I. CLASS DESCRIPTION

The evolution of vertebrates is one of the most compelling stories in comparative biology. For millions of years vertebrates have flourished in the seas and on land by employing a variety of morphological specializations for feeding, locomotion, and reproduction. Yet, all vertebrates retain similarities in their design regardless of how structural components function in different lineages and environments. This course examines the shared and transformed anatomical attributes among vertebrates in the context of function and phylogenetic history. We pursue that objective by integrating lecture discussions with laboratory observations, dissections and an independent project. Prerequisites: BIOL 305 or EOSC 301W. 4 units.

II. LEARNING OUTCOMES

- Be able to recognize the evolutionary relationships among the Major Vertebrate groups and think about vertebrate relationships in the context of descent with modification.
- Explain why knowledge of comparative anatomy is critical to understanding human form and function.
- Be able to give an example of descent with modification for each of the anatomical systems we examine:
  - Musculoskeletal (cranial and axial)
  - Integumentary
  - Circulatory
  - Digestive
  - Nervous
- Be able to independently analyze an unknown anatomical specimen.
- Be able to analyze several types of anatomical information including live specimens, preserved whole specimens, anatomical preparations as well as medical imaging (x-rays, CT scans, MRI, histological slides).
- Infer function from anatomical form comparisons.

III. REQUIRED TEXTBOOK AND OTHER MATERIALS

IV. COURSE STRUCTURE

The class will meet twice weekly for a combined lecture and laboratory period. Students will study, and on some occasions, dissect preserved specimens; discuss the evolutionary relationships of vertebrate groups and track the evolution of vertebrate form; discuss and when possible test the relationship between form and function. Learning will be student-centered with group activities and peer-to-peer teaching and learning. iPads will be used as electronic notebooks during activities, to hold textbook and dissection notes and document project/dissection progress to be shared with peers. An atlas of human anatomy (supplied with the issued iPads) will be used to compare human anatomy throughout the course.

V. REQUIRED ASSIGNMENTS

Research project (20%): Students will work in pairs over the entire semester, to identify, prepare and analyze a zoological specimen randomly chosen by them from the professor’s collection, in order to develop the practical skills necessary for comparative anatomy, practice scientific writing and synthesize the material presented in the classroom. Over the course of the semester, they will submit and obtain feedback the following items: specimen identification, literature review, proposal, specimen preparation, data collection, analysis, first draft of manuscript. The final manuscript will be graded based on a rubric that will be made available to the students.

In class topic presentations (2.5%): Students are expected to read the relevant pages of the dissecting guide and plan for the week before coming to class. To encourage student participation, a student will be picked at random each class to present the topic, activities (e.g. dissections) for the rest of the class. Students may be selected multiple times over the semester, and presentation will be graded as satisfactory/unsatisfactory.

Weekly presentations of vertebrate coolness (2.5%): Students will sign up at the beginning of the semester for one class each during which they will present a topic of interest from the news relevant to vertebrate evolution and anatomy. They will present the topic in a 2 slide presentation (maximum 5 minutes) to the classroom, in order to practice the distillation of important and exciting information. Graded as satisfactory /unsatisfactory.
Prelab quizzes/ assignments (2.5%): Weekly assignments will prepare students for class participation by giving examples of the type of questions that will be asked during an exam, so that students can focus on the important type of information during class. Submitted and graded online as satisfactory/unsatisfactory.

Weekly post-lab quiz (2.5%): Students will repeat the preparatory exercise for that week, but this time it will be graded. This exercise will reinforce understanding of the material and will provide feedback to the instructor on unclear topics.

Two midterm exams (20% each, 40% total): These will serve as assessments of student progress and will consist of fill-in the blank or short answers, short essays and anatomical identifications.

Final Exam (20% for new material, 10% cumulative, 30% total): Same format as midterm exams.

VI. COURSE POLICIES

Attendance is mandatory. Tardiness of more than 5 minutes will be considered an absence. If you have to miss a class you need to have a valid medical excuse and provide the instructor with a note. More than one inexcusable absence will automatically result in an incomplete grade.

Assignments are designed to help you prepare for class, reinforce in-class material, and provide an occasion for applying your knowledge and skills. Therefore, all assignments must be completed on time and submitted via Blackboard. No late assignments and no email or paper assignments will be accepted - no exceptions.

Exceptions: you may be excused from preparing for 2 class meetings. This includes in-class topic presentations, Weekly presentations of vertebrate coolness, Prelab quizzes/ assignments and Weekly post-lab quizzes. To be excused you must submit a request online (Blackboard) before the beginning of class.

Safety is our priority. No open toed shoes, no eating or drinking in the lab, no make-up application in the lab. First day included!

Academic integrity is expected of all students and faculty at USD. In this class, this means no plagiarizing assignments from any other source including your fellow class mates. It also means acting in a collegial manner, participating equally in your group and assisting your classmates whenever required.

Accessibility: Every attempt will be made to accommodate all types of learners. Please see instructor with your requests.

Cell Phone Policy: The use of cell phones during lecture and laboratory time is prohibited. This includes texting or answering/making phone calls. Please silence your phones prior to the beginning of class (vibrate mode does not count).
Use of Animals: In this class we will be dissecting a number of different animals including a lamprey, shark, salamander, and rabbit. I expect that all animals will be dissected properly and with respect to the animals. I use real animals for dissection because it provides greater learning than models or computer programs alone. To learn anatomy effectively, you must get your hands dirty (figuratively, we have gloves to keep your hands clean). If you have concerns with the dissections, please come to see me so we can discuss your concerns.

Inclusion and Diversity: In learning about organismal diversity we will also celebrate the diversity among us. This class welcomes students from all ethnic and racial backgrounds regardless of sexual orientation, gender or socioeconomic background. IF YOU EVER FEEL UNCOMFORTABLE BY SOMEONE’S ACTIONS OR SPEECH, PLEASE TALK TO DR. DANOS. CLASSROOM LEARNING WILL NOT BE LIMITED TO COMPARATIVE ANATOMY AND CONVERSATIONS ABOUT TOPICS OF INCLUSION ARE PARTICULARLY ENCOURAGED. IF THE ACTIONS/SPEECH ARE OF DR. DANOS AND YOU ARE NOT READY TO DISCUSS IT WITH HER, YOU CAN ADDRESS YOUR CONCERNS WITH ANY OTHER MEMBER OF THE USD FACULTY INCLUDING THE BIOLOGY CHAIR DR. MICHAEL MAYER.

VII. GRADING AND ASSESSMENT

Grading is not curved to encourage collaboration and team work. Final grades will follow the scheme below:

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

To do well in this class:
- Review material weekly.
- Work with your classmates- organize weekly study hours.
- Participate in classroom activities, including dissections, note taking, annotating images and drawings.
- Start working on your project early, ask questions often.
### VIII. Class schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Textbook reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Introduction</td>
<td>Chapter 1</td>
</tr>
<tr>
<td>Week 2</td>
<td>Vertebrate Diversity</td>
<td>Chapter 2 &amp; 3</td>
</tr>
<tr>
<td>Week 3</td>
<td>Life History</td>
<td>Chapter 4</td>
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<tr>
<td>Week 4</td>
<td>Integumentary structures</td>
<td>Chapter 6</td>
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<td><strong>Midterm 1</strong></td>
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<tr>
<td>Week 5</td>
<td>Cranial Skeleton</td>
<td>Chapter 7</td>
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<tr>
<td>Week 6</td>
<td>Postcranial Skeleton- Axial- Appendicular</td>
<td>Chapters 8 &amp; 9</td>
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<tr>
<td>Week 7</td>
<td>Muscular System</td>
<td>Chapter 10</td>
</tr>
<tr>
<td>Week 8</td>
<td>Muscular System</td>
<td><strong>Midterm 2</strong></td>
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<tr>
<td>Week 9</td>
<td>Respiratory System</td>
<td>Chapter 11</td>
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<tr>
<td>Week 10</td>
<td>Circulatory System</td>
<td>Chapter 12</td>
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<tr>
<td>Week 11</td>
<td>Digestive System</td>
<td>Chapter 13</td>
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<tr>
<td>Week 12</td>
<td>Urogenital System (No class on Thanksgiving Thursday)</td>
<td>Chapter 14</td>
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<tr>
<td>Week 13</td>
<td>Nervous System</td>
<td>Chapter 16</td>
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<tr>
<td>Week 14</td>
<td>Sensory Organs</td>
<td>Chapter 17</td>
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<tr>
<td>Week 15</td>
<td><strong>Final presentations and Review</strong></td>
<td></td>
</tr>
<tr>
<td>Date TBD</td>
<td><strong>Final Exam</strong></td>
<td></td>
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**NOTE:** Final project poster presentation will take place on December 12\textsuperscript{th} during 12:00-2:00pm in a joint session with other classes. Lunch will be served.