

**Kingsborough Community College  
The City University of New York  
Department of Biological Sciences**

**Biology 2100 - Section 01-Lec (13813) and Section 01L-Lab (13402)**

**Comparative Anatomy  
Course Outline – Fall 2023**

Professor: Mary Theresa Ortiz, Ph.D.

Email: [MOrtiz@kbcc.cuny.edu](mailto:MOrtiz@kbcc.cuny.edu)

Lecture and Laboratory are online. Classes start 9/8/23 and end 12/8/23.

**Course Description**

Biology 21 is a 4-credit, 6-hour course with laboratory and lecture components, open to students who have completed Biology 14, and have passed the CUNY Math and English exams. It fulfills one of the two (Group V) laboratory course requirements for Biology majors.

This semester this course is offered in a hybrid format. Students are expected to know Blackboard, Word, and Email (including attachments) as well as have access to the Internet and spend significant time doing online reading and writing assignments. Course fulfills writing intensive graduation requirement. Honors enrichment component option available for students with a G.P.A. of 3.2 or higher.

Form, structure, classification and adaptive modifications of vertebrates, animals with backbones. Through dissections, representative vertebrates [dogfish, cat, etc.] are studied; vertebrates' major body systems and development of various representative structures are compared; relationships between form and function, and the use of certain structures in specific environments.

**Required Text:**Vertebrates – Comparative Anatomy, Function, Evolution

Kenneth V. Kardong, Ph.D., McGraw-Hill, New York

You may use any of the following editions of the textbook: 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup>, 8<sup>th</sup>

Below is a link to the 6<sup>th</sup> edition of the textbook:

<https://ia801607.us.archive.org/16/items/KardongVertebratesComparativeAnatomyFunctionEvolution6thTxtbk/>

Once the page opens, click on the first listing to open the book (it will take several minutes to load). Be patient.

Once open, save it for reading so that you do not have to download it again.

**Required Laboratory Manual:**Lab exercises supplied via Comparative Anatomy Lab Manual on Blackboard.

**Required Laboratory Equipment:** Online Lab Manual and Videos posted in Blackboard. A full-length lab coat, closed-toed shoes, and goggles are required to enter the lab. No one will be admitted to lab without the above.

**Course Outcomes**

1. Recognize the relationships between form and function in vertebrates.
2. Compare anatomy and body systems across the vertebrate classes, identifying similarities and differences, and conjecturing on adaptive modifications through natural selection.
3. Recognize the significance of embryonic development in vertebrate anatomical formation.

4. Further develop skills in observations and manual dexterity through careful and comprehensive dissection of representative vertebrates, recognizing their specialized design adaptations.
5. Conduct research as part of a class project utilizing knowledge of comparative anatomy.

#### Academic Integrity

Academic integrity means that all the work you do in this course (exams, quizzes, reports, papers, etc.) is your OWN work and no one else's. It includes not cheating on exams or quizzes in any way, as well as avoiding plagiarism in your writing. Plagiarism is using anyone else's work or ideas without proper attribution. This means that if you quote, paraphrase, or even describe in your own words, an idea that comes from someone else's writing, you MUST acknowledge that author in parentheses at the end of the sentence or sentences in which you have summarized his or her idea. Plagiarism, whether intentional or not, is taken seriously and can result in a failing grade. It is always **very** obvious if you do it, so do not risk it. If you are not sure how to reference a source, ask the instructor for help. Your instructor adheres to CUNY policy on academic integrity, which can be found in your student handbook or online at [http://www.kingborough.edu/Academic\\_Integrity\\_Policy.pdf](http://www.kingborough.edu/Academic_Integrity_Policy.pdf). These sources explain the policy in detail and give examples. Please be aware that academic dishonesty may result in a failing grade on the exam or in the course, as well as dismissal from the college. Additional websites that may be of use include: turnitin.com, citationmachine.com and plagiarism.org. (Polizzotto, K., personal communication, 2008). Any work that is plagiarized, whether intentional or not, will earn a grade of zero. Subsequent offenses will result in formal reprimands as stated above.

#### Civility Statement

As an institution of higher education, Kingsborough Community College and its faculty and staff are committed to its entire student body. As such, we strive to interact with each student equitably and professionally while providing an environment of mutual respect and civility.

In the event a student has an allegation charge brought against him/her that is a breach of the Henderson Rules to Maintain Public Order or the Campus Code of Conduct, an immediate investigation will commence followed by a conciliation conference to determine the appropriate outcome within a thirty-day period.

The Judicial Affairs process at Kingsborough Community College is critical in providing an agenda for safety, yet simultaneously offering protection of the rights of students who may have been accused of being in violation of the Henderson Rules to Maintain Public Order and/or the Campus Code of Conduct. These rights have been afforded to each Kingsborough student under the bylaws that were established in 1969.

#### Accessibility

Access-Ability Services (AAS) serves as a liaison and resource to the KCC community regarding disability issues, promotes equal access to all KCC programs and activities, and makes every reasonable effort to provide appropriate accommodations and assistance to students with disabilities. Please contact this office if you require such accommodations and assistance. Your instructor will be glad to make the accommodations you need, but you must have documentation from the Access-Ability office for any accommodations.

Pronouns: If you have preferred pronouns (ex. he/she/they), please let me know so I may use your preferences.

## LECTURE TOPICS AND SEQUENCE

<u>Week</u>	<u>Topic(s)</u>	<u>Textbook Chapter(s)</u>
1	Introduction	1
	Origin of Chordates	2
2	The Vertebrate Story	3
	Biological Design	4
3	Life History	5
	Integument	6
4	Skeletal System: The Skull	7
	Skeletal System: The Axial Skeleton	8
5	Skeletal System: The Appendicular Skeleton	9
6	The Muscular System	10
7	The Respiratory System	11
8	The Circulatory System	12
9	The Digestive System	13
10	The Urogenital System	14
11	The Endocrine System	15
12	The Nervous System	16
	Sense Organs	17

LABORATORY TOPICS AND SEQUENCE

<u>Week</u>	<u>Topic(s)</u>	<u>Lab Exercises(s)</u> (via Blackboard)
1	Amphioxus Anatomy Lamprey Anatomy	Amphioxus Dissection Lamprey Dissection
2	Dogfish Shark External Anatomy & Integument Skeletal System Muscular System	Shark 1 Dissection Shark 2 Dissection Shark 3 Dissection
3	Dogfish Shark - continued Internal Anatomy	Shark 4 Dissection
4	Dogfish Shark – continued Internal Anatomy – continued	Shark 4 Dissection
5	Perch	Perch Dissection
6	Necturus (Mud Puppy)/Salamander External Anatomy & Integumentary System Skeletal System Muscular System Internal Anatomy Salamander	Necturus 1 Dissection Necturus 2 Dissection Necturus 3 Dissection Necturus 4 Dissection Salamander Dissection
7	Reptiles – Turtle	Turtle Dissection
8	Cat External Anatomy & Integumentary System Skeletal System	Cat 1 Dissection Cat 2 Dissection
9	Cat – continued Muscular System	Cat 3 Dissection
10	Cat – continued Internal Anatomy	Cat 4 Dissection
11	Cat – continued Internal Anatomy – continued	Cat 4 Dissection
12	Research Project/Lab Wrap Up	

## Notes:

1. Comparative anatomy is an intensive study of the features common to vertebrates. The organ systems of these animals will be studied with an evolutionary theme to show the gradual trend toward greater complexity and more specialization in higher vertebrates.
2. In this course you will dissect several representative vertebrate animals as your studies take you from the simple to the more complex organisms.
3. Dissection is an art that allows us to learn and takes patience and practice. It is not mutilation.
4. You are encouraged to read each assignment and lab carefully, take accurate and complete notes, and ask questions. Comparative anatomy is an exciting learning journey. Enjoy it!

### **Attendance Policy, WU, and INC Grades**

Students who stop submitting work or responding to emails will earn a WU final grade. INC is only assigned if a student is passing the class and can pass the class if they take the final. All college policies regarding attendance and grades will be adhered to.

### **Grading**

#### **Lecture**

1. Exams - Three (3) lecture exams will be given on the dates on the tentative schedule. Each will be graded on a scale of 100 points. No make-ups will be given. A missed exam counts as a zero for that exam. However, the lowest exam grade will be dropped at the end of the semester. The two (2) highest exam grades will be counted and comprise 10% of your final grade.
2. Assignments – Assignments are assigned via Blackboard and are due online on the dates indicated on the calendar and on Blackboard. Assignments will be submitted by each group, not individually. Late assignments will not be accepted/graded and will result in a grade of zero. The lowest assignment grade will be dropped at the end of the semester. The Assignments comprise 20% of your final grade. Each student in the group will earn the same grade on each assignment.
3. Final Exam – Final exam is cumulative and comprises 20% of the final grade. Details to follow.

#### **Laboratory**

1. Practical Exams – Three (3) practical exams will be given on the dates indicated on the tentative schedule. Details for each will be provided in laboratory. Each practical exam will be graded on a scale of 100 points. No make-ups will be given. A missed practical exam counts as a zero for that exam. However, the lowest practical exam grade will be dropped at the end of the semester. The two (2) highest practical exam grades will be counted and comprise 10% of your final grade.
2. Quizzes – Quizzes will be given on the dates indicated on the tentative schedule. Each will be graded on a scale of 100 points. No make-ups will be given. A missed quiz counts as a zero for that quiz. However, the lowest quiz grade will be dropped at the end of the semester. The remaining highest quiz grades will be averaged and will comprise 10% of your final grade.
3. Research Project – Each student will participate in a class research project on live vertebrates. A report will be submitted for this project by each group. More details on the research project will follow. The Research Project comprises 30% of your final grade.

#### **Grade Summary**

Lecture:	Exams	10%	Laboratory:	Lab Quizzes	10%
	Weekly Assignments	20%		Practical Exams	10%
	<u>Final Exam</u>	<u>20%</u>		<u>Research Project</u>	<u>30%</u>
	Total	50%		Total	50%

Lecture + Laboratory = 50% + 50% = 100%

**All assignments are due on the dates indicated on the tentative schedule or as announced in class. Late assignments will not be accepted and will result in a grade of zero.**

## **BIO2100 COMPARATIVE ANATOMY TENTATIVE SCHEDULE FALL 2023**

**Week 1 – Wed 9/13/2023** (Fri 9/8/2022: class starts) Amphioxus and Lamprey Dissection; First Lab  
Complete lecture and lab readings and view lab videos in Week 1 on Blackboard. Lab 1 on 9/13/23.

**Week 2 – Wed 9/20/2023** Shark Dissection 1

Mon 9/18/2023 – **Lecture Assignment 1** due 9am EST as a Word document uploaded to File Exchange in your group on Blackboard.

Wed 9/20/2023 – **Quiz 1** at the start of Lab 2 on the Amphioxus and Lamprey.  
Complete lecture and lab readings and view lab videos in Week 2 on Blackboard.

**Week 3 – Wed 9/27/2023** Shark Dissection 2

Tue 9/26/2023 – **Lecture Assignment 2** due 9am EST as a Word document uploaded to File Exchange in your Group on Blackboard.

Wed 9/27/2023 – **Lab Quiz 2** at the start of Lab 3 on the external anatomy of the shark.  
Complete lecture and lab readings for Week 3 and review lab videos in Week 2 on Blackboard.  
Note: See Exam 1 Additional Study Questions in Week 3 on Blackboard.

**Week 4 – Wed 10/4/2023** Shark Dissection 3

Mon 10/2/2023 - **Lecture Exam 1** is available 8am to 11:59pm EST. It is due by 11:59pm EST on this date (10/2/2023). You have from 8am to 11:59pm EST to do the test. After 11:59pm EST, the test will be unavailable.

Complete lecture and lab readings in Week 4 and review lab videos in Week 2 on Blackboard.  
Lab 4 is on Wed 10/4/23. **Presentation proposal due in lab.**

**Week 5 – Wed 10/11/2023** Perch Dissection (Mon 10/9/2023 – no class)

Tue 10/10/2023 – **Lecture Assignment 3** due 9am EST as a Word document uploaded to File Exchange in your Group on Blackboard.

Wed 10/11/2023 – **Practical 1** on the Shark at the start of Lab 5.  
Complete lecture and lab readings and view lab videos in Week 5 on Blackboard.

**Week 6 – Wed 10/18/2023** Mudpuppy Dissection

Mon 10/16/2023 - **Lecture Assignment 4** due 9am EST as a Word document uploaded to File Exchange in your Group on Blackboard.

Wed 10/18/2023 – **Lab Quiz 3** on the Perch at the start of Lab 6.  
Complete lecture and lab readings and view lab videos in Week 6 on Blackboard.

**Week 7 – Wed 10/25/2023** Turtle Dissection

Mon 10/23/2023 - **Lecture Assignment 5** due 9am EST as a Word document uploaded to File Exchange in your Group on Blackboard.

Wed 10/25/2023 – **Lab Quiz 4** on the Mudpuppy/Salamander at the start of Lab 7.  
Complete lecture and lab readings and view lab videos in Week 7 on Blackboard.

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**Week 8 – Wed 11/1/2023** Cat Dissection 1

Mon 10/30/2023 – **Lecture Exam 2** is available 8:00am to 11:59pm EST. It is due by 11:59pm EST on this date (10/30/2023). You have from 8am to 11:59pm EST for the test. After 11:59pm EST, the test will be unavailable.

Complete lecture and lab readings and view lab videos in Week 8 on Blackboard.

**Week 9 – Wed 11/8/2023** Cat Dissection 2

Mon 11/6/2023 – **Lecture Assignment 6** due 9am EST as a Word document uploaded to File Exchange in your Group on Blackboard.

Wed 11/8/2023 – **Practical 2** on the Turtle at the start of Lab 9.

Complete lecture and lab readings and view lab videos in Week 9 on Blackboard.

**Week 10 – Wed 11/15/2023** Cat Dissection 3

Wed 11/15/2023 – **Lab Quiz 5** on Cat External Anatomy at the start of Lab 10.

Complete lecture and lab readings and view lab videos in Week 10 on Blackboard.

**Week of 11/20/2023 (No class Wed 11/22/23)**

Mon 11/20/2023 – **Lecture Assignment 7** due 9am EST as a Word document uploaded to File Exchange in your Group on Blackboard.

Tue 11/21/2023 – **Research Project Report and Data Table** due at 9am EST as a Word document uploaded to File Exchange in your Group on Blackboard.

**Week 11 – Wed 11/29/2023** Cat Dissection 4

Mon 11/27/2023 – **Lecture Exam 3** is available 8:00am to 11:59pm EST. It is due by 11:59pm EST on this date (11/14/2022). You have from 8am to 11:59pm EST for the test. After 11:59pm EST, the test will be unavailable.

Fri 12/1/2023 – **Lecture Assignment 8** due 9am EST as a Word document uploaded to File Exchange in your Group on Blackboard.

Complete lecture and lab readings and view lab videos in Week 11 on Blackboard.

**Week 12 – Wed 12/6/2023**

Wed 12/6/2023 – **Practical 3** on the Cat at the start of Lab 12.

Wed 12/6/2023 – **Presentations in Lab**

Review for Final Exam

**Final – Wed 12/13/2023** (Mon 12/11/2023 – Reading Day)

Sun 12/10/23 – Last day to withdraw to earn a “W” grade.

Wed 12/13/2023 – **Final Exam** - time (EST) – TBA.

## Student Objectives – Lecture

### Ch. 1 - Introduction

1. Define anatomy and physiology and distinguish between the two.
2. Define comparative anatomy.
3. List the distinguishing characteristics of chordates and vertebrates.
4. Discuss historical aspects of the field of comparative anatomy and key individuals who played a role in its formation.
5. Define morphological terms (symmetry, segmentation, etc.) and provide examples of each.
6. Define and describe phylogeny.
7. Interpret and use a cladogram.
8. Define paleontology.
9. Examine the fossil record.

### Ch.2 – Origin of Chordates

10. State the characteristics of Protochordates (Hemichordates and Urochordates)

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### Ch.3 – The Vertebrate Story

11. Outline the vertebrate groups (Agnathans, Gnathostomes, Teleostomi, Tetrapods, Amniotes).
12. Distinguish the vertebrate groups using their unique characteristics.

### Ch.4 – Biological Design

13. Examine the sizes and shapes associated with vertebrates.
14. Study the basic principles of Biomechanics and Biophysics (ex. velocity, acceleration, force, diffusion, exchange) and how these principles are applied to vertebrate organisms.

### Ch.5 – Life History

15. Examine the embryological development of vertebrate organisms (fertilization, cleavage, gastrulation, neurulation).
16. Study organogenesis and tissue development in vertebrates (epithelial, connective, neural).
17. Explain the development of the coelom.
18. Study maturation in vertebrates.
19. Distinguish between Ontogeny and Phylogeny, and the Biogenetic Laws associated with each.

### Ch. 6 – Integument

20. List and discuss the general features of the Integument (Epidermis and Dermis) in vertebrates.
21. Discuss the phylogeny of Integument in fish, amphibians, reptiles, birds and mammals.
22. Discuss the specializations of the Integument (nails, claws, hooves, horns, antlers, baleen, scales, armor, mucus, color, etc.).

### Ch. 7 – Skeletal System: The Skull

23. Discuss and distinguish between the Chondocranium, Splanchnocranium and Dermatocranium.
24. Provide an overview of skull morphology.
25. Discuss phylogeny of the skull in agnathans and gnathostomes.
26. Provide an overview of skull function and design.



#### Ch. 8 – Skeletal System: The Axial Skeleton

27. List and describe the basic components of the Axial Skeleton (vertebrae, ribs, sternum, gastralia).
28. Discuss the embryonic development of the axial skeleton in fishes and tetrapods.
29. Discuss the phylogeny of the axial skeleton in fishes and tetrapods.
30. Discuss mechanical design considerations in the vertebrate axial skeleton.

#### Ch. 9 – Skeletal System: The Appendicular Skeleton

31. List and discuss the basic components of the appendicular skeleton (fins, limbs).
32. Discuss the origin of paired fins.
33. Discuss the phylogeny of the vertebrate appendicular skeleton in fishes and tetrapods.
34. Discuss the evolution of the appendicular skeleton.
35. Discuss mechanical design considerations in the vertebrate appendicular skeleton (swimming, terrestrial locomotion, flight).

#### Ch. 10 – The Muscular System

36. List and describe the types and structure of muscle.
37. Describe basic muscle contraction on a microscopic and molecular level.
38. Discuss muscle mechanics in terms of length, tension, force, shortening and action.
39. Describe the embryonic origin of muscles.
40. Compare the anatomy of muscles across the vertebrates.

#### Ch. 11 – The Respiratory System

41. List and describe the vertebrate respiratory organs.
42. Explain ventilatory mechanisms.
43. Compare respiratory systems across the vertebrates.
44. Discuss gas exchange, including breathing in air and water.
45. Discuss the evolution of respiratory organs.

#### Ch. 12 – The Circulatory System

46. List and describe the components of the vertebrate circulatory system (blood, vessels, heart).
47. Distinguish between single and double circulation.
48. Describe the embryonic development of the cardiovascular system.
49. Compare blood vessels across the vertebrates.
50. Compare hearts across the vertebrates.
51. Discuss cardiovascular system specialized adaptations (fetal, placental, etc.) across vertebrates.
52. List and describe the components of vertebrate lymphatic systems.
53. Discuss the form and function of vertebrate lymphatic systems.

#### Ch. 13 – The Digestive System

54. List and describe the components of the vertebrate digestive system, including accessory organs.
55. Describe the function and evolution of the vertebrate digestive system.

#### Ch. 14 – The Urogenital System

56. List and discuss the components of the vertebrate urinary system.
57. Describe in detail the structure and function of kidneys across the vertebrates.
58. Discuss the evolution of the vertebrate urinary system.

59. Describe the structure of the mammalian reproductive system.
60. Discuss the embryonic development of the vertebrate reproductive system.
61. Describe the reproductive tracts of vertebrates.
62. List and describe the components of female reproductive systems in vertebrates.
63. List and describe the components of male reproductive systems in vertebrates.
64. Compare external and internal fertilization across the vertebrates.

#### Ch. 15 – The Endocrine System

65. List and describe the organs of the endocrine system in vertebrates.
66. Discuss the phylogeny of endocrine organs in vertebrates.
67. Discuss the evolution of the endocrine system in vertebrates.

#### Ch. 16 – The Nervous System

68. List and discuss the types of cells in the vertebrate nervous system.
69. List and discuss the components of the vertebrate peripheral nervous system.
70. Discuss the functions of the vertebrate peripheral nervous system.
71. List and discuss the components of the central nervous system in vertebrates.
72. Discuss the functions of the central nervous system in vertebrates.

#### Ch. 17 – Sensory Organs

73. List and discuss the components of a sensory organ in vertebrates.
74. List and discuss general and special sensory organs in vertebrates.

#### Student Objectives – Laboratory

1. List and demonstrate laboratory safety procedures.
2. Identify components of Amphioxus anatomy.
3. Identify components of Lamprey external anatomy.
4. Virtually dissect and identify internal anatomical structures of the Lamprey.
5. Identify components of Dogfish shark external anatomy.
6. Virtually dissect the Dogfish shark; identify internal components of the integumentary, skeletal, muscular, digestive, respiratory, urogenital, circulatory, lymphatic, nervous & endocrine systems.
7. Identify components of external Perch anatomy.
8. Virtually dissect the Perch and identify internal anatomical components.
9. Identify external anatomical components of Necturus (Mud Puppy).
10. Virtually dissect Necturus; identify components of the integumentary, skeletal, muscular, digestive, respiratory, urogenital, circulatory, lymphatic, nervous & endocrine systems.
11. Identify external anatomical components of a Turtle.
12. Virtually dissect a Turtle and identify components of the integumentary, skeletal, muscular, digestive, respiratory, urogenital, circulatory, lymphatic, nervous & endocrine systems.
13. Identify external anatomical and skeletal components of Birds.
14. Identify external anatomical components of the Cat.
15. Virtually dissect the Cat and identify components of its integumentary, skeletal, muscular, digestive, respiratory, urogenital, circulatory, lymphatic, nervous & endocrine systems.
16. Compare the anatomical features of Amphioxus, Lamprey, Dogfish Shark, Perch, Necturus (Mud Puppy), Reptiles, Birds and Cat.
17. Participate in a class research project, report findings in the form of a written lab report.