



**Department of .....Biology.....**

**College of ..... Science .....**

**University of .....Salahaddin....**

**Subject: ..... Comparative anatomy.**

**Course Book – (Year 4)**

**Lecturer's name; (Assist. Prof. Sarbaz I.**

**Mohammed, PhD Theory + Darya**

**M. Azeez (practical)**

**Academic Year: 2023/2024**

## Course Book

1. Course name	<b>Chordata &amp; comparative anatomy</b>
2. Lecturer in charge	<b>Dr. Sarbaz I. Mohammed</b>
3. Department/ College	<b>Biology/ Science</b>
4. Contact	e-mail: <a href="mailto:Sarbaz.mohammed@su.edu.krd">Sarbaz.mohammed@su.edu.krd</a> Tel: (+9647504545386)
5. Time (in hours) per week	For example, Theory: 2h/week Practical: 3Lx2h/week
6. Office hours	<b>To be Return to the schedule on the office door</b>
7. Course code	
8. Teacher's academic profile	<p style="text-align: center;"><b>1- Assist. prof. Dr. Sarbaz I. Mohammed</b></p> <ul style="list-style-type: none"> <li>• I graduate from Salahaddin University in 1987(Ranked 4<sup>th</sup> in department). In 1997 I finished my MSc degree and start as Assistant Lecturer Teaching Practical animal physiology, Practical hematology, Practical parasitology, practical cell biology and Practical Invertebrate Biology.</li> <li>• For 8 years I worked as a Member of the Examination Committee for College of Science.</li> </ul> <p>In 2007 I get my PhD degree in hematology and from that time, as a Lecturer, I am in charge in teaching comparative theory for 4<sup>th</sup> class students, Supervising MSc and diploma student, Teaching Advanced hematology and endocrinology for Graduate student.</p> <p>I am head of Kurdistan natural history museum from 2008</p>
9. Keywords	<b>Chordata, anatomy and vertebrate</b>
<p><b>10. Course overview:</b></p> <p>In this section the lecturer shall write an overview about the subject he/she is giving. The course overview must cover:</p> <ul style="list-style-type: none"> <li>▪ The importance of studying the subject</li> <li>▪ Understanding of the fundamental concepts of the course</li> <li>▪ Principles and theories of the course</li> <li>▪ A sound knowledge of the major areas of the subject</li> <li>▪ Sufficient knowledge and understanding to secure employment</li> </ul> <p>This should not be less than 200 words</p>	
<p><b>11. Course objective:</b></p> <p><b>Terminology, Classification of vertebrate, evolution, phylogeny of chordate, anatomy of Chordata, homologous structure, heterologous structure.</b></p>	

- **Classification of subphylum vertebrata (class Myxini, Cephalaspidomorphi, Chondrichthyes, Osteichthyes, amphibian, reptilian, Aves and mammals)**
- **Relationship among fishes, amphibian, reptilian, Aves and mammals**
- **Compression & phylogeny integumentary system, Digestive sys. Circulatory sys. Nervous sys. Skeletal sys (vertebrate, sternum, pectoral & pelvic girdle, skull). Muscular sys. Excretory sys and endocrine sys. among Chordata.**

## 12. Student's obligation

### Classroom polices:

**1- Attendance:** You are strongly encouraged to attend class on a regular basis, as participation is important to your understanding of the material. This is your opportunity to ask questions. **You are responsible for obtaining any information you miss due to absence**

**2- Lateness:** Lateness to class is disruptive

**3-Talking:** During class, please refrain from side conversations. These can be disruptive to your fellow students and your professor

## 13. Forms of teaching

Course Book, white board and PowerPoint

## 14. Assessment scheme

Breakdown of overall assessment and examination

Component	Date	Percent
Exam1	--/--/2023	10 %
Q Exam	--/--/2023	5 %
Respecting Classroom Policy		15%
Total		15% T +35%P

## 15. Student learning outcome:

After completion of this course, you will be able to:

- Define common terms used in classification and the structure of chordata.
- Identify all the possible methods for preparation of samples
- Different structure and shape of animals
- Identify basic classification of vertebrate
- Anatomical compression among classes

- Study Relation of structure to morphology
- General characters of different classes
- Structure and functional evolution among vertebrate.

**16. Course Reading List and References:**

1. Diogo R. and Virginia A. (2010) Muscles of Vertebrates. CRC Press Taylor & Francis Group an informa business.
2. Kardong K.V. (2008) Vertebrates comparative anatomy, function and evolution. 5<sup>th</sup> edit. McGraw-Hill.
3. Gerardo De Iuliis (2007). The Dissection of Vertebrates. Academic Press is an imprint of Elsevier.
4. Phillip E. Pack (2001) Cliffs AP<sup>a</sup> Biology, 2nd Edition. Hungry Minds, Inc.

**17. The Topics:**

**Lecturer's name**

- |   |         |
|---|---------|
| 1- The phylum chordata; vertebrate ancestry; kinds of vertebrates. The protochordata (body wall. All body organs) | Week 1  |
| 2- Types of vertebrates (class; cyclostomata), Class Chondrichthyes, and Class osteichthyes (teleostomi)          | Week 2  |
| 3- Class; amphibian, Class; Reptilia, Class; Aves, Class; Mamalia   | Week 3  |
| 4- Evolution  | Week 4  |
| 5- Evolution  | Week 5  |
| 6- Comparative anatomy of endoskeleton sys  | Week 6  |
| 7- Comparative anatomy of axial skeleton sys  | Week 7  |
| 8- Comparative anatomy of (appendicular skeleton) pectoral girdle sys   | Week 8  |
|   | Week 9  |
| 9- Comparative anatomy of pelvic girdle sys   | Week 10 |
| 10- Comparative anatomy of integumentary sys.   |         |
| 11- Comparative anatomy of skin derivatives sys   | Week 11 |
| 12- Comparative anatomy of digestive sys  | Week 12 |
| 13- Comparative anatomy of circulatory sys  | Week 13 |
| 14- Examination   | Week 14 |
| 15- Comparative anatomy of excretory sys  | Week 15 |
| 16- Comparative anatomy of muscular sys   | Week 16 |

**18. Practical Topics (If there is any)**

In this section The lecturer shall write titles of all practical topics he/she is going to give during the term. This also includes a brief description of the objectives of each topic, date and time of the lecture

Lecturer's name  
ex: (2 hrs)  
ex: 14/10/2021

## 19. Examinations:

### Q1/ Fill the following blanks with suitable answer (15 Marks).

- 1- The complexity of digestive system depends on the -----, -----, -----.
- 2- The buccopharyngeal cavity in reptiles is divided into two passages by means of ----- to ventral ----- passages and dorsal ----- passages.
- 3- Myomeres are divided into ventral ----- & dorsal ----- masses by a ----- that extends along the transverse processes of the vertebrae.
- 4- Hooves are composed of ventral plate called -----, and dorsal plate -----, attached to the bone by -----.
- 5- Most galliformes are ----- bodied with thick ----- and moderately long -----, and have rounded and Concave -----.
- 6- Penguins drink salt water because their ----- gland filters excess salt from the -----.
- 7- In fish, the lateral septum senses ----- and low ----- and ----- direction flow.
- 8- ----- is genetic change in a population of organisms over time, that produced by -----.
- 9- Character that was possessed by the common ancestor of the species on a branch of an evolutionary tree is called-----

### Q2/ Answer by true (T) or false (F) (14 Marks).

- 1- The lizard's right kidneys are positioned farther front than the left.
- 2- Omasum is a true stomach represents 8 % of stomach, has typical enzyme activity.
- 3- Origin of muscles is a proximal site of attachment that is rarely fixed.
- 4- Rabbit has two pairs of upper and one pair of lower incisors.
- 5- Lizards have lost the lower temporal opening or both in snakes.
- 6- The volume of extrinsic muscle is relatively large in posterior limbs than fore limbs because of greater leverage required for locomotion.
- 7- Enamel of teeth is epidermal in origin.
- 8- Skin pigmentation in bird due to presence of chromatophores.
- 9- Forelimbs in chelonia with 2<sup>nd</sup> to 5<sup>th</sup> digits long, supporting thin membrane.
- 10- In skates teeth usually flattened and fuse to form pavement for crushing food.
- 11- In bony fish sounds are transmitted through the soft tissue to the inner ear.
- 12- Digestive systems in jawless fish without stomach.
- 13- Natural selection proposed by Lamark
- 14- Monophyletic mean species derived from on ancestor

### Q3/ Explain (12 marks).

- 1- Difference between invertebrate and vertebrate nervous systems?
- 2- Difference between amphibian's epidermis and reptile's outer epidermis?
- 3- Reptile kidneys are produce less concentrated liquid urine. Why?
- 4- Difference between lower and higher vertebrate's spinal nerves.

### Q4/ Draw and label (9 marks)

- 1- Draw and label the *Ciona* sp.
- 2- Draw and label the cross section of axial muscles in tetrapodes.

3- Draw and label the contour feather.

**20. Extra notes:**

Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks.

**21. Peer review**

پیداچوونہوہی ھاوہل

This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing few sentences in this section.

*(A peer is person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject).*

نہم کورسبوو کہ دہبیت لہ لایمن ھاوہلئیکی ئەکادیمیہوہ سہیر بکریت و ناوہرۆکی بابہتہکانی کورسہکە پەسەند بکات و جەند ووشەپەک بنووسنیت لەسەر شیاوی ناوہرۆکی کورسہکە و واژووی لەسەر بکات.  
ھاوہل ئەو کەسەپە کە زانیاری ھەبیت لەسەر کورسہکە و دہبیت پلہی زانستی لہ ماموستا کەمتر نەبیت.

Theory Lecturer's

Assist. Prof. Sarbaz I. Mohammed



**Department of Biology**

**College of Science**

**University of -----Salahaddin**

**Subject: Practical Comparative anatomy**

**Course Book –Year 4**

**Lecturer's name: Darya M. Aziz**

**M.Sc. in Zoology /Haematology**

**Academic Year: 2023/2024**

## **Course Book**

<b>1. Course name</b>	Practical Comparative anatomy
<b>2. Lecturer in charge</b>	
<b>3. Department/ College</b>	Biology/Science
<b>4. Contact</b>	

<b>5. Time (in hours) per week</b>	Practical: 6h/week
<b>6. Office hours</b>	6hr /week
<b>7. Course code</b>	
<b>8. Teacher's academic profile</b>	<p><b>Darya M. Aziz</b></p> <p>I graduated from Salahaddin university in 2010. In Oct. 1<sup>st</sup></p> <p>I received my M.Sc. degree in Zoology /Haematology and started teaching as Assistant lecturer in 2016.</p> <p>I have become member in Biological syndicate in 2010.</p>
<b>9. Keywords</b>	Chordata, classification, anatomy and vertebrate
<b>10. Course overview:</b>	
Dissection and study of representative chordate systems with emphasis on the anatomy and evolution of fishes, amphibians, reptiles, birds, and mammals.	
<b>11. Course objective:</b>	
<ol style="list-style-type: none"> <li>1. To learn the anatomy of several representative chordates</li> <li>2. To gain familiarity with anatomical terms and descriptors</li> <li>3. To learn how to use guides and diagrams to identify anatomical features in an actual organism</li> <li>4. To learn dissection techniques</li> <li>5. To understand how morphology relates to function</li> <li>6. To understand how biomechanical constraints influence anatomy and physiology</li> <li>7. To understand the basic workings of major vertebrate systems (including the integumentary system, skeletal system, muscular system, digestive system, respiratory system, circulatory system, urogenital system, and nervous system).</li> <li>8. To be able to discuss the characteristic features of all vertebrates and know the broad pattern of the evolutionary relationships of vertebrates.</li> <li>9. To acquire skill and confidence for dissection, and be able to identify the major organs and their details in a vertebrate.</li> </ol>	
<b>12. Student's obligation</b>	
<p>1- Attendance: You are strongly encouraged to attend class on a regular basis, as participation is important to your understanding of the material. This is your opportunity to ask questions. You are responsible for obtaining any information you miss due to absence</p> <p>2- Lateness: Lateness to class is disruptive</p> <p>3-Talking: During class please refrain from side conversations. These can be disruptive to your fellow students and your teacher.</p>	
<b>13. Forms of teaching</b>	
Different forms of teaching will be used to reach the objectives of the course: power point presentations for the head titles and definitions, movies, photographs, classification of animals and any other illustrations, besides worksheet will be designed to let the chance for practicing on several aspects of the course in the classroom, furthermore	



students will be asked to collect samples. There will be classroom sample and slide drawing.

#### 14. Assessment scheme

Exams	60%
Research Project or Copy book	20%
In class quizzes	10%
Home works assignment	10%

100%

Written exams will be short answer and essay in format. Exams will cover theoretical and objective information, including an emphasis on practical questions on specimens studied in class and also its identification. Questions on specimens and anatomical parts that you have not seen before will also be used on exams to evaluate your ability to use the information you have learned. The final exam will cover key concepts and general information that you are expected to have learned during the semester.

#### 15. Student learning outcome:

To gain an understanding of structural, functional, and evolutionary relationships among anatomical parts within and between major taxa of chordates especially those species present in Kurdistan region of Iraq.

#### 16. Course Reading List and References:

1. Weichert, C. K., (1970). Anatomy of the chordates.4th edit. McGraw-Hill Book Company.
2. Kent G. C. and Carr R. K., (2001). Comparative Anatomy of the vertebrates.9th edit.McGraw-Hill Higher Education.
3. Hildebrand M. and Goslow G. E., (2001). Analysis of Vertebrate Structure.5th edit.John Wiley & Sons, INC.
4. Ganguly B. B., Adhikari S. and Sinha A. K., (2008). Biology of Animals.7th edit. Vol. II. New Central Book Agency (P) Ltd.
5. Lal S. S., (2009).Practical Zoology Vertebrate.10th. Rastogi Publications
6. Diogo R. and Virginia A. (2010) MUSCLES OF VERTEBRATES. CRC Press Taylor & Francis Group an informa business.
7. Kardong K.V. (2008) Vertebrates comparative anatomy, function and evolution. 5th edit. McGraw-Hill.
8. Gerardo De Iuliis (2007) The Dissection of Vertebrates. Academic Press is an imprint of Elsevier.
9. Phillip E. Pack (2001) CliffsAP<sup>a</sup> Biology, 2nd Edition. Hungry Minds, Inc

#### 17. The Topics:

Lecturer's name

	<p>Lecturer's name ex: (2 hrs)  ex: 14/10/2020</p>
<p><b>18. Practical Topics (If there is any)</b></p>	
<p><b>Lab. 1:</b> Terminology, Origin of chordate, classification of phylum chordate; Characteristics of chordate, classified into; 1- Subphylum; Hemichordata (e.g. Balanoglossus), Hemichordates considered an invertebrate because, 2- Subphylum; Urochordata (e.g. Ciona and Molgula), 3- Subphylum; Cephalochordata (e.g. Amphioxus lanceolatus), 4- Sub phylum: Vertebrata (Craniata), Differences between protochordates and vertebrates, Evidence for relationships between protochordates and vertebrates Subphylum: Vertebrata (Vertebrates), Super class (1): Agnatha (jawless fish), Class 1: Myxini (Hagfish), Class 2: Cephalaspidomorphi (Lamprey),</p> <p><b>Lab.2:</b> Super class (2): Gnathostomata, Order (1): Selachii (Squalidae), Order (2): Batoidea (Rajomorphii) (Skates and rays, 476 sp), Class 2: Osteichthyes (bony fish), Relationship with amphibian, Did descendants of the lobe-finned fishes or lungfishes move onto the land?</p> <p><b>Lab. 3:</b> Class (3); Amphibians, Order 1 = Apoda, Urodela, and Anura, Class (4) = Reptilia, Subclass (1) = Anapsida (skull has no temporal opening behind eye). Subclass (2) = Euryapsida, Subclass (3) = Synapsida, Subclass (4) = Diapsida (Skull has two temporal opening behind eye, in each side).</p> <p><b>Lab. 4:</b> Class (5) = Aves (bird), Classification, Class (6) = Mammalian, Classification, What are differences between apes and humans?</p> <p><b>Lab. 5:</b> Integumentary system. The integument or outer covering of the body is commonly referred to as the skin. Together with its derivatives are called integumentary system. It is continuous with the mucous membrane lining the eyelids, mouth, nostrils, and the openings of the rectum and urogenital organs. Comparative anatomy of the integument structures: - Amphioxus B- Cyclostomes. C- Fishes D- Amphibians E- Reptiles F-Birds G- Mammals.</p> <p><b>Lab. 6:</b> Skin derivatives, in many vertebrates the skin gives rise to various integumentary structures, which gives it protection. Skin derivatives are two types: 1- Epidermal structure: 2- Dermal structure: Comparative</p>	<p>ex: (3-4 hrs)  ex: 1/10/2024</p>

anatomy of the Skin derivatives: - Amphioxus B- Cyclostomes. C- Fishes. There are 4 types of dermal fish scales. 1-Ganoid scales. 2- Placoid scales. 3- Ctenoid scales 4- Cycloid scales. are 4 types of dermal fish scales.

1-Ganoid scales. 2- Placoid scales. 3- Ctenoid scales 4- Cycloid scales. D- Amphibians E- Reptiles F-Birds (Spur, Feather, Beaks & Bills, Talons and Teeth) G-Mammals (Hairs, furs, Claws, Nails, Hooves, Horns, Hollow horns, Keratin-fiber horns, Antlers, Porcupine quills, Giraffe horns and Prong horns).

**Lab. 7:** Digestive Systems, in all vertebrates the digestive tract is complete, having a mouth at end and an anus at the other end. The primary function of digestive system is to transfer nutrients, water, and electrolytes from food into the animal body's internal environment. The complexity of digestive system depends on the feeding habitats, food type, and animal behavior. The digestive system in higher vertebrate animals is more complex than in lower vertebrate animals. Comparative anatomy of the digestive tract among Amphioxus B- Cyclostomes C- Fishes D-Amphibians E- Reptiles F-Birds G- Mammals.

**Lab. 8:** Muscles system, Vertebrate Muscles includes: Skeletal, striated, voluntary muscles, Smooth muscle, Cardiac muscle and Electric organs. Names of skeletal muscles are based on: Direction of fibers, Location or position, Number of divisions, Shape, Origin and/or insertion, Action, Size, or some combination of these. Axial muscles in cyclostoma, fish and tetrapods. Tetrapods, like fish, have epaxial&hypaxial masses, & these retain some evidence of metamerism even in the highest tetrapods. A- Epaxials of tetrapods: B- Hypaxials of tetrapods (a- Oblique & transverse muscles b- Rectus muscles and Sub-vertebral muscles). Function of Epaxials of Tetrapods, Function of Hypaxials of Tetrapods.

**Lab. 9:** Nervous System, Subdivisions of the Vertebrate Nervous System: 1- Central Nervous System. 2-Peripheral Nervous System. 3- Autonomic nervous system. Nervous System Includes: nerve cells (or neurons), Neuroglia cells, Nerves. Brain: 1- Prosencephalon (forebrain) – 2- Mesencephalon (midbrain) 3- Rhombencephalon (hindbrain). Spinal cord, Comparative anatomy of the spinal cord among Amphioxus B- Cyclostomes C- Fishes and Amphibians Damniotes. Spinal nerves: Difference between lower and higher vertebrates?. Functional types of neurons in spinal nerves (& other nerves). Cranial nerves, Difference between invertebrate and vertebrate nervous systems?

**Lab. 10:** Circulatory system, a portal system, the heart and its evolution in Amphioxus, Hearts of gill-breathing fishes, Hearts of

Dipnoans and Amphibians, Hearts of Amniotes. Arterial channels.

**Lab. 11:** Evolution of arteries: In amphioxus, Cyclostomes, Fishes, Tetrapods. Evolution of posterior arteries, Veins system (Cardinal system & abdominal system).

**Lab. 12 :** Excretory system. Kidneys are the primary adult excretory organs. Other organs that may contribute to the elimination of wastes from the body are the gills, lungs, skin, parts of digestive system, and various salt glands. Together, these organs perform two related and essential function: Types of kidneys: In some of the invertebrates, amphioxus, in Holonephros (Archinephros), in anamniote kidney; (Pronephros, Opisthonephros), in amniotes (reptiles, birds, and mammals) - (Mesonephros&Metanephros), Urinary bladders.

**Lab.13 :** Skeleton system, 1- Exoskeleton 2- Endoskeleton: - refers to internal skeleton structure of the body. It is composed of cartilage, bone, or combination of the two & serves for support, protection, movement, attached to muscles, mineral storage, & formation of RBC and it's mesodermal in origin. (Axial skel.&Appendicularskel). Basic Components of Axial Skeleton: Vertebrae: Comparative anatomy of vertebra:- In amphioxus, lampreys, cartilaginous fishes, bony fishes, amphibians, lizard & crocodilians, birds and Mammals.

**Lab.14:** Sternum (Brest bone), the sternum, found only in tetrapods, is composed of mid-ventral skeletal elements closely related to the pectoral girdle and to the thoracic ribs. Its functions are to strengthen the body wall, help protect the thoracic viscera and help in ventilating the lungs. Comparative of sternum in Amphibians, Reptiles, Birds and Mammals; Ribs, Fish ribs, in Amphibians, Reptiles, Birds and Mammals.

**Lab. 15:** Pectoral girdles, the pectoral girdle suspends the forelimbs and is supported by muscular attachment only to the axial skeleton. Comparative In shark, In bony fish, Amphibian girdles, In the urodela forelimb, In the anura forelimb, The pectoral girdle of bird consists on each side of a large coracoid, a thin, narrow scapula and a slender clavicle. The 2 clavicles which are fused medially to a small interclavicle form the furcula (wishbone). In bird's forelimb, the pectoral girdle of mammals (Forelimb in human).

**Lab. 16:** Pelvic Girdles & Hind Limb. The pelvic girdle is composed of a ventral ischium, a dorsal ilium, and an anterior, ventral pubis. All three bones join at the acetabulum serves as the point of articulation of the hind limb with pelvic girdle. The ilium

on each side attached to the transverse process of the sacral vertebra. The two pubis bones usually unite ventrally at the pubic symphysis & the ischia often at ischial symphysis. The pelvic girdles in fishes, urodela, anura, birds, mammals, mammalian hind limb and man hind limb

**Lab 17:** Joints refers to an articulation between 2 or more bones come in close contact in the body and are attached to each other by ligaments or cartilage. Joints are mainly classified structurally and functionally. Structural classification is determined by how the bones connect to each other, while functional classification is determined by the degree of movement between the articulating bones. Structural classification 1- fibrous joint - joined by fibrous connective tissue 2- cartilaginous joint - joined by cartilage 3- synovial joint - not directly joined.

**Lab. 18:** Skull. The skull is a skeletal framework of the vertebral head. The part of the skull which surrounds and protects the brain is called the cranium. The skull of most vertebrates is derived from three embryonic components. 1- Neurocranium 2- Dermatocranium 3- Visceral skeletons

**Lab. 19:** Comparative anatomy of skull 1- Cyclostomes 2- Shark 3- Bony fish 4- Anura 5- Bird 6- Mammals.

**Lab. 20:** Endocrine system. The endocrine system consists of a number of ductless glands which secrete substances called hormones into the blood or lymph. They are carried by the circulating fluid to all parts of the body. They are all derived embryologically from epithelial surfaces, with the exception of the interstitial cells of the testis. Aminogenic Tissue and the Adrenal Medulla, in fishes and Amphibians, Amniota, Steroidogenic tissue and adrenal cortex, Thyroid gland, Parathyroid glands, Pancreas glands, Thymus glands and Avian bursa of Fabricius.

**Lab. 21:** Animal behavior: - Is response to stimuli in its environment. The capacity for behavior is inherited, but much inherited behavior can be modified by experience. Instinctive Behavior (Genes and behavior), Hormones and Behavior, Learned behavior, Categories of learned behavior and Communication signals.

**Lab. 22:** Illegitimate Signalers and Receivers, Sometimes the wrong parties intercept communication signals. In certain assassin bugs hook dead and drained bodies of termite prey on their dorsal surface to acquire the odor of their victims. By deceptively

signaling that they belong to a termite colony, they hunt termite victims more easily. The female of certain predatory fireflies, if one observes a flash from a male firefly, she flashes back. If she can lure him into attack range, he becomes her meal. Mating behavior, Costs and benefits of parenting, Benefits of living in social groups, Cooperative predator avoidance, the selfish herd, Dominance hierarchies, Evolution of altruism.

**Lab. 23a:** Reproductive system. The two cardinal concerns of living things are the maintenance of self and the perpetuation of the species. Reproduction is essential only so that the species may continue to live upon the earth. Two methods of reproduction, asexual and sexual, are recognized. Reproductive organs (eggs, sperms, gonads, in male testes, in female ovaries and both secrete hormones). Comparative anatomy of ovaries and oviduct in female of chordates.

**Lab. 23b:** Reproductive system. Comparative anatomy of testes, seminal duct and sperm cell in male of chordates.

**Lab. 24:** Respiratory system, every living cell in an organism consumes oxygen. A supply of oxygen is essential to that phase of metabolism known as catabolism. Comparative anatomy of the nasal passages, gills and lungs of chordates.

**Lab. 25:** Receptor organ, comparative anatomy of eyes of chordates

**Lab. 26:** Hearing system, Comparative anatomy inner ear, middle ear and external ears of chordates.

## 19. Examinations:

### Comparative anatomy/ Practical

Q1/A- Identify the sample (with scientific name)



Q1/B-Write characters of order Galliformes.

Q2/ Write five (5) characters of Osteichthyes.

Q3/A- Identify the sample and to which family it belongs (scientific name)



Q3/B-write five (5) Characteristics of Hemichordata

Q4/A-Define the following: -

1-Weberian apparatus 2-Evolution 3-Chromatophores 4-Temporal fenestra

Q4/B-Identify the samples and write their families (scientific name).

Sample 1



Sample 2



Q5/A-Identify the sample and to which family it belongs (scientific name)



Q5/B- Differentiate between legless lizard and snake.

Q6/A-Identify the sample and to which order it belongs ?



Q6/B-Differentiate between Euryapsida and Synapsida

Q7/write five (5) characters of Class Reptilia

Q8/Identify the samples with scientific name and write their families.

Sample 1

sample 2

sample 3







Sample 4



Sample 5

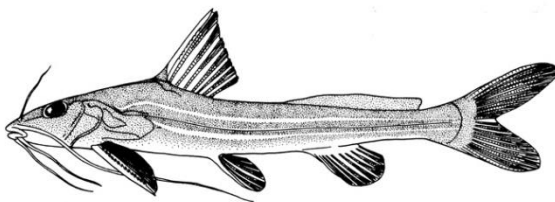


Q9/A-Write characters of order Anura(Salientia).

Q9/B-Identify the sample and write its family.



Q10/A-Identify the sample and to which family it belongs?



Q10/B-Write characters of family in (Q10/A above)

**20. Extra notes:**

**21. Peer review**

پیداچونہوہی ھاوہل

**Practical course lecturer**

Darya M. Azeez

**Course Supervisors**

Assis. Prof. Sarbaz I. Mohammad