

B R O O K D A L E C O M M U N I T Y C O L L E G E

Biology 206 Syllabus

Vertebrate Zoology



CODE: BIOL 206

TITLE: Vertebrate Zoology

DIVISION: STEM

DEPARTMENT: Biology

COURSE DESCRIPTION: This course is designed for the science major, pre-professional or advanced health science student. Through classroom and laboratory experiences, the student will demonstrate an understanding of probable origins of, and be able to identify in detail, the anatomical characteristics of organisms of the phylum Chordata. Starting with the primitive Amphioxus and progressing to the complex mammals, the student will demonstrate an understanding of the ontogenic and phylogenic relationships of the three chordate subphyla and seven vertebrate classes. Laboratory experiences include detailed dissection of representative organisms. **NOTE: This course is offered only in the Spring term.**

PREREQUISITES: A grade of “C” or higher in BIOL 102 or BIOL 112.

PREREQUISITES OR COREQUISITES:

COREQUISITES:

CREDITS: 4

LECTURE HOURS: 3

LAB/STUDIO HOURS: 3

REQUIRED MATERIALS:

Textbook: VERTEBRATES: Kenneth V. Kardong, Eighth Edition, 2019; McGraw-Hill Publishing Company

Lab Manual: COMPARATIVE ANATOMY: Dale W. Fishbeck and Aurora Sebastiani, Third Edition, 2015; Morton Publishing Company

ADDITIONAL TIME REQUIREMENTS:

Additional weekly lab time is required. (See instructor)

COURSE LEARNING OUTCOMES:

- The student will demonstrate an understanding of, and be able to identify in detail, the anatomical characteristics of members of the phylum Chordata. Beginning with the primitive Amphioxus and progressing to the complex mammals. (Mathematical/Scientific Reasoning/Information Literacy)
- The student will demonstrate an understanding of the ontogenic and phylogenic relationships of the three chordate subphyla and several vertebrate classes. (Mathematical/Scientific Reasoning/Information Literacy)

GRADING STANDARD:

A student must have an average of 65% or better for the classroom component and an average of 65% or better for the laboratory component of the course in order to earn a passing grade for the course.

Upon completion of the course, grades will be assigned as follows:

A	= 92 – 100%
A-	= 89 – 91%
B+	= 86 – 88%
B	= 82 – 85%
B-	= 79 – 81%
C+	= 76 – 78%
C	= 70 – 75%
D	= 65 – 69%
F	= <65%

Unit examination results will be reported as the grade assigned by the faculty calculated to the first decimal place. These grades will be weighed according to course grading policy. In calculating the course grade, 0.5 will round up to the next numerical grade and 0.4 will round down to the next lower numerical grade.

A grade of C or better is required in all pre-requisite courses. Career studies courses must have a grade of C or better to count toward the Mathematics / Science Program – Biology Option.

Students are permitted to withdraw from the course without penalty until approximately 80% of the semester is complete. Please see term schedule for the exact deadline.

At the end of the semester, application for an Incomplete may be made if a student with proper documentation needs to complete no more than one lecture exam and/or one laboratory practical. The granting of an Incomplete is at the discretion of the instructor.

COURSE CONTENT:

Unit One:	Chordate Development, Histology & Anatomic Directions
Unit Two:	Chordate Body Plan, Evolution & Taxonomy
Unit Three:	SubPhylum Vertebrata & Class Agnatha
Unit Four:	The Cartilaginous and Bony Fishes
Unit Five:	Early Tetrapods I
Unit Six:	Early Tetrapods II
Unit Seven:	Aves
Unit Eight:	Mammalia

DEPARTMENT POLICIES:

Attendance during class and laboratory sessions is strongly recommended for optimum performance in biology courses.

Lecture exams will be given in class or in the Testing Center, depending on instructor preference.

Laboratory practicals will be given during laboratory sessions, in accordance with schedules provided by the lab instructor. Exams and practicals must be taken at the times designated by the instructor or lab instructor. A student who misses a lecture exam or laboratory practical must provide prior notification and proper documentation in order to take the exam or laboratory practical. The acceptance of said prior notification and proper documentation will be determined by the instructor.

Documentation must be provided within one week of the student's return to the classroom for a make-up exam or laboratory practical to be scheduled. A student who is unable to provide proper documentation for a missed exam or laboratory practical will be given a grade of zero for that exercise. Students may not re-take exams or laboratory practicals on which they perform poorly.

Requirements for the completion of laboratory are listed in the laboratory responsibility sheets for individual courses. Requirements for course completion are listed in individual instructor syllabi.

A student must have an average of 65% or better for the classroom component and an average of 65% or better for the laboratory component of the course in order to earn a passing grade for the course.

COLLEGE POLICIES:

As an academic institution, Brookdale facilitates the free exchange of ideas, upholds the virtues of civil discourse, and honors diverse perspectives informed by credible sources. Our College values all students and strives for inclusion and safety regardless of a student's disability, age, sex, gender identity, sexual orientation, race, ethnicity, country of origin, immigration status, religious affiliation, political orientation, socioeconomic standing, and veteran status. For additional information, support services, and engagement opportunities, please visit www.brookdalecc.edu/support/

For information regarding:

- ◆ Brookdale's Academic Integrity Code
- ◆ Student Conduct Code
- ◆ Student Grade Appeal Process

Please refer to the **STUDENT HANDBOOK AND BCC CATALOG.**

Notification for Students with Disabilities:

Brookdale Community College offers reasonable accommodations and/or services to persons with disabilities. Students with disabilities who wish to self-identify must contact the Accessibility Services Office at 732-224-2730 (voice) or 732-842-4211 (TTY) to provide appropriate documentation of the disability and request specific accommodations or services. If a student qualifies, reasonable accommodations and/or services, which are appropriate for the college level and are recommended in the documentation, can be approved.

ADDITIONAL INFORMATION:

Course Website: *Biology Department information and BIOL 206 resources are available on the Brookdale website: <http://www.brookdalecc.edu/stem-institute/biology/>*

Mental Health:

24/7/365 Resources:

- Monmouth Medical Center Psychiatric Emergency Services at (732) 923-6999
- 2nd Floor Youth Helpline – Available to talk with you about any problem, distress, or hardship you are experiencing. Call or text at 888-222-2228 or visit the website at <https://www.2ndfloor.org/>

Faculty Counselors:

- Students who need to make an appointment with a faculty counselor can do so by calling 732-224-1822 (non-emergency line) during business hours. Faculty counselors are licensed mental health professionals who can assist students and refer them to other mental health resources.

Diversity Statement:

Brookdale Community College fosters an environment of inclusion and belonging. We promote a safe and open culture, encourage dialogue respecting diverse perspectives informed by credible sources, and uphold the virtues of civil discourse. We celebrate all identities with the understanding that ultimately, diversity, equity, and inclusion cultivate belonging and make us a stronger Brookdale community.

**The syllabus is intended to give student guidance in what may be covered during the semester and will be followed as closely as possible. However, the faculty member reserves the right to modify, supplement, and make changes as the need arise.*

BIOL-206
Course #

Vertebrate Zoology
Title

#1 of 8 units

4.0
Credits

Name of Unit: Chapter 1: Chordate Development, Histology and Anatomic Directions

Unit Objectives: Review early chordate development through neurulation; identify the principle tissues of the chordate body and correctly use anatomic terms and directions.

Method of Evaluation: Unit Test

Learning Objectives	Recommended Learning Experiences
The student will be able to:	1. Class Discussion 2. Textbook Readings
1. Describe microlecithal, mesolecithal and macrolecithal as egg types characteristic of the chordates; identify isolecithal and telolecithal eggs in terms of yolk distribution.	
2. Describe the zygote as a diploid, single-celled embryo.	
3. Define cleavage and describe the types of cleavage typical of each egg type.	
4. Explain the importance of the blastula over the morula in terms of specialization and differentiation.	
5. Use the frog as an example to describe epiboly and invagination as the cell movements of gastrulation.	
6. Identify the three primary germ layers and the fates of each in the developing chordate body.	
7. Describe neurulation and development of a dorsal hollow nerve chord as one of the primary chordate characteristics.	
8. Differentiate between organogenesis and histogenesis; name the four principle animal tissue types.	
9. Define epithelial tissues as forming coverings or linings and having little or no intercellular space.	

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#1 of 8 units

4.0
Credits

Learning Objectives	Recommended Learning Experiences
The student will be able to:	1. Class Discussion 2. Textbook Readings
10. Describe lateral adherences, free (apical) surfaces and basement membranes (basal surfaces) as the characteristic surfaces of epithelial cells and tissues; note specializations of these surfaces that may appear	
11. Differentiate between simple and stratified epithelial tissues.	
12. Describe squamous, cuboidal and columnar as the characteristic shapes of epithelial cells.	
13. List examples of where the major epithelial tissue types would be found in the chordate body.	
14. Describe pseudostratified columnar epithelia and where it would be found in the chordate body.	
15. Describe the classification of epithelia according to sensory, germinal, cuticular and glandular functions.	
16. Differentiate epithelial from connective tissues in terms of intercellular space and matrix materials.	
17. Differentiate between embryonic and adult connective tissues.	
18. Identify cell types, matrix materials and location in the body of the loose connective tissues.	
19. Identify cell types, matrix materials and location in the body of the dense connective tissues.	
20. Locate and describe the structure of serous membranes, mucous membranes and cutaneous membranes.	
21. Briefly describe the structure of muscle tissue.	
22. Briefly describe the structure of nerve tissue.	

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Vertebrate Zoology
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#1 of 8 units

4.0
Credits

Learning Objectives	Recommended Learning Experiences
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The student will be able to:

1. Class Discussion
2. Textbook Readings

23. Define and differentiate the following terms:

- A. Superior (Cephalic) and Inferior (Caudal)
- B. Anterior (Ventral) and Posterior (Dorsal)
- C. Medial and Lateral
- D. Median
- E. Proximal and distal
- F. Central and Peripheral
- G. External (Superficial) and Internal (Deep)
- H. Parietal and Visceral
- I. Homology and Analogy
- J. Convergent, Divergent and Parallel Evolution
- K. Neotony and Paedogenesis (Paedomorphosis)
- L. Generalized and Specialized
- M. Higher and Lower Forms
- N. Simple and Advanced
- O. Degenerate, Vestigial Rudimentary

24. Describe the following anatomic planes:

- A. Sagittal, Mid-sagittal and Para-sagittal
- B. Coronal (Frontal)
- C. Transverse (Cross)
- D. Oblique

25. Describe Haeckel's and VanBaer's versions of the biogenetic law.

26. Successfully complete assigned laboratory experiences.

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Course #

Vertebrate Zoology
Title

#2 of 8 units

4.0
Credits

Name of Unit: Chordate Body Plan, Evolution and Taxonomy

Unit Objectives: Describe: The body structure of the idealized chordate; the probable origins of the phylum and subphyla; and the major groups within the Vertebrata.

Method of Evaluation: Unit Test

Learning Objectives	Recommended Learning Experiences
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The student will be able to:

1. Class Discussion
2. Textbook Readings

1. Review the four primary characteristics of the phylum Chordata:
 - a. Dorsal hollow nerve chord
 - b. Pharyngeal gill slits
 - c. Notochord
 - d. Post-anal tail.
2. Establish the body plan of the idealized chordate by describing the following structures and systems; being sure to cite similarities and differences to invertebrate patterns:
 - a. Bilateral symmetry
 - b. Regional differentiation
 - c. Gills
 - d. Notochord
 - e. Nervous system
 - f. Digestive system
 - g. Kidneys
 - h. Reproductive system
 - i. Circulatory system
 - j. Coelom
 - k. Muscles
 - l. Skeleton
 - m. Appendages
 - n. Segmentation
3. Review the principles of modern evolutionary thought to include discussions of: Homology vs. analogy; genes and mutations; adaptation and evolution.
4. Describe Annelid, Arthropods and Echinoderm Theories of Chordate Evolution by citing valid and invalid points of each; support the echinoderm theory as most plausible.
5. Describe the probable line of descent of the chordate subphyla.

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Vertebrate Zoology
Title

#2 of 8 units

4.0
Credits

Learning Objectives	Recommended Learning Experiences
The student will be able to:	1. Class Discussion 2. Textbook Readings
6. Describe in detail the anatomy of amphioxus; citing the systems that do and do not support amphioxus as an example of an idealized chordate.	
7. Describe briefly the anatomy of both adult and larval urochordates; discuss why some may consider the tunicates more advanced than amphioxus.	
8. Discuss why the Hemichordata were once considered a chordate subphylum but today may be placed phylogenetically before the echinoderms.	
9. Review briefly the major geologic eras listing what animal groups arose and/or became dominant during each.	
10. Assign each of the seven vertebrate classes into the following groups. a. Agnathostomes v. Gnathostomes b. Pisces vs. Tetrapoda c. Anamniotes vs. Amniotes d. Poikilotherms (Ectotherms) vs. Homeotherms (Endotherms)	
11. Successfully complete assigned laboratory experiences.	

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Course #

Vertebrate Zoology

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#3 of 8 units**4.0**

Credits

Name of Unit: SubPhylum Vertebrata and Class Agnatha

Unit Objectives: Describe: The characteristics of the Vertebrata as a group; Extinct and living members of Class Agnatha emphasizing the sea lamprey as example

Method of Evaluation: Unit Test

Learning Objectives	Recommended Learning Experiences
The student will be able to:	1. Class Discussion
	2. Textbook Readings
1. Characterize the Vertebrata in terms of brain, cranium, vertebrae and foramina.	
2. List and describe briefly the major taxonomic categories within the piscine group.	
3. Describe briefly the characteristics of Class Agnatha, Order Cyclostomata and the Ostracoderms.	
4. Describe the Ostracoderms (Osteostraci) relating their characteristics to higher vertebrate groups as bases of probably evolutionary lines.	
5. Describe briefly the life history of <u>Petromyzon marinus</u> .	
6. Describe the external anatomy of the lamprey.	
7. Describe the integument of the lamprey to include mucous cells, pigmentation and naked teeth.	
8. Describe the skeleton of the lamprey to include the notochord, neural arches, skull and branchial basket.	
9. Describe briefly the musculature of the lamprey to include specializations of branchial, lingual and buccal regions.	
10. Describe the anatomy of the digestive and respiratory systems of the lamprey; include the sagittal section of the head region.	
11. Describe feeding and respiratory action in the adult and larval lamprey.	
12. Describe circulation in the lamprey as essentially the same as in amphioxus.	

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#3 of 8 units

4.0
Credits

Learning Objectives	Recommended Learning Experiences
The student will be able to:	1. Class Discussion 2. Textbook Readings
13. Describe in detail the structure of a two chambered heart to include the great vessels	
14. List the major components of the venous system of the lamprey as an early vertebrate pattern.	
15. Describe the archinephros and associated ducts in ammocetes.	
16. Describe the opisthonephros and associated ducts in the adult lamprey.	
17. Compare the structure and function of the coelomic funnels and glomeruli.	
18. Describe the male and female reproductive systems of the lamprey; how do they depart from the idealized pattern.	
19. Identify the primary and secondary brain vesicles of the lamprey.	
20. Identify the major adult brain structures and cranial nerves associated with the secondary brain vesicles.	
21. Identify the major cavities and passages of the brain.	
22. Describe briefly the spinal cord and spinal nerves.	
23. Differentiate between gray and white matter. Note how its arrangement in the spinal cord can be used as evidence of advancement throughout the vertebrate group.	
24. Successfully complete assigned laboratory experiences.	

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#4 of 8 units

4.0
Credits

Name of Unit: The Cartilaginous and Bony fishes

Unit Objectives: Describe the characteristics of extinct and living members of classes Chondrichthyes and Osteichthyes using the shark as principle example

Method of Evaluation: Unit Test

Learning Objectives	Recommended Learning Experiences
The student will be able to:	1. Class Discussion 2. Textbook Readings
1. Describe the placoderms relating their characteristics to higher vertebrate groups.	
2. Describe the probable evolution of jaws and development of the splanchnocranium.	
3. Describe autostylic, amphistylic and hyostylic jaw attachments of fishes.	
4. Describe the development of the chondrocranium.	
5. Describe briefly the dermatocranium of fishes.	
6. Identify the parts of a typical vertebra, distinguish between caudal and trunk vertebrae and characterize vertebrae according to various shapes of the centra.	
7. Distinguish between dorsal and ventral ribs, establish which represents the probable origin of tetrapod ribs.	
8. Identify the major components of pectoral and pelvic girdles and appendages.	
9. Describe the integument of fishes to include glands, chromatophores and scale types.	
10. Describe the external anatomy of fishes including tail shapes.	
11. Describe the digestive system of fishes as a typical vertebrate pattern including: Teeth, structure of the gut wall, and serous membranes.	

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#4 of 8 units

4.0
Credits

Learning Objectives	Recommended Learning Experiences
The student will be able to:	1. Class Discussion 2. Textbook Readings
12. Identify the embryonic and adult urinary organs and ducts of fishes.	
13. Differentiate between osmoregulators and osmoconformers; discuss varying tolerances of fishes to changes in salinity.	
14. Identify male and female reproductive organs and ducts.	
15. Describe the circulatory system of fishes to include aortic arches and single vessels	
16. List the requirements of a respiratory membrane; identify gill clefts and respiratory specializations in fishes.	
17. Name the ten cranial nerves and list whether each is sensory, motor or mixed in function.	
18. Discuss advancements in spinal cord and spinal nerve structure in the fishes.	
19. Successfully complete assigned laboratory experiences.	

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Course #

Vertebrate Zoology
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#5 of 8 units

4.0
Credits

Name of Unit: Early Tetrapods I

Unit Objective: State the challenges of a terrestrial existence; explain the probable origin of superclass Tetrapoda from subclass Choanichthyes; describe the early tetrapod skeleton using classes Amphibia and Reptilia as specific examples.

Method of Evaluation: Unit Test

Learning Objectives	Recommended Learning Experiences
The student will be able to:	1. Class Discussion 2. Textbook Readings
1. State the challenges of a terrestrial existence and summarize anatomic changes in the tetrapod body to adapt to same.	
2. List and describe briefly members of subclass Sarcopterygii (Choanichthyes).	
3. List and describe briefly members of class Amphibia.	
4. List and describe briefly members of class Reptilia.	
5. Support the probable origin of the Tetrapoda from the Crossopterygii as opposed to the Dipnoi based on limb structure.	
6. State the significance of labyrinthine teeth in relating Rhipidistia and Labyrinthodontia.	
7. Describe the use of rachitinous evidence (diplospondyly) in ascertaining probable relationships within the tetrapod group.	
8. Characterize the tetrapod skull as being composed of a dermal roof (dermatocranium), palatal complex (splanchnocranium) and brain case (chondrocranium).	
9. Describe the dermal roof of an early amphibian skull as being composed of tooth-bearing marginal bones, a longitudinal series along the midline, a circumorbital series, a temporal series and cheek bones.	

Learning Objectives	Recommended Learning Experiences
10. Describe the palatal complex of an early amphibian skull as being composed of pterygoid, vomer, palatine and quadrate elements.	
11. Describe the brain case of an early amphibian skull as being composed of sphenoid, occipital, otic and ethmoid regions.	
12. Use the concept of cranial akinesis as supportive evidence of phylogenetic progression in reduction of the number of skull bones in the tetrapods.	
13. Summarize the fates of the visceral arches in amphibia and reptilia.	
14. Describe the temporal fenestrae of reptilian and higher tetrapod skulls.	
15. Discuss briefly the structure of chelonian, rhynchcephalian, saurian, serpentine and crocodilian skulls.	
16. Construct a phylogenetic tree of the tetrapoda.	
17. Identify the jaw attachments of amphibia and reptilia (as well as the crossopterygii) as autostylic.	
18. Describe the axial skeleton of Amphibia, to include central types vertebral regions and girdles, using the necturus and frog as examples.	
19. Describe the axial skeleton of reptiles, to include central types vertebral regions girdles, and ribs.	
20. Successfully complete assigned laboratory experiences.	

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Vertebrate Zoology

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#6 of 8 units**4.0**

Credits

Name of Unit: Early Tetrapods II

Unit Objectives: Emphasizing the transition to land, describe the integumentary, cardiovascular, respiratory, digestive, urogenital and nervous systems of classes Amphibia and Reptilia.

Method of Evaluation: Unit Test

Learning Objectives	Recommended Learning Experiences
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The student will be able to:

1. Class Discussion
2. Textbook Readings

1. Describe the structure of the amphibian integument noting especially the abundance of glands and the paucity of scales.

2. Describe the structure of the reptilian integument noting especially the paucity of glands and the abundance of scales.

3. Relate the structure of the reptilian vs the amphibian integument as modification for a terrestrial existence.

4. Compare the structure of an artery, vein and capillary.

5. Describe arteriovenous bridges, sinusoids, and erectile columns as specialized blood vessels.

6. Review single and double circulatory systems; review portal systems.

7. Describe the amphibian heart as a transitional structure ontogenically and phylogenically.

8. Describe the primitive (embryonic) pattern of aortic arches and cite the fates of each in teleosts, urodeles, anurans and reptiles.

9. Describe briefly the complete double circulatory system in the Crocodilia.

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Vertebrate Zoology
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#6 of 8 units

4.0
Credits

Learning Objectives	Recommended Learning Experiences
The student will be able to:	1. Class Discussion 2. Textbook Readings
10. Describe the tetrapod respiratory system as an ontogenic and phylogenic modification of the piscine pharynx, relate the probable origin of lungs to physostomous swim bladders, list other derivatives of the pharynx.	
11. Describe amphibian respiration by relating time of life and habitat to reliance on cutaneous, bucco-pharyngeal and lung mechanisms.	
12. Describe reptilian respiration as an adaptation to a terrestrial existence.	
13. Identify the allantois and cloaca as specialized respiratory mechanisms	
14. Describe choanae, oral glands, tongue and teeth in amphibia.	
15. Describe choanae, oral glands, tongue and teeth in reptilia; describe Jacobsen's (vomeronasal) organ.	
16. Identify the embryonic (larval) and adult kidney in amphibia.	
17. Identify the embryonic and adult kidney in reptilia	
18. Describe the origin of the tetrapod urinary bladder.	
19. Compare amphibian and reptilian patterns of reproduction citing the aquatic or terrestrial characteristics of each.	
20. Describe the advantages of amniote development; describe urogenital specializations of male and female systems requisite to amniote reproduction.	
21. Describe briefly changes in brain and spinal cord correlative to a tetrapod/terrestrial existence.	

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Vertebrate Zoology
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#6 of 8 units

4.0
Credits

Learning Objectives	Recommended Learning Experiences
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The student will be able to:

1. Class Discussion
2. Textbook Readings

22. Identify the cauda equina, pia-arachnoid, dura mater, terminal nerve, (spinal) accessory nerve and hypoglossal nerve.

23. Explain how observed behaviors contributed to the conclusion that the Crocodilia possess a neocortex.

24. Successfully complete assigned laboratory experiences.

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Vertebrate Zoology

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#7 of 8 units**4.0**

Credits

Name of Unit: Aves

Unit Objective: Describe the probable origins and adaptations for flight of class Aves

Method of Evaluation: Unit Test

Learning Objectives	Recommended Learning Experiences
The student will be able to:	1. Class Discussion 2. Textbook Readings
1. List and describe briefly the characteristics of class Aves.	
2. List and describe briefly examples of extinct and living members of class Aves.	
3. Explain the probable origins of the birds from bipedal dinosaurs.	
4. Describe the skeleton of birds as being modified for flight.	
5. Describe the integument of birds giving special attention to feathers (structure and types), scales, claws, glands, beaks and bills.	
6. Describe the digestive systems of birds noting differences from the general chordate pattern.	
7. Describe modification of the avian respiratory system to support the high metabolic demands of flight.	
8. Identify the embryonic and adult kidney types of birds, describe urinary system adaptations for flight.	
9. Describe specializations of the mullerian duct system for the production of a cleidoic egg	
10. Describe male and female reproductive specializations for flight	
11. Differentiate between altricial and precocious patterns of development	
12. Describe the pattern of aortic arches in birds.	
13. Describe briefly advancements in the brains of birds.	
14. Successfully complete assigned laboratory experiences.	

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Vertebrate Zoology

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#8 of 8 units**4.0**

Credits

Name of Unit: Mammalia

Unit Objective: Describe the origins, diversity and characteristics of class Mammalia

Method of Evaluation: Unit Test

Learning Objectives	Recommended Learning Experiences
The student will be able to:	1. Class Discussion 2. Textbook Readings

1. List and describe briefly twelve characteristics of class Mammalia.

2. Identify and describe briefly the subclasses, cohorts and orders of class Mammalia.

3. Explain the probable origin of the mammals using a tetrapod phylogenetic tree to establish relationships.

4. Describe the structure of hair and its probable homologies; identify different types of hair and growth patterns.

5. Describe the integumentary glands of the mammals.

6. Describe bills, claws, nails, hooves, horns and antlers as derivatives of the mammalian integument; note homologies where applicable.

7. Describe dentition in mammals; include dental formulae, diastemas and tusks.

8. Compare and contrast the structure of a “typical” mammalian stomach to that of a polygastric (ruminant).

9. Describe the structure of the Mullerian ducts in monotremes, metatheria and eutheria.

10. Describe testicular descent in mammals.

11. Describe the fate of the cloaca in male and female mammals; note the human female as an apparent exception to the pattern.

12. Successfully complete assigned laboratory experiences.