Phylum Chordata</th>
<th>Phylum Chordata</th>
<th>Phylum Chordata</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subphylum Vertebrata</td>
<td>Subphylum Vertebrata</td>
<td>Subphylum Vertebrata</td>
</tr>
<tr>
<td>Class Reptilia</td>
<td>Class Reptilia</td>
<td>Class Reptilia</td>
</tr>
<tr>
<td>Order Testudines</td>
<td>Order Testudines</td>
<td>Order Testudines</td>
</tr>
<tr>
<td>Family Cheloniidae</td>
<td>Family Chelydridae</td>
<td>Family Emydidae</td>
</tr>
<tr>
<td>Genus <em>Chelonia</em></td>
<td>Genus <em>Chelydra</em></td>
<td>Genus <em>Dermochelys</em></td>
</tr>
<tr>
<td>Species <em>C. mydas</em></td>
<td>Species <em>C. serpentina</em></td>
<td>Species <em>D. coriacea</em></td>
</tr>
<tr>
<td>Common name: green turtle</td>
<td>Common name: common snapping turtle</td>
<td>Common name: leatherback</td>
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</table>

(Fig. 4)

<table>
<thead>
<tr>
<th>Phylum Chordata</th>
<th>Phylum Chordata</th>
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<tbody>
<tr>
<td>Subphylum Vertebrata</td>
<td>Subphylum Vertebrata</td>
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</tr>
<tr>
<td>Class Reptilia</td>
<td>Class Reptilia</td>
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</tr>
<tr>
<td>Order Testudines</td>
<td>Order Testudines</td>
<td>Order Testudines</td>
</tr>
<tr>
<td>Family Emydidae</td>
<td>Family Emydidae</td>
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</tr>
<tr>
<td>Genus <em>Clemmys</em></td>
<td>Genus <em>Deirochelys</em></td>
<td>Genus <em>Terrapene</em></td>
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<tr>
<td>Species <em>C. guttata</em></td>
<td>Species <em>D. reticularia</em></td>
<td>Species <em>T. carolina</em></td>
</tr>
<tr>
<td>Common name: spotted turtle</td>
<td>Common name: chicken turtle</td>
<td>Common name: eastern box turtle</td>
</tr>
</tbody>
</table>

(Fig. 7)

<table>
<thead>
<tr>
<th>Phylum Chordata</th>
<th>Phylum Chordata</th>
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<td>Subphylum Vertebrata</td>
<td>Subphylum Vertebrata</td>
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<tr>
<td>Class Reptilia</td>
<td>Class Reptilia</td>
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<td>Order Testudines</td>
<td>Order Testudines</td>
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</tr>
<tr>
<td>Family Emydidae</td>
<td>Family Emydidae</td>
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</tr>
<tr>
<td>Genus <em>Pseudemys</em></td>
<td>Genus <em>Emydidae</em></td>
<td>Genus <em>Emydidae</em></td>
</tr>
<tr>
<td>Species <em>P. scripta</em></td>
<td>Species <em>T. scripta</em></td>
<td>Species <em>T. carolina</em></td>
</tr>
<tr>
<td>Common name: slider</td>
<td>Common name: slider</td>
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</table>

(Fig. 10)
Rubric for grading the live animal lab report

<table>
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<th>Point value</th>
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</tr>
</tbody>
</table>

See next page for an example to follow, for writing the live animal lab report.
Date of lab period: September 32, 1925

Name: Student Passworthington

Title: Live animals under the microscope

Materials: sample of lake water
           sample of drainage ditch water
           sample of swamp water
           sample of tree moss
           microscope

Methods: We used a microscope to examine samples of lake water, drainage ditch water, swamp water, and tree moss, to determine what animal phyla were present in each sample.

Results:

<table>
<thead>
<tr>
<th>Lake water (Fig. 1)</th>
<th>Swamp water (Fig. 2)</th>
<th>Drainage ditch (Fig. 3)</th>
<th>Tree moss (Fig. 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>phylum Ciliophora</td>
<td>phylum Arthropoda</td>
<td>phylum Platyhelminthes</td>
<td>phylum Nematoda</td>
</tr>
<tr>
<td>clade Viridiplantae</td>
<td>phylum Ciliophora</td>
<td>phylum Arthropoda</td>
<td>phylum Arthropoda</td>
</tr>
<tr>
<td>phylum Tardigrada</td>
<td></td>
<td>phylum Nematoda</td>
<td></td>
</tr>
<tr>
<td>phylum Rotifera</td>
<td></td>
<td>clade Viridiplantae</td>
<td></td>
</tr>
<tr>
<td>phylum Arthropoda</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>phylum Annelida</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 3: Lab Instructions

Lab A (anatomy): microscope and animal development

Part 1: Microscope parts and usage
Instructions: Follow these instructions at the pace established by your teacher.
1. Carry a microscope to your table (one microscope per pair of students). When carrying a microscope, always support it from beneath with one hand and grip the arm with your other hand.
2. Make sure the scanning power objective (short-barelled lens on nosepiece) is snapped into place, and keep it there until instructed otherwise.
3. Use a Kimwipe to clean the ocular lenses, the glass circle in the middle of the stage, the objective lenses, and the light.
4. Turn the bulb on.
5. Adjust the eyepieces (which house the ocular lenses) to the width of your eyes until you can see through the ocular lenses with both eyes open.
6. Move the iris diaphragm lever. What happens to the light?
7. Turn the coarse adjustment knob, the fine adjustment knob, and the stage clamp knobs. In each case, which way does the stage move?
8. Four barrels, each with an objective lens at the end, hang downward from the rotating nosepiece. In order from short to long, they are called the scanning objective, low power, high power, and the oil-immersion lens. Below, record the magnification that each provides, and record the color of the stripe around the barrel.

<table>
<thead>
<tr>
<th>Objective</th>
<th>Magnification</th>
<th>Stripe Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scanning objective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low power objective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High power objective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil-immersion objective</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. Obtain a slide with the letter E, and use the stage clamp to secure it to the stage.
10. Center the specimen (the “e”) over the glass circle in the middle of the stage.
11. Use the coarse and fine focus knobs to focus the image of the specimen.
12. Rotate the nosepiece so that the low power objective snaps into place.
   Is the specimen still in focus? ____ If not, focus the image.
13. Rotate the nosepiece so that the high power objective snaps into place. Is the specimen still in focus? ______ If not, focus the image.

14. Never use the oil-immersion lens without first applying a drop of oil to the slide.

15. Is the “e” right-side up or upside-down? ____________

16. When you move the stage left, does the image move left or right? _______

17. When you move the stage toward you, does the image move toward or away from you? _________

18. Before removing the slide, snap the scanning objective back into place.

In future labs, always use the following procedure with the microscope.

1. When carrying a microscope, always support it from beneath with one hand and grip the arm with your other hand.
2. Use a Kimwipe to clean the ocular lenses, the glass circle in the middle of the stage, the objective lenses, and the light.
3. Make sure the scanning objective is snapped into place before clamping a slide to the stage.
4. Never use the oil-immersion lens without first applying a drop of oil to the slide.
5. Before removing the slide, snap the scanning objective back into place.
6. Before putting the microscope away, use a Kimwipe to clean the ocular lenses and (if you’ve been using oil) the objective lenses.

Part 2: Animal development

Lab manual fig. 3.9

Instructions: Use the microscope slide indicated below to test the hypotheses listed below.
Questions that this procedure will answer: At what stage does a starfish begin to gain volume (grow larger)? Before that stage, what happens to the sizes of the cells? At what stage are the cells so small that they cannot be discerned, even at high power?

Lab report:

Hypotheses: A starfish begins to gain volume at the four-cell stage.
A starfish begins to gain volume at the eight-cell stage.
A starfish begins to gain volume at the blastula stage.
A starfish begins to gain volume at the early gastrula stage.
A starfish begins to gain volume at the late gastrula stage.
A starfish begins to gain volume at the bipinnaria larva stage.

Specimens to illustrate: stages of starfish development on the Starfish development w.m. slide
Terms with which to label figure(s):
unfertilized egg
fertilized egg
four-cell stage
eight-cell stage
blastula
early gastrula
late gastrula (in the lab manual, this is just labeled “gastrula”)
bipinnaria larva

Also label the blastopore in your drawing of the early gastrula, and label the archenteron in your drawing of the late gastrula.
Lab B (anatomy): vertebrates

Part 1: The amniote ribcage:
Instructions: Observe the skeletons of the following animals to test the following hypotheses.

Mammals: cat, bat, monkey, human
Reptiles: lizard, snake, pigeon

Questions that this procedure will answer: In which group (Mammalia or Reptilia) is the ribcage continuous from the shoulder to the pelvis, and in which group is there a division between a ribbed thoracic region and a ribless lumbar region?

Lab report:
Hypotheses:
Division between a ribbed thoracic region and a ribless lumbar region is present in Reptilia.
Division between a ribbed thoracic region and a ribless lumbar region is absent in Reptilia.
Division between a ribbed thoracic region and a ribless lumbar region is present in Mammalia.
Division between a ribbed thoracic region and a ribless lumbar region is absent in Mammalia.

Specimens to illustrate: none

Part 2: Viscera (internal organs) of the cat and the shark

Instructions: 1. Before dissection, line the dissection tray with one layer of paper towels to absorb preservative and minimize the effort it takes to clean the tray later.
2. Dissect a shark (following the instructions given verbally by the teacher) and compare its internal organs (brain, respiratory system, digestive tract, spleen, etc.) with those of a cat, or dissect a cat and compare its internal organs with those of a shark.
3. Follow the verbal instructions given by the teacher as to the use of the saw, scissors, and scalpel.

Note: a. The scalpel is to be used only rarely, in fact almost never.
   b. Never use the scalpel on any tough material (e.g. bone, cartilage, etc.)
   c. For most cuts, use the scissors.

Questions that this procedure will answer: Are the internal organs of a shark identical to those of a cat? What, if anything, is different between the two animals in regard to the morphology and/or location of the brain, respiratory system, digestive tract, spleen, and reproductive organs?

Lab report:
Hypotheses:
There are no differences between the internal organs of a shark and those of a cat.
There are differences between the internal organs of a shark and those of a cat.

Specimens to illustrate: preserved shark, preserved cat
Terms with which to label figure(s): (names of any organs for which your group found differences between shark and cat)

Note: in the Results section, be specific about what differences (color, size, shape, etc.) are present between the cat organs and the shark organs.

Cleanup procedure (for this and subsequent lab periods):
1. Place dissected animals and trash in a bucket that your teacher will specify. (Exception: cats. Double-bag them using bags the teacher provides. The teacher will dispose of them later.)
2. Use dish soap and a scrubber to scrub your trays clean. Scrub even the sides and the undersides to remove any gunk that may have dripped downward from trays that were stacked above your tray after the last lab period. Important: If the sink does not drain, use a gloved hand to seize any cat hair, animal gunk, cover slips, etc. that have clogged the drain entrance, and dispose of this trash. You may have to repeat this several times while washing. Last person to wash dishes in the sink: After the water has drained, wipe sides and bottom of sink with a paper towel and alcohol.
3. Stack dishes in the special way that your teacher will show you.
4. Disinfect tabletop on which dissection was performed, by spraying alcohol on it and wiping thoroughly with a paper towel.
Lab C (taxonomy): mammals

Instructions: Of the various mammal specimens on the tables in the lab room, choose ten. Of the ten, choose at least one from each table. While in the lab, draw each of the ten specimens, and label them “Fig. 1,” “Fig. 2,” etc.

For the lab report, follow the example on p. 9 of this syllabus to list the taxa to which each specimen belongs. For each specimen, list the following:

- phylum
- subphylum
- class
- order
- family
- genus
- species
- common name
- figure number

Note: for most specimens the genus, species, and common name are given for you on a tag.

A list of taxa to which each specimen belongs can be found on www.wikipedia.org by doing a search on the animal’s common name. For example, for the domestic pig, if you run a search for “domestic pig,” Wikipedia will take you to the domestic pig page, and in the upper right of the page is the taxonomic breakdown.

Note: on some pages, Wikipedia lists more taxonomic ranks than you need. For example, it may list subspecies. But because subspecies is not on the list above, there is no need to add subspecies to the lab report.

Note: Wikipedia does not list the subphylum for any of these animals. For all mammals, the subphylum is Vertebrata.
**Lab D (taxonomy): reptiles, amphibians, and fishes**

Instructions: Of the various animal specimens on the tables in the lab room, choose ten. Of the ten, choose at least one from each table. While in the lab, draw each of the ten specimens, and label them “Fig. 1,” “Fig. 2,” etc.

For the lab report, follow the example on p. 9 of this syllabus to list the taxa to which each specimen belongs. For each specimen, list the following:

- phylum
- subphylum
- class
- order
- family
- genus
- common name
- figure number

**Note:** This time, you do not need to list the species name.
**Note:** for most specimens the genus, species, and common name are given for you on a tag.

If using Wikipedia, use the same procedure described on the previous page for Lab C.

**Note:** on some pages, Wikipedia lists more taxonomic ranks than you need. For example, it may list subspecies. But because subspecies is not on the list above, there is no need to add subspecies to the lab report.

**Note:** Wikipedia does not list the subphylum for any of these animals. For all of them, the subphylum is Vertebrata.
Lab E (anatomy): lower chordates and Echinodermata

Part 1: Amphioxus

Instructions: Observed preserved amphioxus to test the hypotheses below, and observe microscope slides of amphioxus to illustrate the internal organs of amphioxus.

Questions that this procedure will answer: Is an amphioxus radially or bilaterally symmetrical?

Lab report:
Hypotheses: An amphioxus is radially symmetrical.
An amphioxus is bilaterally symmetrical.

Specimens to illustrate: preserved amphioxus; amphioxus on Amphioxus w.m. slide
Terms with which to label figure(s):
notochord
pharynx (labelled “gill bars” in lab manual)
intestine
anus
post-anal tail (labelled “caudal fin” in lab manual)
nerve cord

Part 2: Echinodermata

Instructions: Use scissors to dissect a starfish or a sea cucumber, and use observations of both (one which your group will dissect, and the other which another group will dissect) to test the hypotheses below.

Questions that this procedure will answer: Internally, is a starfish radially or bilaterally symmetrical?
Internally, is a sea cucumber radially or bilaterally symmetrical?

Lab report:
Hypotheses: Internally, a starfish is radially symmetrical.
Internally, a starfish is bilaterally symmetrical.
Internally, a sea cucumber is radially symmetrical.
Internally, a sea cucumber is bilaterally symmetrical.

Specimens to illustrate: preserved starfish; preserved sea cucumber
Terms with which to label figure(s):
starfish
madreporite plate
tentacles
stone canal
pharynx
ring canal
stomach
radial canal
intestine
ampulla
cloaca
tube feet
anus
gonad
gonad
pyloric ceca
tube feet
cardiac stomach
respiratory tree
pyloric stomach
intestine
anus
Lab F (anatomy): Arthropoda

Part 1: Comparison of appendages in horseshoe crab and crayfish

Lab manual fig. 13.1, 14.1

Instructions: Use observations of the external anatomy of a preserved horseshoe crab and a preserved crayfish to test the hypotheses below.

Questions that this procedure will answer: Are the appendages of a horseshoe crab identical to those of a crayfish?

Lab report:

Hypotheses: The appendages of a horseshoe crab are identical to those of a crayfish.
The appendages of a horseshoe crab are not identical to those of a crayfish.

Specimens to illustrate: preserved horseshoe crab; preserved crayfish

Terms with which to label figure(s):

<table>
<thead>
<tr>
<th>horseshoe crab</th>
<th>crayfish</th>
</tr>
</thead>
<tbody>
<tr>
<td>subphylum Chelicerata</td>
<td>subphylum Crustacea</td>
</tr>
<tr>
<td>compound eye</td>
<td>eye</td>
</tr>
<tr>
<td>carapace</td>
<td>antennules</td>
</tr>
<tr>
<td>abdomen</td>
<td>antennae</td>
</tr>
<tr>
<td>telson</td>
<td>chelipeds</td>
</tr>
<tr>
<td>chelicerae</td>
<td>walking legs</td>
</tr>
<tr>
<td>pedipalps</td>
<td>swimmerets</td>
</tr>
<tr>
<td>walking legs</td>
<td>uropods</td>
</tr>
<tr>
<td>mouth</td>
<td>telson</td>
</tr>
<tr>
<td>book gills</td>
<td>carapace</td>
</tr>
<tr>
<td>genital operculum</td>
<td>abdomen</td>
</tr>
</tbody>
</table>

Part 2: Crayfish appendages and gills

Lab manual fig. 14.3

Instructions: Remove all the appendages of a crayfish on one side. Use observations of the appendages to test the hypotheses below.

Questions that this procedure will answer: Which crayfish appendages bear gills?

Lab report:

Hypotheses: Crayfish maxillae bear gills.
Crayfish maxillae do not bear gills
Crayfish maxillipeds bear gills.
Crayfish maxillipeds do not bear gills.
Crayfish chelipeds bear gills.
Crayfish chelipeds do not bear gills.
Crayfish walking legs bear gills.
Crayfish walking legs do not bear gills.
Crayfish swimmerets bear gills.
Crayfish swimmerets do not bear gills.

Specimens to illustrate: none.

Continued on next page
Part 3: Crayfish internal anatomy

Lab manual fig. 14.4

Instructions: Use scissors to remove one side of the carapace and the exoskeleton of the abdomen. Use observations of the internal anatomy to test the hypotheses below.

Questions that this procedure will answer: Is the antennal gland really green?

Lab report:

Hypotheses: The antennal gland is green.
The antennal gland is not green.

Specimen to illustrate: preserved crayfish

Terms with which to label figure(s):
- antennal gland
- nerve cord
- cardiac stomach
- pyloric stomach
- intestine
- anus
- heart
Lab G (taxonomy): arthropods

Instructions: Of the various arthropod specimens on the tables in the lab room, choose ten. Of the ten, choose at least one from each table. While in the lab, draw each of the ten specimens, and label them “Fig. 1,” “Fig. 2,” etc.

For the lab report, follow the example on p. 9 of this syllabus to list the taxa to which each specimen belongs. For each specimen, list the following:

- phylum
- subphylum
- class
- order
- family
- genus
- figure number

Note: This time, you do not need to list the species name or common name.
Note: for most specimens the genus is given for you on a label. If the genus name is not given, do not use the specimen.

If using Wikipedia, use the same procedure described on the previous page for Lab C, but run a search on the genus name instead of the common name.

Note: on some pages, Wikipedia lists more taxonomic ranks than you need. For example, it may list subspecies. But because subspecies is not on the list above, there is no need to add subspecies to the lab report.

Note: Wikipedia lists the subphylum for some of these animals but not all of them. If it does not list the subphylum, click on the class name and Wikipedia will take you to a page on which the subphylum is listed.

Problems with certain specimens:

- *Peneus*: This is misspelled on the label. The correct spelling is *Penaeus*. On Wikipedia, search using the correct spelling.

- *Phosphorea*: Wikipedia does not have an article on this genus. Do not use it.

- *Spirobolus*: Wikipedia does not have an article on this genus. Do not use it.
Lab H (anatomy): Annelida, Mollusca

Part 1: Earthworm

Instructions: Use a scalpel to make a longitudinal incision all the way down an earthworm. Use observation of the viscera to test the hypotheses below.

Questions that this procedure will answer: Does every segment of an earthworm contain the same set of contents?

Lab report:
Hypotheses:
- Each segment of an earthworm contains the same contents.
- Not every segment of an earthworm contains the same contents.

Specimen to illustrate: preserved earthworm
Terms with which to label figure(s):
- clitellum
- nerve cord
- pharynx
- esophagus
- crop
- gizzard
- seminal vesicles
- nephridium

Part 2: Mussel

Instructions: Use scissors to pry open the valves of a preserved mussel and to cut the adductor muscles so that it opens easily. Next, use scissors to cut away the left mantle, exposing the rest of the internal organs. Use observations of the organs to test the hypotheses below.

Questions that this procedure will answer: Internally, is a mussel bilaterally symmetrical?

Lab report:
Hypotheses:
- Internally, a mussel is bilaterally symmetrical.
- Internally, a mussel is not bilaterally symmetrical.

Specimens to illustrate: preserved mussel
Terms with which to label figure(s):
- valve
- umbo
- mantle
- foot
- anterior adductor
- posterior adductor
- gill
- stomach
- intestine
- digestive gland
Lab I (anatomy): Platyhelminthes

Lab manual fig. 9.1, 9.2, 9.3, 9.7

Instructions: Use observations of specimens on microscope slides to test the hypotheses below. Use a specimen of Planaria (class Turbellaria), a specimen of Clonorchis (class Trematoda), and a specimen of Dipylidium (Cestoda).

Remember to use the microscope procedures from Lab A (wiping the lenses, starting and ending on scanning power, etc.)

Questions that this procedure will answer: Are the digestive and reproductive tracts identical in the three classes of Platyhelminthes?

Lab report:

Hypotheses: The digestive tract is identical in members of all three classes of Platyhelminthes.
The digestive tracts differ between the members of the three classes of Platyhelminthes.
The reproductive tract is identical in members of all three classes of Platyhelminthes.
The reproductive tracts differ between the members of the three classes of Platyhelminthes.

Specimens to illustrate: Planaria on Planaria slide or Planaria plain and digestive tract slide;
Clonorchis on Clonorchis sinensis slide
Dipylidium on Dipylidium caninum slide

Terms with which to label figure(s):

<table>
<thead>
<tr>
<th>Planaria</th>
<th>Clonorchis</th>
<th>Dipylidium</th>
</tr>
</thead>
<tbody>
<tr>
<td>class Turbellaria</td>
<td>class Trematoda</td>
<td>class Cestoda</td>
</tr>
<tr>
<td>pharynx</td>
<td>oral sucker</td>
<td>testes</td>
</tr>
<tr>
<td>intestine</td>
<td>ventral sucker</td>
<td>vas deferens</td>
</tr>
<tr>
<td>eyespots</td>
<td>pharynx</td>
<td>vagina</td>
</tr>
<tr>
<td>auricles</td>
<td>intestine</td>
<td>ovary</td>
</tr>
<tr>
<td></td>
<td>yolk gland</td>
<td>yolk gland</td>
</tr>
<tr>
<td></td>
<td>uterus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>anterior testis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>posterior testis</td>
<td></td>
</tr>
</tbody>
</table>
Lab J (anatomy): Cnidaria, Porifera

Part 1: Cnidaria
Lab manual fig. 8.1, 8.3
Instructions: Use observations of specimens on microscope slides to test the hypotheses below.

Questions that this procedure will answer: How many cell layers are in the body wall of a Hydra?
The tentacle of an Obelia hydroid is how many cells in diameter? Does an Obelia medusa have three-part, four-part, or five-part symmetry?

Lab report:
Hypotheses: 1. In Hydra, the body wall is only one cell layer thick. 2. In Hydra, the body wall is more than one cell layer thick. 3. The tentacle of an Obelia hydroid is only one cell in diameter. 4. The tentacle of an Obelia hydroid is more than one cell in diameter. 5. An Obelia medusa has three-part symmetry. 6. An Obelia medusa has four-part symmetry. 7. An Obelia medusa has five-part symmetry.

Specimens to illustrate: Hydra on Hydra c.s. slide Obelia on Obelia hydroid colony slide Obelia on Obelia medusa or Obelia medusa strew slide

Terms with which to label figure(s):

<table>
<thead>
<tr>
<th>Hydra</th>
<th>Obelia hydroid colony</th>
<th>Obelia medusa</th>
</tr>
</thead>
<tbody>
<tr>
<td>epidermis</td>
<td>coenosarc</td>
<td>medusa</td>
</tr>
<tr>
<td>mesoglea</td>
<td>perisarc</td>
<td>gonad</td>
</tr>
<tr>
<td>gastrodermis</td>
<td>gonangium</td>
<td></td>
</tr>
<tr>
<td>gastrovascular cavity</td>
<td>hydranth (polyp)</td>
<td></td>
</tr>
</tbody>
</table>

Part 2: Porifera
Lab manual fig. 7.1
Instructions: Use observations of specimens on microscope slides to test the hypotheses below.

Questions that this procedure will answer: Are the radial canals of Grantia lined with choanocytes or pinacocytes?

Are all Grantia spicules identical? Are Grantia spicules and commercial sponge fibers identical?

Lab report:
Hypotheses: 1. The radial canals of Grantia are lined with choanocytes. 2. The radial canals of Grantia are lined with pinacocytes. 3. All Grantia spicules are identical. 4. Not all Grantia spicules are identical. 5. Grantia spicules and commercial sponge fibers are identical. 5. Grantia spicules and commercial sponge fibers are not identical.

Continued on next page
Specimens to illustrate:

- *Grantia* on *Grantia choanocytes c.s.* slide
- *Grantia* spicules on *Grantia spicules* slide
- commercial sponge fibers on *commercial sponge fibers* slide

Terms with which to label figure(s):

<table>
<thead>
<tr>
<th><em>Grantia</em> cross-section</th>
<th><em>Grantia</em> spicules</th>
<th>commercial sponge fibers</th>
</tr>
</thead>
<tbody>
<tr>
<td>spongocoel</td>
<td>spicules</td>
<td>fibers</td>
</tr>
<tr>
<td>radial canal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>choanocytes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lab K (anatomy): protozoans

Lab manual fig. 6.1, 6.2, 6.5, 6.8, 6.15, 6.17
Instructions: Use observations of specimens on microscope slides to test the hypotheses below.

Questions that this procedure will answer:
Do specimens of *Amoeba proteus* all take the same shape when prepared for a microscope slide?
Are all radiolarian tests (shells) identical?
Are cilia and flagella thick enough in diameter to be visible at high power (or lower powers) with a light microscope?

Lab report:
Hypotheses:
- Specimens of *Amoeba proteus* all take the same shape when prepared for a microscope slide.
- Specimens of *Amoeba proteus* do not all take the same shape when prepared for a microscope slide.
- All radiolarian tests are identical.
- Not all radiolarian tests are identical.
- Cilia and flagella are thick enough in diameter to be visible at high power with a light microscope.
- Cilia and flagella are not thick enough in diameter to be visible at high power with a light microscope.

Specimens to illustrate:
- *Amoeba proteus* on *Amoeba proteus* slide
- Radiolarian tests on *Radiolaria w.m.* or *Radiolaria strew* slide
- *Euglena* on *Euglena* slide
- *Volvox* on *Volvox* or *Volvox asexual reproduction* slide
- *Paramecium* on *Paramecium caudatum* slide
- *Vorticella* on *Vorticella w.m.* slide

Terms with which to label figure(s):

<table>
<thead>
<tr>
<th>Amoeba</th>
<th>Radiolaria</th>
</tr>
</thead>
<tbody>
<tr>
<td>phylum Amoebozoa</td>
<td>phylum Radiolaria tests</td>
</tr>
<tr>
<td>pseudopodia</td>
<td></td>
</tr>
<tr>
<td>nucleus</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Euglena</th>
<th>Volvox</th>
<th>Paramecium</th>
<th>Vorticella</th>
</tr>
</thead>
<tbody>
<tr>
<td>phylum Euglenozoa</td>
<td>clade Viridiplantae</td>
<td>phylum Ciliophora nucleus</td>
<td>phylum Ciliophora stalk</td>
</tr>
<tr>
<td>chloroplasts</td>
<td>daughter colony</td>
<td></td>
<td>cytopharynx</td>
</tr>
</tbody>
</table>
Lab L (live animals): live animals under the microscope

Lab manual Key to Common Freshwater Aquatic Invertebrates of North America (pp. 380-384)

Instructions: You will examine water drops from each of four sources. For three of the four sources, use a dropper to place a drop of water on a slide. If one source is moss, touch the moss to the surface of the slide and wiggle the moss a little; this will shake microscopic organisms off the moss and onto the slide. Using a light microscope, observe the live animals to determine which phyla are present.

Question that this procedure will answer: Members of which phyla are present in these four samples?

Lab report:
In the Results section, tell which phyla you saw in each sample.

Specimens to illustrate: whatever animals and protozoa you find in the pond water.
## Appendix 4: Animal Observation Field Log

### Rubric for grading field logs

<table>
<thead>
<tr>
<th>Point value</th>
<th>Points earned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **The report is typed, is single-spaced, and is in 12-point font.**  
  - 3

- **The field log includes 3 hours of animal observation, with no**  
  - observation period of less than 20 minutes. The animals are  
  - not pets, are non-human, and are awake.  
  - 15

- **At the top of the first page is the name(s) of the student(s), the semester**  
  - and year, and a line with “ZOOL 200 animal observation field log”  
  - 3

- **The first paragraph of each observation includes:**  
  - the date of the observation  
  - the time (or approximate time) of the observation  
  - the geographic location of the observation  
  - a brief description of environmental factors such as weather and  
  - temperature,  
  - 4

- **Each observation begins with an underlined heading that mentions the**  
  - duration of the observation.  
  - 2

- **The observations of behavior are described in great detail.**  
  - 3

- **For every animal mentioned, immediately after the first mention of the**  
  - common name, there follows a taxonomic name in parentheses,  
  - preferably the genus and species. If genus and species are not known,  
  - use the smallest taxon to which you are certain the animal belongs.  
  - 3

- **Taxonomic conventions of capitalization and font (italics or no italics) are**  
  - correctly followed.  
  - 2

**Total:**  
- 35

See next page for an example to follow, for writing field log.
First observation: 20 minutes
On July 26, 2012, we stood on the lower of the two public observation decks at Brooks Falls in Katmai National Park, Lake and Peninsula County, Alaska, and observed brown bears (Ursus arctos). The observations occurred over a 20-minute period outdoors on a sunny day with a temperature between 60° and 70° F. The observations were made at a shallow, rocky river with a waterfall approximately six feet high, with thick forest on either side of the river.

As we stood on the lower deck, the waterfall was about 100 yards upstream to our left. A group of four brown bears, each standing on all fours, was spread out across the river at the base of the waterfall, waiting for salmon to leap up the waterfall from below. The four bears were approximately evenly spaced, each about 18 feet from the next, each facing the waterfall. We designated them Bears 1 – 4, in order from our left to our right. Two gulls (Larus) circled overhead, and a third stood on a rock between Bears 2 and 3.

About 30 s into our observations, Bear 4 turned to the left and leapt into the water, apparently after a salmon, which it missed. Bear 4 pounced a second time in approximately the same spot, then walked across the river to our left and up the bank.

A fifth bear (Bear 5) with lighter-colored fur than the others approached the deck from our left from the woods, then plunged into the river’s edge, apparently after a salmon, which it missed. Bear 5 then walked back ashore and out of sight into the woods. Bear 4 reentered the river from the left, about 20 feet behind and to the left of Bear 1. Bear 5 then also reentered the river from the left about 40 feet behind Bear 4, walked toward Bear 4, then turned around and bounded downstream away from Bear 4. Bear 4 walked a little to the right, startling into flight two gulls that had landed nearby. Bear 5 turned toward the middle of the river and pounced, missing another salmon. It then walked to the middle of the river, startling into flight a gull that had landed there on a rock. Bear 5 climbed onto the rock and pounced into the water, missing another salmon. It then stood on its hindlimbs, shook water off its neck, and climbed back onto the rock. There it leaned back and forth to the left and right for about 30 s, then left its rock and climbed onto another rock about 10 feet away, displacing two gulls that had been standing on the rock. It stayed there only a few seconds, then walked halfway to the opposite bank, turned and walked a few paces upstream, found another rock, stood bipedally on it, then headed back downstream with its face in the water for a few seconds. It lifted its head up, walked a bit further, and pounced in the water again, missing another salmon. It then stood bipedally briefly, resumed walking with its face in the water, stood bipedally again briefly, and resumed walking downstream with its face alternately in and out of the water. It continued this alternation, changing direction frequently, for several minutes until it finally caught a salmon with a successful pounce.

Sitting on its haunches in the middle of the river, Bear 5 held the salmon in its forepaws and used its teeth to rip off the salmon’s skin. As it did so, Bear 4 circled it from behind, then approached Bear 5 from the front and growled from just over one body’s length away. Bear 5 turned its head to the right in an apparent attempt to ignore Bear 4. Bear 4 came closer to Bear 5, lowered its head, and bellowed twice. Bear 5 rushed toward Bear 4 with an open mouth, and the two stood bipedally and crashed into each other’s chests. They then stood facing each other on all fours with lowered heads for about 5 s. Bear 5 then picked up the salmon, which Bear 4 had dropped, and slowly walked with it toward the opposite shore as Bear 5 stood in place and watched. Bear 5 then turned toward the waterfall with lowered head and ears, then left the river toward the left bank.

After eating the salmon, Bear 4 returned to where it had left Bear 5. Bear 1 caught a salmon and carried it across the river toward the opposite shore. Bear 1 passed immediately in front of Bear 4 but crossed the river unchallenged and ate its fish at the river’s edge. Meanwhile, Bear 1 made nervous-looking left and right neck motions, keeping its snout mainly pointed downward. Bear 1 then returned to the river, and Bear 4 moved downstream. Bear 1 took the spot where Bear 4 had just been, caught a salmon, and began to eat it. Bear 4 approached Bear 1 to about 10 feet but did not challenge Bear 1 as it fed. After finishing the salmon, Bear 1 moved back to its original spot on the left at the waterfall. Bear 4 then moved to where Bear 1 had eaten the salmon, stood bipedally and looked around, apparently for pieces of salmon, but found none and then stood on all fours facing the waterfall.
Second observation: 60 minutes
On July 17, 2012, we observed a snail (Gastropoda)…. [note to students: to save paper, I’ll stop the example here.]