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A HANDBOOK OF PRACTICAL ZOOLOGY

FOR B. Sc. II
(AS PER REVISED SYLLABUS OF SHIVAJI UNIVERSITY, KOLHAPUR)

Mr. K. J. Adate
Dr. V. V. Ajagekar
Dr. S. A. Vhanalakar
Prof. (Dr.) L. P. Lanka

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CHOICE BASED CREDIT SYSTEM WITH
MULTIPLE ENTRY AND MULTIPLE EXIT OPTIONS AS PER NEP-2020

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PREFACE

We are delighted to present this practical book on Zoology, designed specifically for second-year students as per the syllabus set up by the Board of Studies (BOS) of Shivaji University, Kolhapur. This book is a result of the collaborative efforts of our esteemed team of authors, who possess extensive knowledge and experience in the field of Zoology.

This practical book aims to provide students with comprehensive and practical knowledge in various areas of Zoology. The book is divided into several sections, covering topics such as Animal Diversity, Biochemistry, Anatomy, Physiology, Histology, Reproductive Zoology and Applied Zoology. Each section has been carefully curated to align with the syllabus, ensuring that students receive a thorough understanding of the subject.

One of the key highlights of this practical book is its emphasis on hands-on learning experiences. We firmly believe that practical learning facilitates a deep understanding of concepts and helps students develop critical thinking and analytical skills. Thus, this book includes a wide range of experiments and activities, accompanied by detailed instructions and explanations, enabling students to actively engage in the learning process. The incorporation of relevant diagrams, illustrations and photographs further enhances the learning experience, making it visually appealing and relatable.

We would also like to appreciate the efforts of the faculty at our institution, who have contributed their knowledge and expertise to curate the content of this book. Their dedication to providing quality education has played a crucial role in the development of this practical book.

Finally, we extend our best wishes to the students who will embark on the journey of practical exploration in Zoology. We hope that this book serves as a valuable resource, assisting you in understanding the intricate world of animals. Embrace the practical activities, explore the wonders of the animal kingdom and develop a lifelong love for the field of Zoology.

- Authors

FOREWORD

As we enter a new era in the field of education with the implementation of the National Education Policy (NEP) 2020, it brings me immense pleasure to present this practical book of Zoology tailored to the syllabus set by the Board of Studies (BOS) of Shivaji University, Kolhapur from June 2023.

Zoology, the study of animals, holds a pivotal position in the biological sciences. It allows us to explore and understand the diverse forms and functions of living organisms and their intricate roles in nature. With the NEP 2020 emphasizing a holistic approach to education, it is vital for students to actively engage in practical learning experiences to grasp the intricacies of Zoology. This practical book has been designed keeping in mind the objectives of the NEP 2020, ensuring that students develop a deep understanding of the subject and acquire critical thinking and problem-solving skills.

The book is divided into various sections, each dedicated to a specific area of Zoology. It covers a wide range of topics, ranging from the study of Animal Diversity Anatomy, Biochemistry, Reproductive Biology and Applied Zoology. The experiments and activities included in this book have been carefully chosen to align with the syllabus. What sets this practical book apart is its emphasis on hands-on learning experiences. Each experiment is accompanied by clear and concise instructions, along with detailed explanations of the underlying concepts. Furthermore, the inclusion of relevant diagrams, illustrations and photographs further enhances the learning experience, making it more engaging and visually stimulating.

I would like to express my heartfelt gratitude to the authors for their invaluable contributions to this practical book. Their extensive knowledge, experience and dedication have been instrumental in curetting the content, ensuring its accuracy and relevance to the syllabus.

Finally, I would like to extend my best wishes to the students who will embark on this journey of practical exploration in Zoology. May this book serve as your trusted companion; igniting your curiosity and fostering a lifelong love for the subject embrace the activities, challenge your assumptions and immerse yourself in the wonders of the natural world.

Dr. V. J. Kulkarni
Former joint Director,
Higher Education, Kolhapur Division

SYLLABUS

ZOOLOGY PRACTICAL-I -NEP 2020)

MARKS-50 (CREDITS: 02)

(Based on Animal Diversity-II and Biochemistry of Semester-III)

UNIT I: **ANIMAL DIVERSITY- II**

1. Study of the following specimens with reference to morphological peculiarities and classification up to orders
    a. **Hemichordata:** Balanoglossus
    b. **Urochardata**: Herdmania
    c. **Cephalochordata:** Branchiostoma (Amphioxus)
    d. **Cyclostomata:** Petromyzon
    e. **Pisces**: Sphyrna (Hammer Headed Shark), Pristis (Saw Fish), Torpedo (Electric Ray), Labeo, Exocoetus (Flying Fish), Anguilla (Eel Fish)
    f. **Amphibia**: Ichthyophis, Salamander, Bufo, Hyla (Tree Frog)
    g. **Reptilia**: Chelone (Turtle), Hemidactylus (Wall Lizard), Chamaeleon, Draco (Flying Lizard), Crocodylus (Crocodile), Gavialis.
    h. **Mammalia**: Duck-billed platypus, Kangaroo, Bat, Squirrel, Loris
2. **Demonstration of Frog**: Digestive System, Respiratory System, Excretory system, Male and Female Reproductive System, Heart and Brain
3. Characters identifying venomous and non-venomous snakes: Russell's viper, Saw scaled viper, Common krait, Indian Cobra, Sea snake, Rat snake and Checkered keel back
4. Study of any six common birds from different orders with the help of photographs and keys.
5. Dissection of brain of fowl.
6. Temporary preparation of Hyoid apparatus, Sclerotic plates, Pecten and Collumella of fowl.
7. Temporary preparation of Placoid, Cycloid and Ctenoid scales in fishes.

UNIT II: **BIOCHEMISTRY**

1. Biochemical tests for Glucose, Fructose, Sucrose, Lactose and Lipid.
2. Estimation of total protein in given solutions by Lowry's method.
3. Study of activity of salivary amylase under optimum conditions.
4. Effect of Temperature and pH on activity of salivary amylase.
5. Urea, urease enzyme activity

PRACTICAL-II

(Based on Reproductive Biology and Applied Zoology of Semester-IV)

UNIT I: REPRODUCTIVE BIOLOGY

1**. Study of Animal house**

a) Set up and maintenance of animal house
b) Breeding techniques
c) Care of normal and experimental animals with the help of model/photographs

2. Stages/phases of menstrual cycle.

3. Surgical techniques

a) Principles of surgery in endocrinology,
b) Ovariectomy, Tubectomy, Hysterectomy, Orchiectomy and Vasectomy in rats through Demonstration or Video

4. Examination of histological sections from photomicrographs/permanent slides of rat

Testis, Epididymis, Ovary, Fallopian Tube, Uterus (proliferative and secretary stages),

Cervix and Vagina

5. Structure of human sperm and ovum

6. Detection of pregnancy by using kit.

7. Study of contraceptive devices by photographs or models.

UNIT II: APPLIED ZOOLOGY

1. Study of arthropod vectors associated with human diseases: Pediculus, Culex, Anopheles, Aedes and Xenopsylla
2. Study of insect pests through damaged products/photographs.

i) Crop pests

a. Gram pod borer (*Helicoverpa armigera*)
b. Sugarcane leaf hopper (*Pyrilla perpusilla*)
c. Lemon Butterfly (*Papilio demoleus*)

ii) Stored grains pests

a. Pulse Beetle (*Callosobruchus chinensis*)
b. Rice Weevil (*Sitophilus oryzae*)
c. Red Flour beetle (*Tribalism castaneum*)

iii) Identifying feature and economic importance of

- **a.** *Helicoverpa armigera* (Cotton bollworm)
- **b.** *Papilio demoleus* (Lime butterfly)
- **c.** *Pyrilla perpusilla* (Sugarcane plant hopper)
- **d.** *Callosobruchus chinensis* (Pulse beetle)
- **e.** *Sitophiluso ryzae* (Rice weevil) and
- **f.** *Tribolium castaneum* (Red flour beetle).

UNIT III: APPLIED ZOOLOGY

- **a. Poultry:** To study the breeds of poultry birds with the help of photographs (2 Indigenous and 2 Exotic poultry birds)
- **b. Sericulture:** To study the Life cycle of mulberry silk moth (*Bombyx mori*),
    i. Types of silk moths – Muga, Tasar and Eri by photographs or specimen

Field trip to sericulture center or poultry farm or animal breeding centre or any suitable place to study animal diversity or any place related to theory syllabus. Submission of field trip report (Printed/Hand writings).

PRACTICAL-I

(Based on Animal Diversity-II and Biochemistry of Semester-III)

UNIT I: ANIMAL DIVERSITY- II

Study of the following specimens with reference to morphological peculiarities and classification up to orders

I. HEMICHORDATA: BALANOGLOSSUS

GENERAL CHARACTERS OF HEMICHORDATA

1. Hemichordates commonly referred to as worm animals, have a slender worm-like body shape.
2. They exhibit bilateral symmetry and possess three distinct body regions: The Proboscis, Collar and Trunk.
3. Hemichordates are triploblastic organisms, meaning they have three germ layers during embryonic development.
4. These organisms possess a true coelom, a fluid-filled body cavity surrounded by mesoderm.
5. The pharynx of hemichordates contains gill slits, which serve as openings for respiration and feeding.
6. A buccal diverticulum, also known as the stomochord, arises from the roof of the buccal cavity.
7. The buccal diverticulum is a projection of the digestive tract unique to hemichordates.
8. Notable examples of hemichordates include Balanoglossus and Saccoglossus.

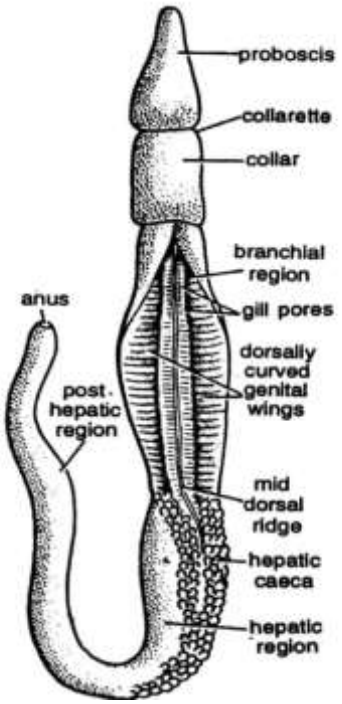
BALANOGLOSSUS

PHYLUM: CHORDATA

SUBPHYLUM: HEMICHORDATA

CLASS: ENTEROPNEUSTA

Balanoglossus is a marine hemichordate worm that possesses unique morphological characters that distinguish it from other organisms. Some of the key morphological features of Balanoglossus are:



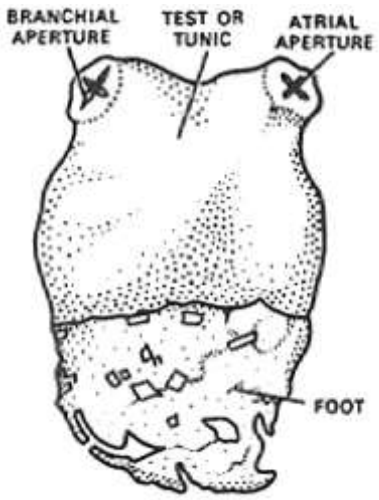
1) Body Shape: Balanoglossus has a long, worm-like body that is cylindrical in shape.
2) Proboscis: It possesses a muscular and extensible proboscis located at the anterior end of the body. The proboscis can be protruded and retracted and is used for feeding and burrowing in the substrate.
3) Collar: A collar or collar-like structure is present just behind the proboscis. It acts as a supporting and protective structure.
4) Slit-like Gill Openings: Balanoglossus has a series of slit-like openings, called gill slits, on the sides of its body. These gill slits are used for respiration and gas exchange.
5) Pharynx: The pharynx is a specialized structure in the digestive system that aids in the ingestion of food and connects the proboscis to the rest of the digestive tract.
6) Stomochord: Balanoglossus possesses a unique structure called the stomochord, which is a hollow, tube-like structure running longitudinally through the body. It functions as a hydrostatic organ and may have a role in providing support to the body.
7) Dorsal Nerve Cord: Balanoglossus has a nerve cord running along the dorsal (upper) side of its body. This nerve cord is part of its simple nervous system.
8) Post-anal Tail: The posterior end of Balanoglossus is elongated and tapers to form a post-anal tail. This tail-like structure helps in locomotion and burrowing.
9) Acorn Worm Appearance: Balanoglossus is often referred to as an "Acorn Worm" due to its superficial resemblance to the shape of an acorn.

GENERAL CHARACTERS OF UROCHORDATA

Urochardata, also known as tunicates or sea squirts are a group of marine invertebrates shows followings general characteristics.

1. **Body Structure**: Urochordates have a sac-like body structure that is covered by a tough, non-living outer covering called a tunic. The tunic gives them their common name, "Tunicates." The body shape can vary from cylindrical to vase-shaped or even flattened.
2. **Chordate Features:** Despite their unique body structure, Urochordates are members of the phylum Chordata, which includes vertebrates. They exhibit some characteristic features of chordates during their larval stage, but many of these features are lost or modified in the adult stage.
3. **Filter Feeders:** Urochordates are filter feeders, meaning they obtain their food by filtering small particles, such as plankton, from the water. They possess an inhalant siphon through which water enters their body, passes through a filtering structure called the pharynx and then exits through an exhalant siphon.
4. **Larval and Adult Stages:** Urochordates undergo metamorphosis during their life cycle. The larval stage, called the tadpole larva, exhibits chordate features such as a notochord, a hollow nerve cord, and a post-anal tail. However, these features are typically lost or greatly modified in the adult stage, which is sessile and more simplified in structure.
5. **Nervous System:** Urochordates possess a rudimentary nervous system. They have a ganglion or nerve center located near the pharynx, from which nerves extend throughout their body.
6. **Reproduction:** Urochordates can reproduce both sexually and asexually. Sexual reproduction typically involves the release of eggs and sperm into the water, where external fertilization occurs. Some urochordates are hermaphroditic, meaning they have both male and female reproductive organs.
7. **Habitat:** Urochordates are primarily marine organisms and are found in various marine habitats worldwide. They can be sessile, attaching themselves to rocks or other surfaces, or free-swimming in the water column.

HERDMANIA



PHYLUM: CHORDATA

SUBPHYLUM: UROCHORDATA

CLASS: THALIACEA

ORDER: PLEUROGONA

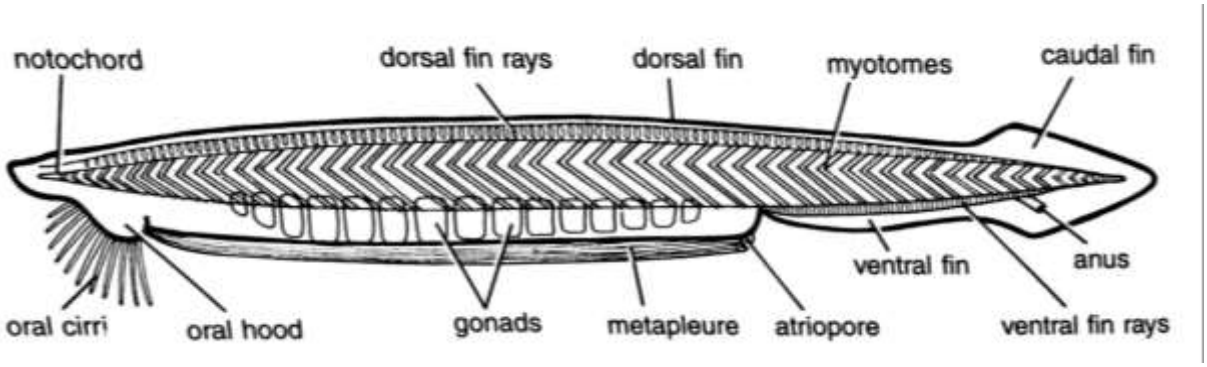
1. Commonly known as Sea squirt.
2. Body is oval with a broad base attached to rocky substratum.
3. Anteriorly body contains branchial siphon on (mouth: Incurrent opening) and atrial siphon (excurrent opening) at free end of the body.
4. The basal foot is dirty in colour due to sand particles, shell pieces and other foreign particles.
5. The entire body is covered by a thick, leathery, translucent protective covering called test or tunic. Below test is mantle.
6. Monoecious. Ovary, testis in the same animal. Reproduction sexual. Oviparous.

GENERAL CHARACTERS OF CEPHALOCHORDATA

Cephalochordata, commonly known as lancelets or amphioxus are a group of marine chordates that share several general characteristics:

1. **Body Structure:** Cephalochordates have a slender and elongated body shape, typically ranging from a few centimeters to a few centimeters long. They lack a distinct head and have a fish-like appearance.
2. **Chordate Features**: Cephalochordates possess several key chordate features throughout their entire life cycle. These include a notochord, a hollow dorsal nerve cord, pharyngeal slits and a post-anal tail. Unlike vertebrates, their notochord persists throughout their entire lives and serves as a supportive structure.
3. **Filter Feeders:** Lancelets are filter feeders, obtaining their food by filtering microscopic particles, such as plankton and detritus, from the water. They possess pharyngeal slits that serve both for respiration and filter feeding. Water enters through the mouth and passes through the pharynx, where food particles are captured and ingested.
4. **Burrowing Lifestyle:** Cephalochordates are bottom-dwelling organisms that burrow into sandy or muddy substrates. They anchor themselves with their posterior end and partially protrude from the substrate with their mouth and anterior end exposed.
5. **Nervous System:** Cephalochordates have a simple nervous system. They possess a dorsal nerve cord running along the length of their body, which is more concentrated in the anterior region where it enlarges into a small brain-like structure. They also have sensory structures, including light-sensitive eyespots.
6. **Reproduction:** Lancelets have separate sexes, meaning they can be either male or female. They reproduce through external fertilization, where eggs and sperm are released into the water column. After fertilization, the eggs develop into free-swimming larvae, which eventually settle and transform into adults.
7. **Habitat:** Cephalochordates are predominantly marine organisms, inhabiting shallow coastal waters and sometimes brackish estuaries. They are often found in sandy or muddy substrates, close to the shoreline.

BRANCHIOSTOMA (AMPHIOXUS)



PHYLUM: CHORDATA

SUBPHYLUM: CEPHALOCHORDATA

CLASS: LEPTOCARDI

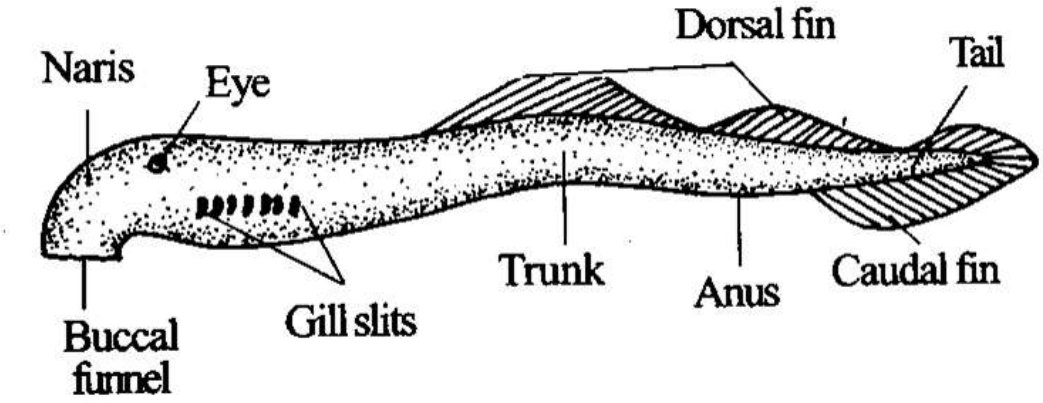
1. It is commonly called as lancelet and is found in shallow marine water.
2. Body is fish like, narrow, elongated, whitish, translucent, laterally compressed and pointed at both the ends.
3. The greater anterior region is the trunk and posterior shorter post anal region is the tail.
4. Below the rostrum there is an oral hood surrounded by oral cirri, which encloses a mouth.
5. Atriopore is located in front of the ventral fin and anus at the base of the caudal fin.
6. Notochord is in the form of a stiff, elongated cylindrical rod like structure lying mid-dorsally above the gut and extends from the tip of the snout to the tail.
7. Myotomes are v shaped muscles on either side of the body.

GENERAL CHARACTERS OF CYCLOSTOMES

Cyclostomes, also known as agnathans are a group of jawless vertebrates that include Lampreys and Hagfish. They possess several general characteristics:

1. **Jawless:** Cyclostomes lack true jaws, distinguishing them from all other vertebrates. Instead of jaws, they have a circular, sucker-like mouth lined with rows of teeth.
2. **Eel-like Body:** Cyclostomes have elongated, eel-like body with a cartilaginous skeleton. They lack paired fins and have a single, continuous dorsal fin running along their back.
3. **Feeding Mechanisms:** Lampreys are parasitic, attaching themselves to other fish and using their teeth and rasping tongue to feed on the host's blood and body fluids. Hagfish, on the other hand are scavengers and feed on dead or dying organisms by burrowing into the carcass and consuming the tissues.
4. **Lack of Scales:** Cyclostomes lack true scales. Instead, their skin is smooth and slimy, secreting copious amounts of mucus for protection.
5. **Notochord Persistence:** Like other chordates, cyclostomes possess a notochord, which is a flexible rod-like structure running along their body. Unlike other vertebrates, the notochord persists throughout their entire lives, as they lack true vertebral columns.
6. **Respiration:** Cyclostomes respire through gills. They have multiple pairs of gill openings located on the sides of their body, through which water is drawn and oxygen is extracted.
7. **Reproduction:** Cyclostomes exhibit complex life cycles. They typically have separate sexes, and fertilization is external, occurring outside the body. Lampreys often migrate from freshwater to the sea for spawning, while hagfishes reproduce in marine environments.
8. **Unique Defense Mechanisms:** Hagfishes possess a unique defense mechanism where they produce copious amounts of slime when threatened. This slime acts as a slippery barrier, making it difficult for predators to capture them.

PETROMYZON



PHYLUM: CHORDATA

SUBPHYLUM: VERTEBRATA

CLASS: CYCLOSTOMATA

ORDER: PETROMYZONIFORMES

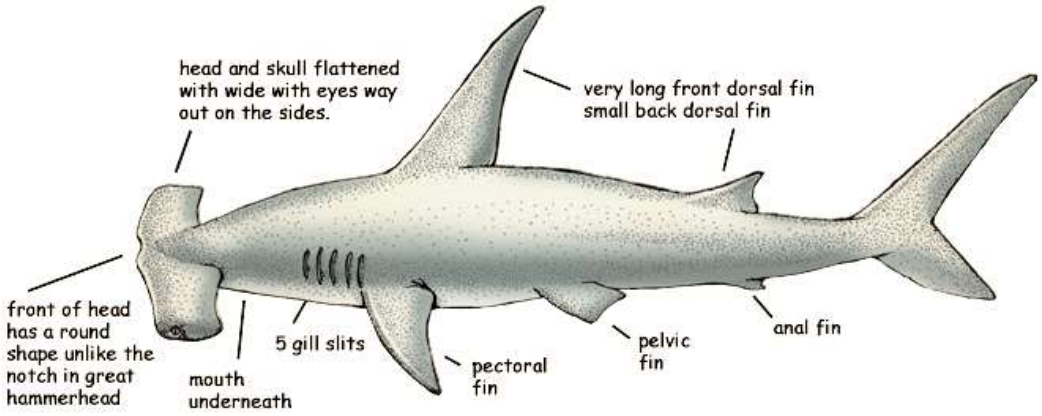
1. Commonly called as lamprey and is marine as well as freshwater.
2. It is ecto-parasitic, on other fishes.
3. They are anadromous i.e. ascending river for spawning.
4. Body is distinguished in to head, trunk and tail.
5. Head and trunk is cylindrical and tail is laterally compressed.
6. Anterior end bears a ventrally directed cup like sucker or funnel surrounded by oral papillae lined by radiating rows of horny teeth.
7. The apex of the buccal funnel bears a small circular mouth opening behind which is found tongue with large horny teeth.
8. Large prominent eyes; without eyelids.
9. Single nostril, seven pairs of external gill slits on lateral side of the head.
10. Cloacal aperture is located at the junction of trunk and tail.
11. Small sensory pores of lateral line system extend along the lateral side of the body below the head.

GENERAL CHARACTERS OF PISCES

Pisces, commonly known as fish, are a diverse group of aquatic vertebrates that possess several general characteristics:

1. **Aquatic Lifestyle:** Fish are exclusively aquatic organisms, inhabiting a wide range of aquatic environments, including freshwater, saltwater and brackish water. They have adapted to living in water through various anatomical and physiological adaptations.
2. **Vertebral Column:** Fish possess a vertebral column, or backbone, which provides structural support to their bodies. The vertebral column is composed of a series of individual vertebrae that protect the spinal cord.
3. **Fins:** Fish have fins that aid in locomotion and stability. The types of fins include paired pectoral fins, paired pelvic fins, dorsal fin(s) on the back and anal fin on the ventral side and often a caudal fin at the tail. These fins help fish maneuver, balance and propel themselves through the water.
4. **Gills:** Fish respire through gills, specialized organs that extract oxygen from water. Gills are located on the sides of the fish's head and consist of thin, filamentous structures that have a large surface area for efficient gas exchange.
5. **Scales:** Most fish have scales covering their bodies, which provide protection and reduce drag while swimming. The scales can vary in shape, size and composition depending on the species.
6. **Ectothermic:** Fish are ectothermic animals, meaning their body temperature is regulated by the temperature of their environment. They are not capable of internally generating their own body heat and rely on external sources to maintain their metabolic processes.
7. **Reproduction:** Fish exhibit a variety of reproductive strategies. Most fish reproduce by external fertilization, where eggs and sperm are released into the water simultaneously for fertilization to occur. Some species exhibit complex courtship behaviors, nest building or parental care.
8. **Sensory Organs:** Fish possess a range of sensory organs that help them navigate and interact with their environment. These include eyes for vision, lateral line system for detecting water movement and pressure changes and a variety of specialized receptors for detecting vibrations, electrical signals and chemical cues.
9. **Diversity**: Fish represent the largest and most diverse group of vertebrates, with over 30,000 known species. They can vary greatly in size, shape, coloration, habitat preferences and feeding habits.

SPHYRNA (HAMMER HEADED SHARK)



PHYLUM: CHORDATA

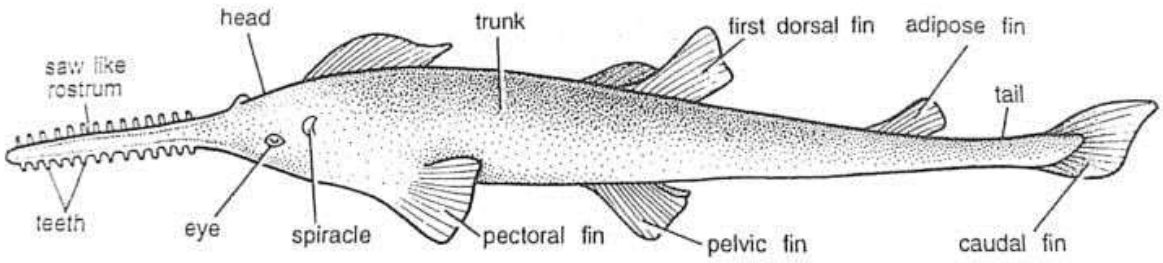
SUBPHYLUM: VERTEBRATA

CLASS: CHONDRICHTHYES

ORDER: PLEUROTREMATA

1. Commonly called hammer headed shark due to hammer-shaped head.
2. The body is elongated, stream lined and is divisible in to head, trunk and tail.
3. Two prominent eyes on each side of the head.
4. Ventral crescentic mouth bounded by upper and lower jaw. Nostril ventral in position.
5. Exoskeleton is in the form of minute placoid scales arranged obliquely all over the body.
6. Five pairs of external gill slits in the form of vertical clefts located behind each eye.
7. Tail is turned upwards and is heterocercal.
8. Exoskeleton is in the form of minute placoid scales arranged obliquely all over the body.
9. It exhibits sexual dimorphism.

PRISTIS (SAW FISH)



PHYLUM: CHORDATA

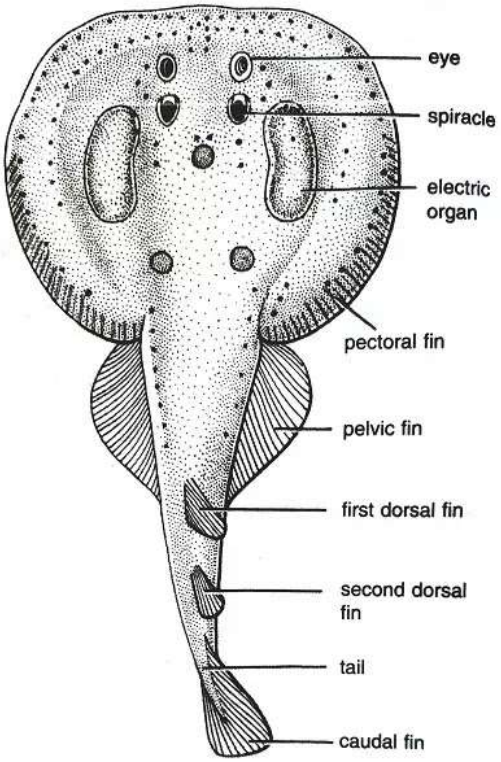
SUBPHYLUM: VERTEBRATA

CLASS: CHONDRICHTHYES

ORDER: RHINOPRISTIFORMES

1. Commonly called as saw fish, weighing 150-500 kg and measuring 3 to 6 meters in length.
2. Body shape is midway between a shark and a ray. The anterior part is flattened dorsoventrally and is ray-like while the posterior part, for more than hall is shark-like. It exhibits close relationship with rays.
3. Elongated, shark like body is slightly depressed and divided into head, trunk and tail.
4. Head contains a pair of eyes and a pair of spiracles behind the eyes. Water passes through the spiracles and goes out through the gill-slits.
5. Mouth ventral.
6. Snout is anteriorly produced into a saw-like rostrum with large and small weakly embedded teeth.
7. Dorsal fins are large. First dorsal fin is opposite to pelvic fin. Second dorsal fin is called adipose fin. Paired fins are pectoral fin and pelvic fin. Tail contains heterocercal caudal fins.
8. Sawfishes are ovoviviparous fishes (that is, fertilized eggs grow within the body of female sawfishes and the young are born alive)

TORPEDO



PHYLUM: CHORDATA

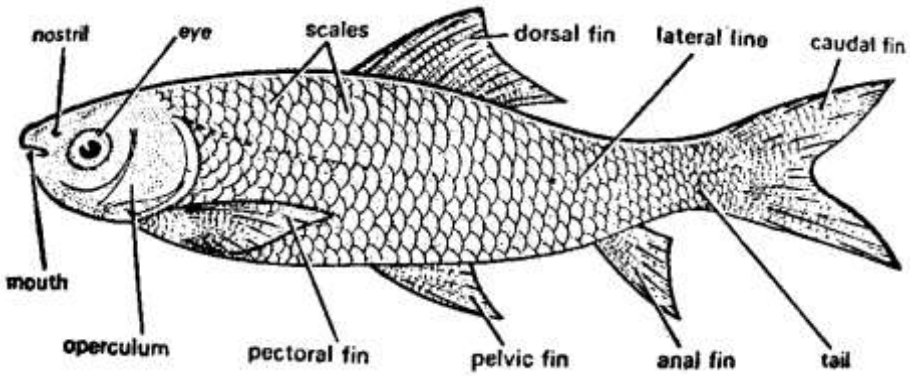
SUBPHYLUM: VERTEBRATA

CLASS: CHONDRICHTHYES

ORDER: HYPOTREMATA

1. The Electric Ray is a marine carnivorous creature, earning its name from the presence of a pair of electric organs.
2. Its body is distinctly divided into an anterior semicircular disk and a posterior tail, with the disk being bordered by pectoral fins.
3. Ventrally, there are five pairs of gill slits.
4. The skin of the Electric Ray is smooth and lacks scales.
5. Dorsally, the eyes and spiracles are closely situated above the electric organs.
6. The mouth is transverse and located ventrally.
7. Its tail is thick and short, featuring two dorsal fins and a caudal fin.
8. The Electric Ray exhibits viviparous reproduction, giving birth to live offspring.

LABEO



PHYLUM: CHORDATA

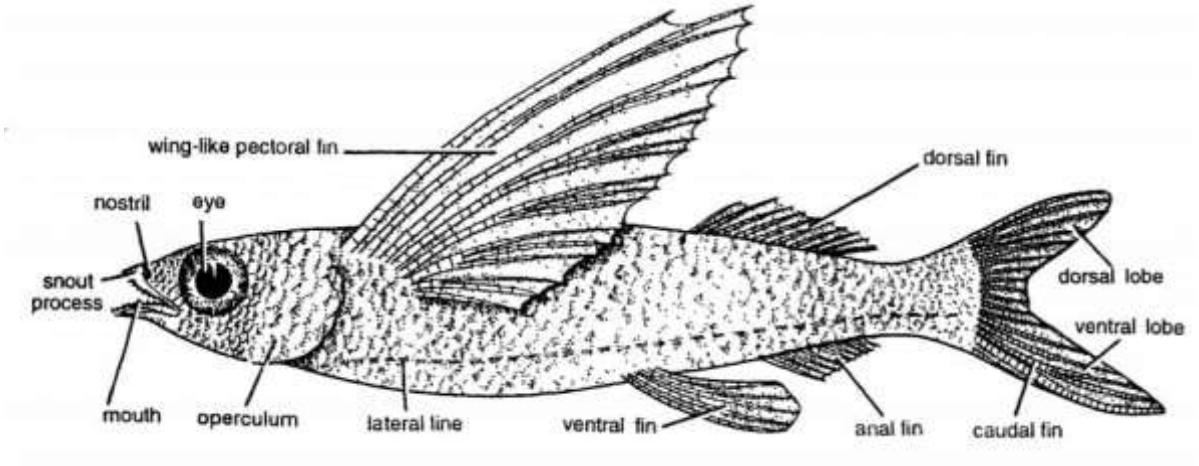
SUBPHYLUM: VERTEBRATA

CLASS: OSTEICHTHYES

ORDER: CYPRINIFORMES

1. The Labeo fish is commonly found in freshwater ponds, lakes and rivers.
2. Its body is divided into distinct regions: the head, trunk and tail.
3. The head is flattened (depressed) and features a mouth, paired nostrils and paired eyes.
4. At the corners of the mouth, you can find two small thread-like sensory maxillary barbells. The mouth, however, lacks teeth.
5. This fish possesses several fins, including dorsal, anal, caudal, paired pectoral and anal fins all supported by soft fin rays.
6. The body of the Labeo fish is covered with overlapping cycloid scales, providing a protective outer layer.
7. The caudal fin is homocercal, characterized by having two equal lobes.

EXOCOETUS



PHYLUM: CHORDATA

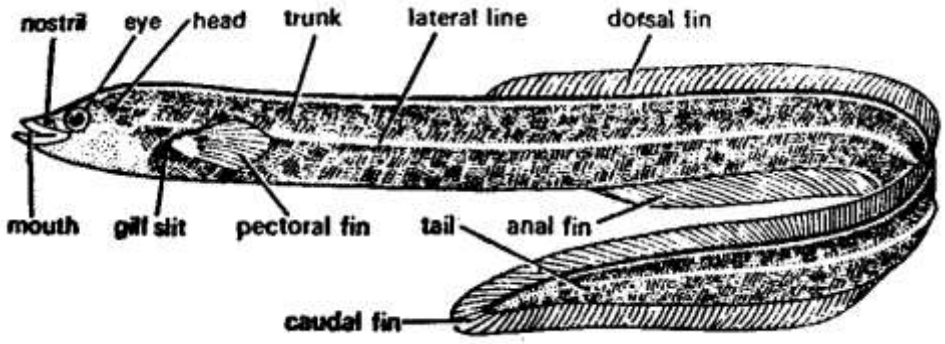
SUBPHYLUM: VERTEBRATA

CLASS: OSTEICHTHYES

ORDER: BELONIFORMES

1. The Flying Fish is commonly known for its remarkable ability to glide above the water's surface.
2. It features a silvery-white body, which is divided into the head, trunk, and tail regions.
3. The body of the Flying Fish is covered with overlapping cycloid scales, providing protection and flexibility.
4. With a small mouth containing teeth in both jaws, it is well-equipped for its feeding habits.
5. The Flying Fish has short dorsal and anal fins, but what set it apart are its exceptionally large pectoral fins that resemble wings. These wings enable the fish to achieve gliding flights, covering distances of up to about 400 meters above the water's surface.
6. The tail of the Flying Fish is homocercal, contributing to its aerodynamic abilities during flight.

ANGUILLA



PHYLUM: CHORDATA

SUBPHYLUM: VERTEBRATA

CLASS: OSTEICHTHYES

ORDER: ANGUILIFORMES

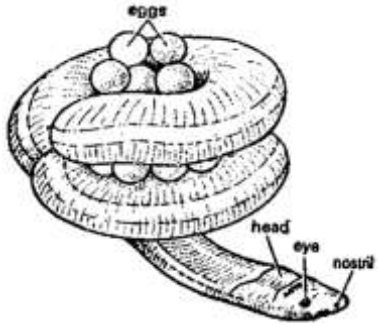
1. The Eel Fish, commonly known as eel, is a freshwater species with the fascinating ability to survive for several hours outside the water.
2. Its body is characterized by its slender, elongated and snake-like appearance, easily divisible into three distinct parts: the head, trunk and tail.
3. The head of the eel contains the mouth, eyes and nostrils, while on each side; an operculum covers the gill slits.
4. Remarkably, the dorsal fin, anal fin and caudal fin are all joined together, forming a continuous fin structure. Behind the operculum, small pectoral fins can be found.
5. Eel fish exhibit a peculiar breeding habit, making their reproductive behavior unique and intriguing.

AMPHIBIA: GENERAL FEATURES AND CLASSIFICATION UP TO ORDERS

GENERAL CHARACTERS OF CLASS AMPHIBIA

1. Amphibians have a distinctive body structure, consisting of a well-defined head with an elongated trunk. Some species may have a neck and tail, while others lack these features.
2. Their skin is highly glandular and moist, providing a crucial function in respiration and water absorption. While most amphibians have naked skin, some apodans may possess dermal scales.
3. Amphibians exhibit two pairs of pentadactylous limbs, meaning they have five digits on each limb. The forelimbs typically have four clawless digits, while the hind limbs have five.
4. Amphibians are ectothermic or cold-blooded animals, meaning their body temperature adjusts to their environment.
5. They often have well-developed eyes with eyelids and a tympanum, which is an external hearing structure.
6. The digestive system of amphibians ends in a cloaca, a common chamber for excretory and reproductive functions.
7. Their heart has three chambers and their red blood cells are nucleated.
8. In adulthood, amphibians respire through lungs, skin, and the buccopharyngeal cavity.
9. Adult salamanders have a mesonephric type kidney, while in caecilians; it is of the opisthonephric type.
10. The central nervous system of amphibians is characterized by ten pairs of cranial nerves.
11. Their vertebrae are procoelous, lacking ribs.
12. The skull typically has two occipital condyles and post temporal fossa and ectopterygoid are absent.
13. Amphibians lay large, yolky eggs of the mesolecithal type, adapted to their semi-aquatic lifestyle.
14. Many amphibian species undergo a tadpole larval stage, an aquatic phase in their life history, before metamorphosing into adults.

ICHTHYOPHIS / UROTYPHLUS



PHYLUM: CHORDATA

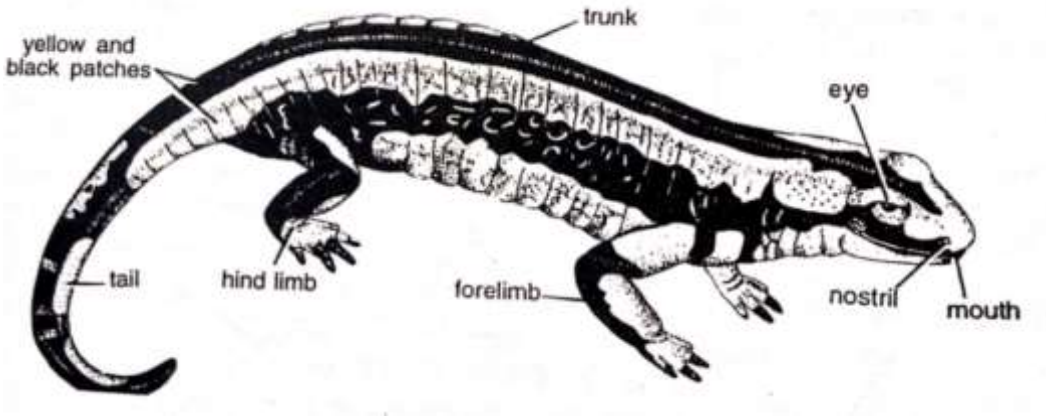
SUBPHYLUM: VERTEBRATA

CLASS: AMPHIBIA

ORDER: GYMNOPHIONA

1. Ichthyophis are limbless amphibians that primarily inhabit moist soil, leading a burrowing lifestyle.
2. They have an elongated body that can measure up to 30 cm in length.
3. Their coloration is typically dark brown or bluish-black, adorned with distinctive yellow bands running along the sides.
4. The skin of Ichthyophis features transverse grooves and is equipped with slime glands and squirt glands that produce an irritating fluid, earning them the common name "coecilla."
5. Limbs and girdles are entirely absent in Ichthyophis, and their tail is either short or vestigial. Their eyes are small in size.
6. The skull of Ichthyophis is compact and roofed with bony vertebrae.
7. Ichthyophis exhibit separate sexes, and their larval stage possesses three pairs of external gills.
8. Notably, the female shows parental care by carefully coiling her body around the eggs until they hatch, ensuring protection and survival of the offspring.

SALAMANDRA



PHYLUM: CHORDATA

SUBPHYLUM: VERTEBRATA

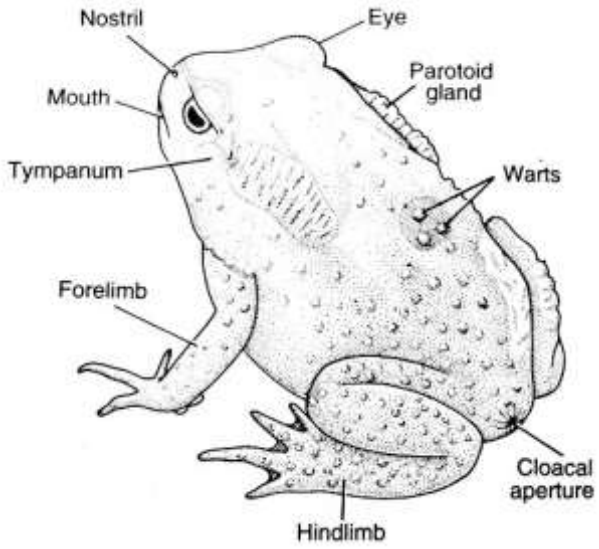
CLASS: AMPHIBIA

ORDER: URODELA

1. The salamander is a lizard-like amphibian, belonging to the family Salamandridae.
2. Its body displays a striking coloration, predominantly black with irregular patches of yellow on its back and limbs. The body is divisible into distinct regions: the head, trunk and tail.
3. The head of the salamander features a prominent mouth, eyes and nostrils.
4. Salamanders have eyes with movable eyelids, enabling them to blink and protect their eyes.
5. Unlike many other amphibians, salamanders lack external ear drums, giving them a more inconspicuous ear structure.
6. The trunk of the salamander bears two pairs of limbs, which are almost equal in size but relatively weak compared to other tetra pods like reptiles and mammals.

Salamanders are fascinating creatures with a unique combination of reptilian and amphibian characteristics, making them well-adapted to their semi-aquatic habitats.

BUFO



PHYLUM: CHORDATA

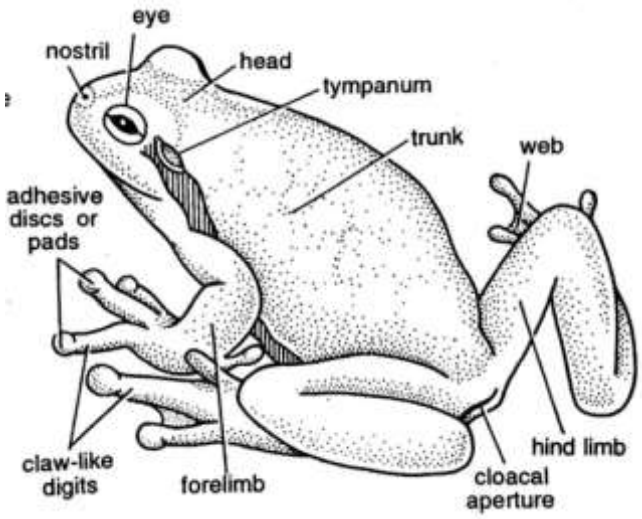
SUBPHYLUM: VERTEBRATA

CLASS: AMPHIBIA

ORDER: ANURA

1. It is a terrestrial and nocturnal creature, preferring to hide under stones or in burrows during the day. The True Toad ventures into water solely for breeding and spawning purposes.
2. Unlike frogs, the True Toad can be distinguished by its rough, dry and warty skin, which features a higher number of poison glands compared to mucous glands.
3. The body of the True Toad is divided into two main parts: the head and the trunk.
4. The head houses the mouth, large eyes, nostrils and a prominent tympanum, which aids in hearing.
5. Positioned behind the eyes, you'll find a pair of poisonous parotid glands, which serve as a defense mechanism against potential predators.
6. Both the forelimbs and hind limbs of the True Toad are relatively short.

HYLA



PHYLUM: CHORDATA

SUBPHYLUM: VERTEBRATA

CLASS: AMPHIBIA

ORDER: ANURA

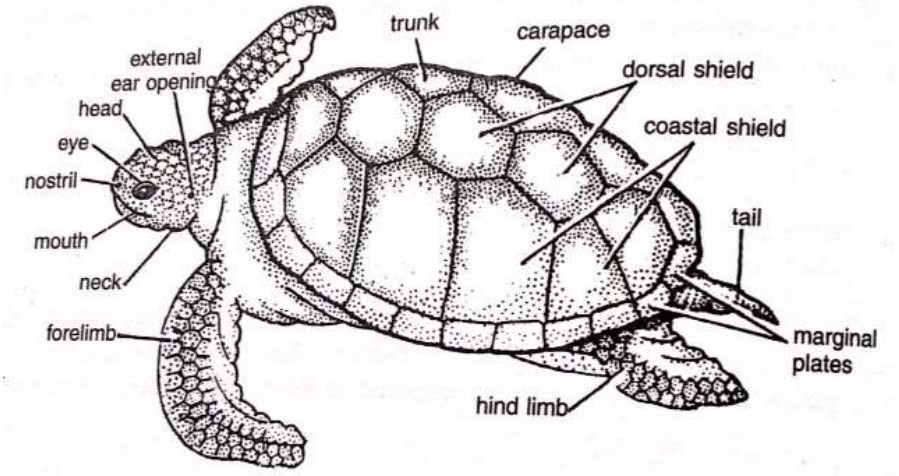
1. The Tree Frog is an arboreal amphibian, meaning it predominantly inhabits and thrives in trees and other elevated vegetation.
2. Its dorsal surface features smooth skin, providing a sleek appearance and aiding in movement through the trees.
3. The head and trunk of the Tree Frog are fused together, creating a more streamlined body shape.
4. The coloration of the Tree Frog can vary based on temperature and activity levels. During calling or mating, it may exhibit a yellower hue, while it could appear duller green or gray when at rest or in cooler conditions.
5. The Tree Frog may have a distinct stripe on its body, which can be longer on one side than the other, adding to its unique appearance.
6. Adapted for its arboreal lifestyle, the Tree Frog possesses long toes with large, sticky toe pads that enable it to cling firmly to plants and surfaces.
7. Tree Frogs are known for their mimicry, using their ability to change color and blend with their surroundings to avoid detection from predators or catch prey.
8. The Tree Frog reproduces through external fertilization, with the female laying eggs in suitable aquatic environments, such as ponds or water-filled tree holes, where the tadpoles will hatch and develop.

GENERAL CHARACTERS OF REPTILIA

Reptilia, commonly known as reptiles, are a group of cold-blooded vertebrates that exhibit several general characteristics:

1. **Dry, Scaly Skin:** Reptiles have dry and scaly skin that helps prevent water loss and provides protection. Their scales are made of keratin and can vary in size, shape and texture depending on the species.
2. **Terrestrial Adaptations:** Most reptiles are adapted to live on land, although some species have secondary adaptations for an aquatic or semi-aquatic lifestyle. Their limbs, if present, are usually positioned at the sides of their bodies, allowing for efficient movement on land.
3. **Ectothermic:** Reptiles are ectothermic animals, meaning they rely on external sources to regulate their body temperature. They bask in the sun or seek shade to adjust their body temperature and maintain metabolic functions.
4. **Lungs:** Reptiles breathe air using lungs. They have a more efficient respiratory system than amphibians, enabling them to extract a higher percentage of oxygen from the air.
5. **Amniotic Eggs:** Reptiles lay amniotic eggs, which have a leathery or calcareous shell. The amniotic egg contains extra embryonic membranes that provide protection, nourishment and waste removal for the developing embryo. This adaptation allows reptiles to reproduce on land without the need for an aquatic environment.
6. **Internal Fertilization**: Reptiles typically reproduce through internal fertilization, where the male transfers sperm directly into the female's reproductive tract. This adaptation increases the chances of successful fertilization in a terrestrial environment.
7. **Three-Chambered Heart:** Reptiles have a three-chambered heart, consisting of two atria and one partially divided ventricle. This heart structure helps to separate oxygenated and deoxygenated blood to some extent, allowing for more efficient oxygen transport compared to amphibians.
8. **Predatory Feeding:** Most reptiles are carnivorous, although some species are herbivorous or omnivorous. They have specialized adaptations, such as sharp teeth or beaks, for capturing and consuming their prey.
9. **Well-Developed Senses:** Reptiles have well-developed sensory systems. They typically have good eyesight, with some species having excellent color vision. They also possess a keen sense of smell and can detect chemical cues in their environment.
10. **Diverse Group:** Reptiles are a diverse group of animals, including Snakes, Lizards, Turtles, Crocodiles and Tuataras. They vary greatly in size, habitat preference, behavior and ecological roles.

CHELONE



PHYLUM: CHORDATA

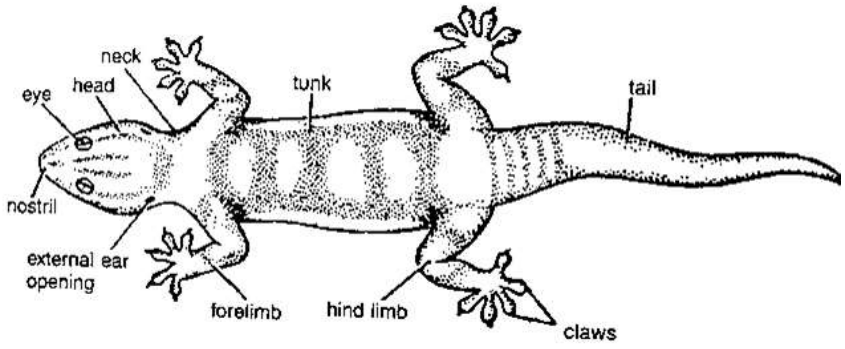
SUBPHYLUM: VERTEBRATA

CLASS: REPTILIA

ORDER: CHELONII

1. The Marine Turtle is a reptile that inhabits marine environments and belongs to the anapsid group, characterized by the absence of temporal fenestrae in their skulls.
2. Its body is divided into distinct regions: the head, trunk, tail and a shell, which provides essential protection.
3. The head of the Marine Turtle contains a mouth, a pair of nostrils, a pair of eyes and a pair of tymphanum (ear openings).
4. The trunk features paddle-like forelimbs and hind limbs, ideally adapted for swimming in the ocean.
5. The tail of the Marine Turtle is short and contributes to its overall streamlined shape.
6. Remarkably, the head, limbs and tail can be withdrawn into the shell, offering a formidable defense against potential threats.
7. Being herbivorous, the Marine Turtle primarily feeds on plants and algae found in marine environments. It follows an oviparous reproductive strategy, laying its eggs in the sandy shores of nesting beaches, where they will hatch and the hatchlings will make their way to the sea.

HEMIDACTYLUS



PHYLUM: CHORDATA

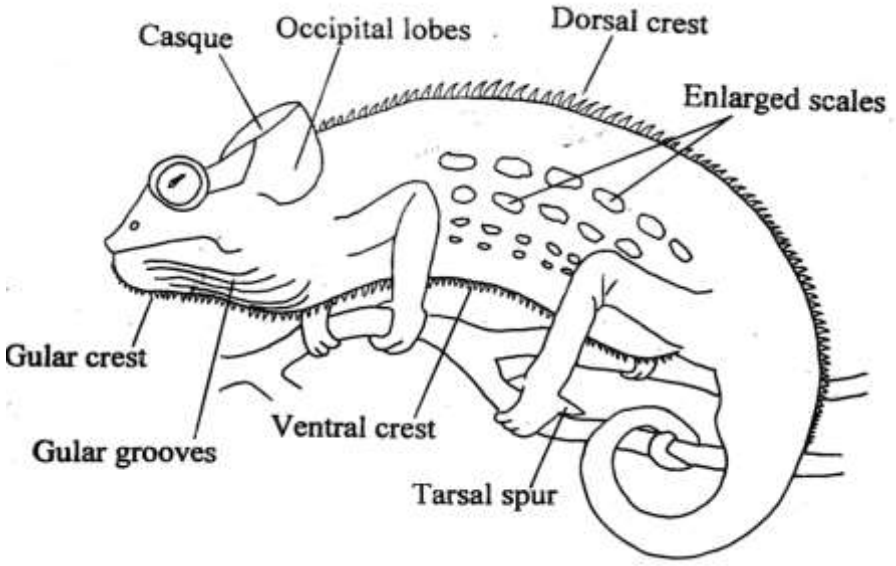
SUBPHYLUM: VERTEBRATA

CLASS: REPTILIA

ORDER: SQUAMATA

1. **Body Shape:** Geckos have a distinct body shape characterized by a flattened and elongated appearance, allowing them to move efficiently on vertical surfaces and ceilings.
2. **Scales:** Their skin is covered in small, granular scales, which may overlap and provide flexibility during movement.
3. **Toes and Foot Pads:** Geckos have specialized toe pads with microscopic hair-like structures called setae, which allow them to adhere to surfaces using Vander Waals forces. This enables them to climb walls and ceilings with ease.
4. **Eyes:** Geckos have large, lidless eyes with vertical pupils, which provide excellent night vision and allow them to be active during low-light conditions.
5. **Nocturnal Adaptations:** Geckos are primarily nocturnal creatures, and their eyes are well-adapted to low light levels, making them efficient hunters during the night.
6. **Tail:** Geckos possess a long, slender tail that aids in balance and can be used as a defense mechanism. Some species are known to shed their tails (autotomy) when threatened, allowing them to escape predators.
7. **Coloration:** Their coloration can vary between species, often serving as camouflage to blend into their natural environment.
8. **Locomotion:** Geckos are skilled climbers and can move vertically on various surfaces using their specialized toe pads. They also have a unique ability called "autotomous locomotion," where they move their legs in an alternating pattern, similar to walking, even when suspended upside down.
9. **Vocalizations:** Some gecko species are known for making vocalizations, which may serve for communication or territorial purposes.

CHAMAELEON



PHYLUM: CHORDATA

SUBPHYLUM: VERTEBRATA

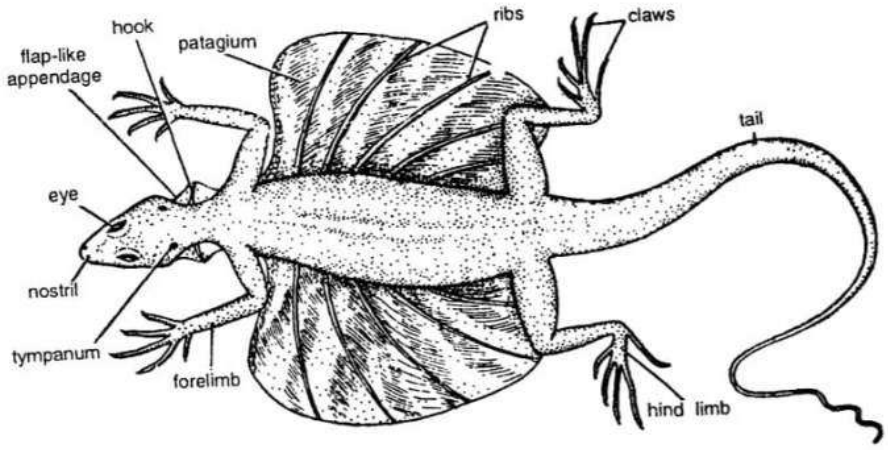
CLASS: REPTILIA

ORDER: SQUAMATA

1. The Indian Chameleon is a fascinating species native to Sri Lanka, India and various other regions in South Asia.
2. **Color Change**: One of the most well-known features of chameleons is their ability to change the color of their skin. They can display a wide range of colors, including various shades of green, brown, yellow, red and even blue and purple. This color change is primarily influenced by their emotions, communication with other chameleons, temperature regulation and camouflage.
3. **Prehensile Tail:** Chameleons possess a long and flexible prehensile tail that they can use to wrap around branches and other surfaces, providing excellent balance and stability during their arboreal lifestyle.
4. **Independent Eye Movement:** Chameleons have unique eyes that can move independently of each other. This enables them to have a 360-degree field of vision and allows one eye to focus on potential prey or predators while the other scans their surroundings.
5. **Projectile Tongue:** Chameleons have an extraordinary tongue that can be rapidly projected out of their mouths to catch insects or other small prey from a distance. Their tongues are sticky, helping them quickly capture their targets.

6. **Zygodactyl Feet:** Chameleons have specialized feet with fused toes that form a gripping structure known as zygodactyl feet. These feet allow them to have a strong grasp on branches and other surfaces, facilitating their climbing abilities.
7. **Casque (Head Crest):** Some species of chameleons have a casque, which is a distinctive head crest or protuberance. The casque's purpose may vary between species, potentially serving as a display structure or as a means of species recognition.
8. **Arboreal Lifestyle:** Chameleons are primarily arboreal, spending most of their time in trees and shrubs. Their physical adaptations, such as prehensile tails and zygodactyl feet, make them well-suited for life in the trees.
9. **Slow Movement:** Chameleons are known for their slow and deliberate movements. This slow pace helps them avoid detection by predators and also conserves energy, especially since they have relatively low metabolic rates.
10. **Camouflage and Communication:** The color-changing ability of chameleons is not only used for camouflage but also serves as a means of communication with other chameleons. Different colors and patterns can convey messages related to aggression, courtship, territoriality, and mating readiness.

DRACO



PHYLUM: CHORDATA

SUBPHYLUM: VERTEBRATA

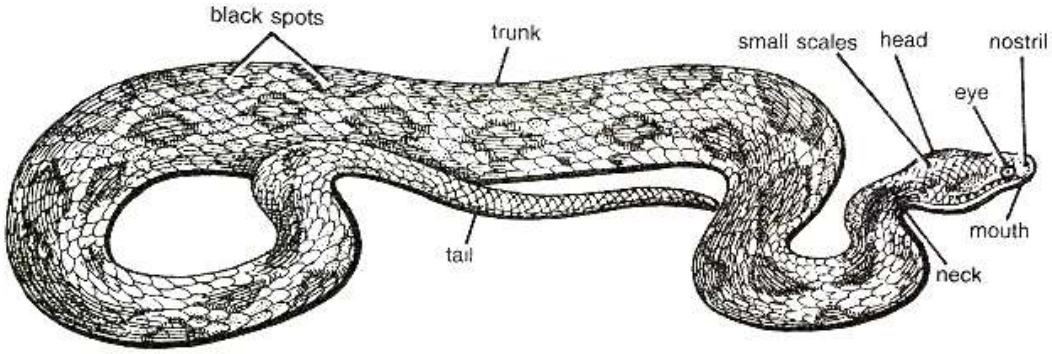
CLASS: REPTILIA

ORDER: SQUAMATA

1. Draco, also known as the flying dragon or gliding lizard, possesses remarkable adaptations that enable it to fly or glide from tree to tree. These adaptations include skin folds on each side of its body that resemble wings.
2. The last five to seven ribs of the Draco lizard become elongated and extend into the wings. Muscles attached to these elongated ribs allow them to move the wings in a bird-like motion while gliding. The scientific term for these wings is "Patagium." During gliding, the Draco lizard can cover distances of up to sixty meters (just under two hundred feet).
3. The Draco lizard exhibits the ability to control and adjust its patagia during gliding, enhancing its maneuverability while in the air. Additionally, its tail functions as a rudder or steering mechanism, aiding in precise navigation.
4. Active during the day, Draco lizards utilize their gliding ability to move effortlessly from one tree to another or even between branches of the same tree. Gliding serves multiple purposes, including foraging for food, finding potential mates and escaping from predators.
5. To establish dominance and protect their territory from other invading lizards, male Draco lizards patrol an area consisting of a few trees.

Draco lizards are incredible creatures with their wing-like adaptations, showcasing a fascinating and unique form of aerial locomotion in the animal kingdom. Their gliding abilities provide them with an advantage in their arboreal habitat, making them a captivating sight to observe in action.

VIPER



PHYLUM: CHORDATA

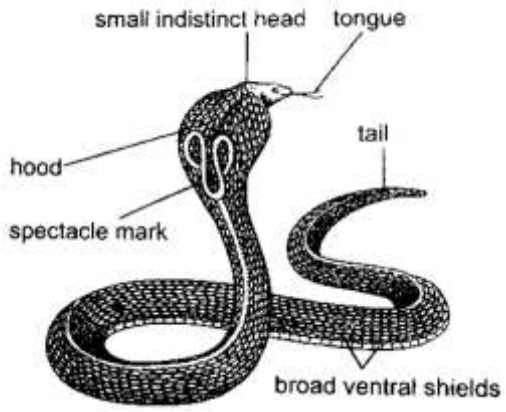
SUB PHYLUM: VERTEBRATA

CLASS: REPTILIA

ORDER: SQUAMATA

1. The Viper Snake is notorious for its deadly venom, which is haemotoxic and poses a serious threat to humans and other animals.
2. On its dorsal side, the Viper Snake displays distinctive diamond-shaped, three longitudinal lines, serving as characteristic markings.
3. The body color of the Viper Snake is pale brown on the upper parts, while the under parts exhibit a yellowish-white hue.
4. The head of the Viper Snake is triangular in shape and covered with very small scales, adding to its distinctive appearance.
5. When excited or threatened, the Viper Snake produces a loud hissing noise, resembling the sound of a pressure cooker, which serves as a warning to potential predators or threats.
6. The snout of the Viper Snake is angular and its nasal opening is quite prominent, contributing to its unique facial features.
7. The Viper Snake's eyes are strikingly golden in color and they have elliptical pupils.
8. A bite from the Viper Snake can cause tremendous pain, swelling, and irritation due to the venom's haemotoxic properties. In severe cases, the venom can lead to heart failure and even death.

NAJA



PHYLUM: CHORDATA

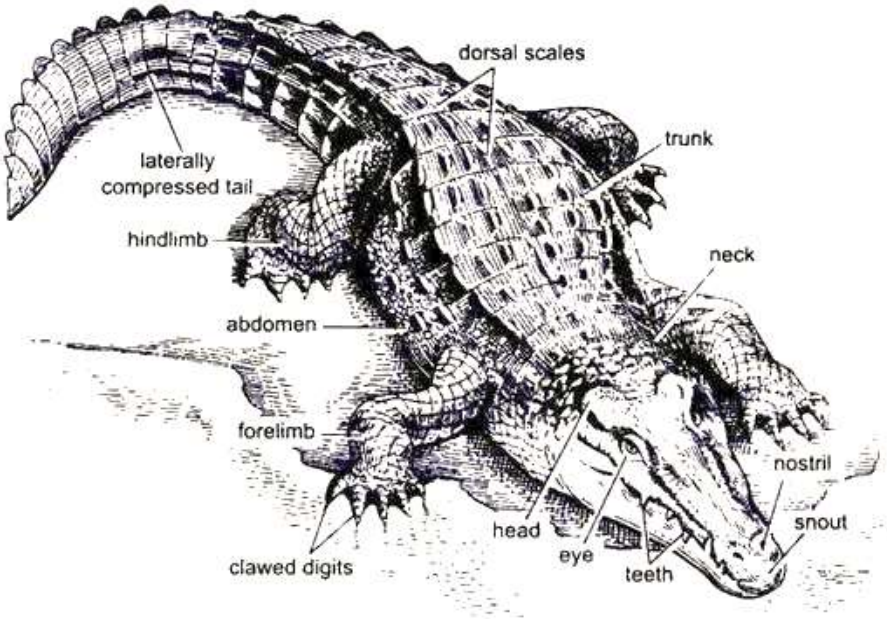
SUB PHYLUM: VERTEBRATA

CLASS: REPTILIA

ORDER: SQUAMATA

1. The Indian Cobra, also known as "Nag" in Marathi, is commonly recognized for its distinctive features and is typically brown or black in color.
2. This species is venomous, and its venom contains neurotoxins, which affect the nervous system of its prey or potential threats.
3. One of its striking characteristics is the expansion of the neck and cervical ribs, forming a hood with a spectacle-like mark on both the dorsal and ventral sides.
4. The Indian Cobra exhibits a large third supra labial scale that extends to touch the eye and nostril, adding to its unique appearance.
5. When threatened or agitated, the Indian Cobra can produce a hissing noise, warning others of its presence. It possesses two poisonous fangs for delivering its venom.
6. The tail of the Indian Cobra is cylindrical and tapers gradually. Its sub caudal scales are divided, providing the snake with agility and flexibility.
7. Ventral scales of the Indian Cobra are smooth and undivided, contributing to its sleek and streamlined body structure.
8. As a carnivorous reptile, the Indian Cobra preys on other animals and it follows an oviparous reproductive strategy, laying eggs for reproduction.

CROCODYLUS



PHYLUM: CHORDATA

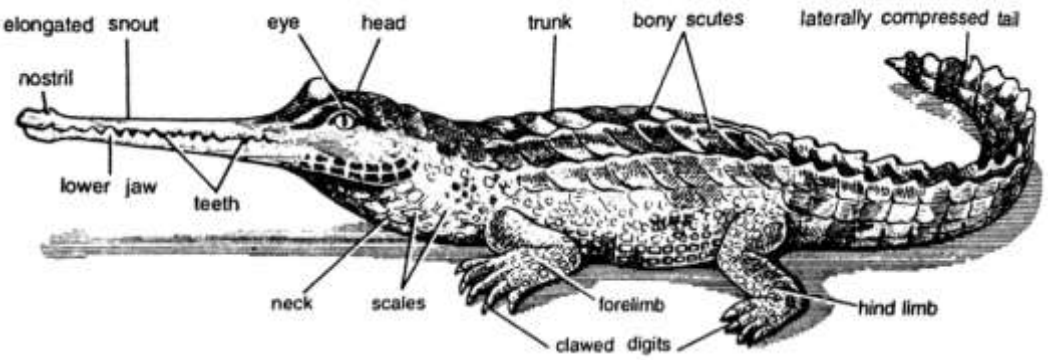
SUBPHYLUM: VERTEBRATA

CLASS: REPTILIA

ORDER: CROCODILIA

1. The Mugger Crocodile, also known as the Marsh Crocodile, is a prominent reptile found in various regions.
2. Its body is covered with a tough and horny exoskeleton consisting of thick scales and dermal plates, providing excellent protection and durability.
3. The Mugger Crocodile possesses a distinct triangular head with a broad snout, which aids in its predatory abilities.
4. With a long and laterally compressed tail, the Mugger Crocodile is well-adapted for swimming and propelling itself through the water.
5. Both the upper and lower jaws of the Mugger Crocodile are armed with 19 stout and powerful teeth on each side, facilitating its carnivorous feeding habits.
6. Unique to crocodilians, the Mugger Crocodile's ears are covered with movable flaps or skin, allowing them to close their ears while submerged.
7. This species exhibits two pairs of limbs with clawed digits, a characteristic shared by all crocodilians, which aids in movement on land and enables them to dig nesting burrows.
8. As a carnivorous reptile, the Mugger Crocodile feeds on various preys and it follows an oviparous reproductive strategy, laying eggs in nests for hatching.

GAVIALIS



PHYLUM: CHORDATA

SUBPHYLUM: VERTEBRATA

CLASS: REPTILIA

ORDER: CROCODILIA

GENUS: *GAVIALIS*

SPECIES: *G. GANGETICUS*

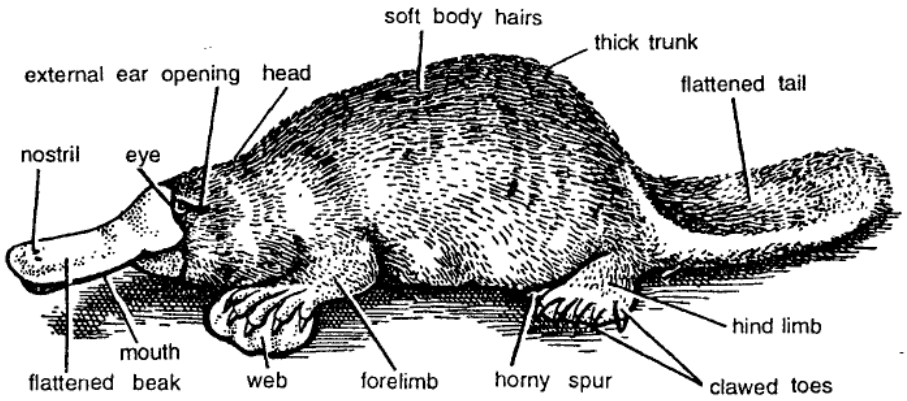
1. The Indian Gharial is native to the northern part of the Indian subcontinent, particularly found in freshwater river systems.
2. Among the largest crocodilians in the world, Indian gharials boast an impressive size and stature.
3. They inhabit clear freshwater rivers characterized by fast-flowing currents, providing an ideal habitat for their unique adaptations.
4. Indian gharials are not well-suited for movement on land, primarily venturing out of the water only for basking and nesting purposes.
5. Adult males can reach lengths between 5 to 6 meters, with some of the larger individuals approaching 6.5 meters. Females are generally smaller, though still exceeding 4 meters in length.
6. The Indian gharial is easily recognizable by its long and slender snout, specifically adapted for catching fish - its primary prey. As individuals age, their snout shape often becomes longer and more streamlined.
7. The jaws of the Indian gharial house an impressive array of between 106 to 110 razor-sharp teeth, well-suited for grasping and consuming fish.
8. For locomotion in the water, Indian gharials possess extensively webbed feet, aiding them in navigating their aquatic habitat with ease.
9. Their smooth scales distinguish them from most crocodiles and alligators, providing them with a sleek and streamlined appearance.

MAMMALIA GENERAL CHARACTERS

Mammalia, commonly known as mammals, are a diverse group of animals that share several general characteristics

1. **Mammary Glands:** Mammals possess mammary glands, which produce milk to nourish their young. These glands are typically found in females, but some male mammals can also produce milk in certain species.
2. **Hair or Fur:** Mammals have hair or fur covering their bodies. Hair serves various functions, including insulation, camouflage, protection and sensory perception.
3. **Endothermic:** Mammals are endothermic animals, meaning they can internally regulate their body temperature. They have a high metabolic rate that generates and maintains their body heat, allowing them to thrive in various environments.
4. **Specialized Teeth:** Mammals have different types of teeth adapted for various functions, such as cutting, tearing, grinding or chewing. The presence of different types of teeth, including incisors, canines, premolars and molars enables them to consume a wide range of diets.
5. **Diaphragm:** Mammals possess a muscular diaphragm, which separates the chest cavity from the abdominal cavity. The diaphragm plays a vital role in respiration by aiding in inhalation and exhalation.
6. **Four-Chambered Heart:** Mammals have a four-chambered heart, consisting of two atria and two ventricles. This heart structure allows for efficient separation of oxygenated and deoxygenated blood, facilitating the delivery of oxygen to body tissues.
7. **Live Birth and Parental Care:** The majority of mammals give birth to live young. They have internal fertilization and the developing embryos are nourished and protected within the mother's body until birth. Mammals often exhibit various forms of parental care, including nursing, grooming and teaching their offspring.
8. **Well-Developed Nervous System:** Mammals have a highly developed nervous system, including a complex brain that enables advanced cognitive abilities, memory, and learning. They also possess well-developed sensory organs, such as eyes, ears and a highly sensitive sense of smell.
9. **Diverse Reproductive Strategies:** Mammals exhibit diverse reproductive strategies, including monotremes that lay eggs, marsupials that have a pouch to carry and nurse their underdeveloped young and placental mammals that have a placenta to nourish the developing embryo.
10. **Social Behavior:** Many mammal species exhibit social behavior, living in complex social groups or forming strong social bonds. This behavior allows for cooperative hunting, protection, and raising offspring.

DUCK-BILLED PLATYPUS



KINGDOM: ANIMALIA
PHYLUM: CHORDATA
CLASS: MAMMALIA
ORDER: MONOTREMATA)
FAMILY: ORNITHORHYNCHIDAE
GENUS: *ORNITHORHYNCHUS*
SPECIES: *ORNITHORHYNCHUS ANATINUS*

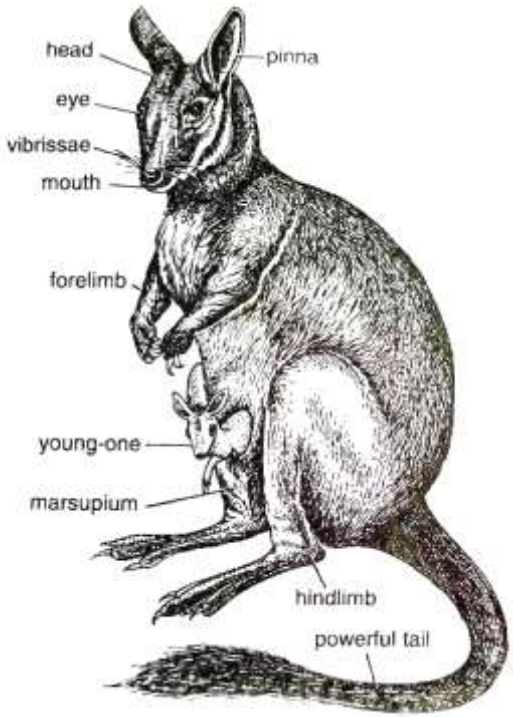
The Duck-Billed Platypus (*Ornithorhynchus anatinus*) is a fascinating and unique monotremes mammal found in Australia. Here are some notable characteristics of this extraordinary creature:

1. **Appearance:** The Duck-Billed Platypus has a peculiar appearance, combining features of mammals, birds and reptiles. It has a beak that resembles that of a duck, which is soft and rubbery, unlike a bird's hard beak. Its body is covered with dense, waterproof fur and it has webbed feet, well-suited for its semi-aquatic lifestyle.
2. **Egg-Laying:** The Platypus is one of the few mammals that lay eggs, making it monotremes. Female platypuses build burrows near water bodies, where they lay eggs and later nurse their young.
3. **Venomous Spurs:** Male Platypuses possess venomous spurs on their hind legs, which they use during territorial disputes or mating encounters. The venom is not lethal to humans, but it can cause severe pain and swelling.
4. **Electro sensory Abilities:** Platypuses have a unique sensory system called electroreception. They can detect electrical signals produced by the muscle contractions of their prey, such as insects and small crustaceans, helping them hunt in the dark underwater environments.

5. **No Teeth:** Unlike most mammals, the Duck-Billed Platypus lacks teeth in adulthood. Instead, it uses hard pads in its mouth to grind and crush its food.
6. **Semi aquatic Lifestyle**: The Platypus is well-adapted for both land and water. It spends much of its time in the water, using its webbed feet and flat tail to swim gracefully. When on land, it can retract its webbing to expose sharp claws for digging burrows.
7. **Nocturnal and Solitary**: Platypuses are primarily nocturnal creatures, active during the night. They are solitary animals, and individuals typically only come together during the breeding season.
8. **Conservation Status:** The Duck-Billed Platypus is considered a vulnerable species due to habitat destruction, pollution and climate change affecting its natural habitat. Conservation efforts are essential to protect this unique and iconic Australian mammal.

The Duck-Billed Platypus remains one of the most remarkable creatures in the animal kingdom, captivating scientists and nature enthusiasts alike with its unusual combination of features and behaviors. Its conservation is of utmost importance to preserve the biodiversity and natural heritage of Australia.

KANGAROO



KINGDOM: ANIMALIA

PHYLUM: CHORDATA

CLASS: MAMMALIA

INFRACLASS: MARSUPIALIA

ORDER: DIPROTODONTIA

SUBORDER: MACROPODIFORMES

FAMILY: MACROPODIDAE

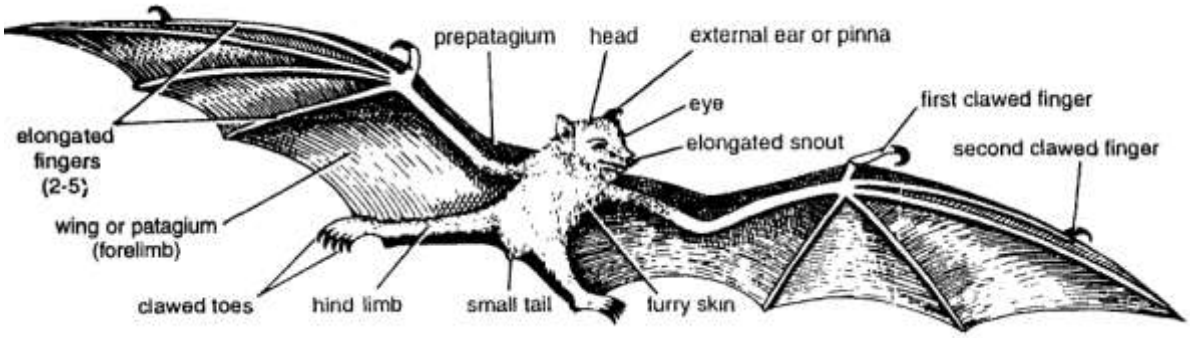
The kangaroo is an iconic marsupial mammal native to Australia. Here are some key features and characteristics of kangaroos:

1. **Unique Locomotion**: Kangaroos are renowned for their distinctive hopping locomotion. Their powerful hind legs and large, muscular tail allow them to cover vast distances in a series of bounds, a behavior known as "Kangaroo Hopping."
2. **Pouched Mammals**: Kangaroos are marsupials, meaning they give birth to relatively undeveloped live young, which continue their development in the mother's pouch. Female kangaroos have a pouch on their belly where they nurture and protect their tiny joeys.

3. **Herbivorous Diet:** Kangaroos are herbivores, primarily grazing on grass and vegetation. They have specialized teeth that allow them to efficiently chew and process plant material.
4. **Sexual Dimorphism**: Male kangaroos, known as bucks or boomers are larger and more muscular than females, called does or flyers. Males also have prominent forelimbs used in mating displays and fighting.
5. **Social Behavior:** Kangaroos can be found in groups called mobs. These social structures vary in size and are typically led by the most dominant male, often referred to as the "Alpha Male."
6. **Nocturnal and Crepuscular:** Kangaroos are mainly active during the late afternoon, evening and early morning. They tend to rest in the shade during the hottest part of the day.
7. **Long Lifespan**: In the wild, kangaroos can live up to 6-8 years, while in captivity; they may live longer, up to 20 years.
8. **Native to Australia:** Kangaroos are exclusively found in Australia and are an integral part of the country's cultural identity, appearing on its coat of arms and numerous emblems.
9. **Conservation Status:** Some kangaroo species face threats due to habitat loss, hunting, and road accidents. However, overall, kangaroo populations are relatively stable in their native habitats.

Kangaroos are fascinating creatures, embodying the spirit of the Australian wilderness and captivating the world with their unique adaptations and behaviors. Their presence in the Australian ecosystem is vital, contributing to the balance and diversity of this remarkable continent's fauna.

BAT



PHYLUM: CHORDATA

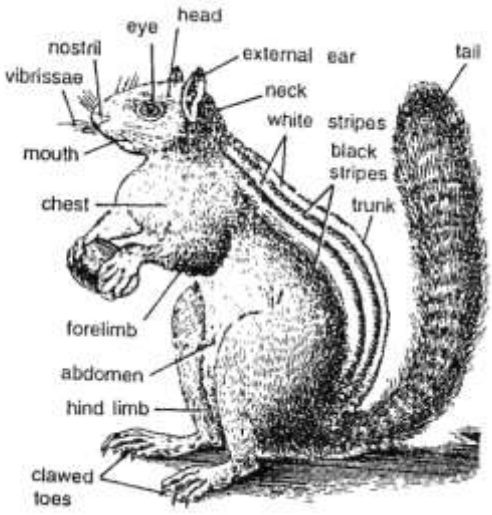
SUBPHYLUM: VERTEBRATA

CLASS: MAMMALIA

ORDER: CHIROPTERA

1. Bats are fascinating aerial mammals, characterized by their unique ability to fly. Their bodies are covered with soft fur, which aids in thermoregulation and provides insulation.
2. With a short snout, bats exhibit various facial structures, depending on their species and feeding habits.
3. One of the distinctive features of bats is their large pinnae, which serve as a tactile organ, helping them detect and interpret sounds while in flight.
4. Although bats possess small eyes, their vision is relatively weak compared to other mammals. However, they have exceptional abilities in echolocation and detecting sound waves.
5. The tail of a bat is typically small and is included in the interfemoral membrane, contributing to their wing structure.
6. Bats are primarily nocturnal creatures, with their flight aided by a unique membrane called the patagium, allowing them to glide or soar through the air.
7. Their dietary preferences vary among species, with some bats being insectivorous, others frugivorous (fruit-eating), and a few even sanguivorous (blood-eating).
8. Notably, bats emit ultrasonic sound waves through their nostrils, which bounce off objects in their surroundings. These sound waves are received by their highly sensitive ears, enabling them to navigate and hunt while in flight through the process of echolocation.

FUNAMBULUS



PHYLUM: CHORDATA

SUBPHYLUM: VERTEBRATA

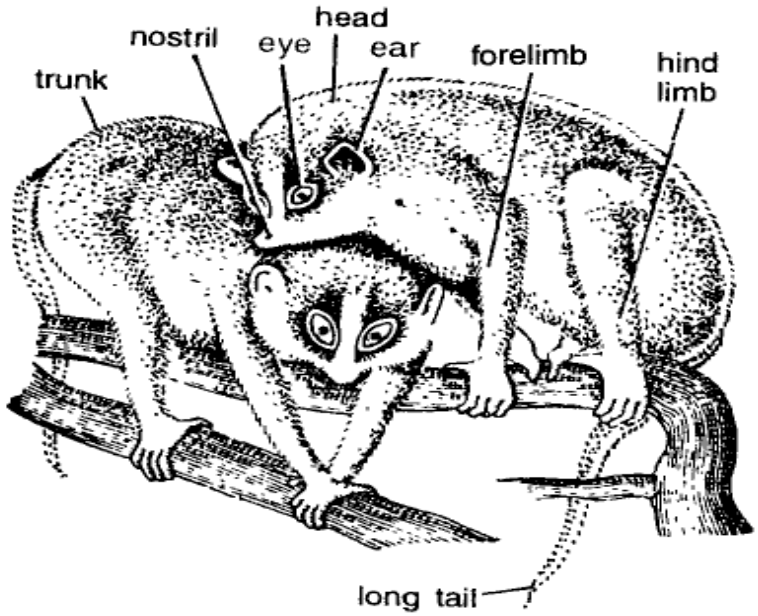
CLASS: MAMMALIA

ORDER: RODENTIA

1. The Indian Palm Squirrel, also known as the Three-Striped Palm Squirrel, is a delightful creature found in the Indian subcontinent.
2. Characterized by its smaller size, it boasts a charming appearance, with a bushy tail slightly shorter than its body.
3. The back of the Indian Palm Squirrel displays a grizzled, grey-brown color, accentuated by three prominent white stripes running from its head to its tail. Notably, the two outer stripes extend from the forelegs to the hind legs only.
4. Complementing its unique appearance, the squirrel's belly is creamy-white, and its tail features interspersed long black and white hair. Its ears are small and triangular in shape.
5. Juvenile squirrels exhibit lighter coloration, which gradually darkens as they mature and age.
6. The Indian Palm Squirrel primarily sustains itself by consuming nuts and fruits. It is fairly vocal and produces a distinctive cry, resembling "chip chip chip," alerting others to the presence of potential danger.

In India, squirrels hold sacred significance and are considered to be divine creatures. Consequently, they are protected and not to be harmed. Many Hindu families even provide them with food, owing to their association with Lord Rama, a revered figure in Hindu mythology.

LORIS



PHYLUM: CHORDATA

SUBPHYLUM: VERTEBRATA

CLASS: MAMMALIA

ORDER: PRIMATES

1. The Loris is adorned with wooly brownish fur, giving it a distinctive silvery sheen.
2. These creatures are primitive and primarily active during the night, displaying remarkable adaptations for life in trees (arboreal).
3. Lories have a varied diet, consuming fruits as well as small animals to meet their nutritional needs.
4. The Loris possesses a fox-like head, featuring a pointed muzzle or snout, contributing to its unique appearance.
5. With closely placed and bulging eyes, Lories have excellent night vision, aiding them in their nocturnal activities.
6. Lories exhibit short and conical external ears, known as pinnae, which play a role in their auditory perception.
7. Notably, these mammals have small nostrils and primitive teeth, characteristic of their evolutionary lineage.
8. The Loris boasts a long tail, though it is not prehensile, meaning it cannot grasp or hold objects. This captivating creature can be found in various regions, including India, Sri Lanka, and Madagascar.

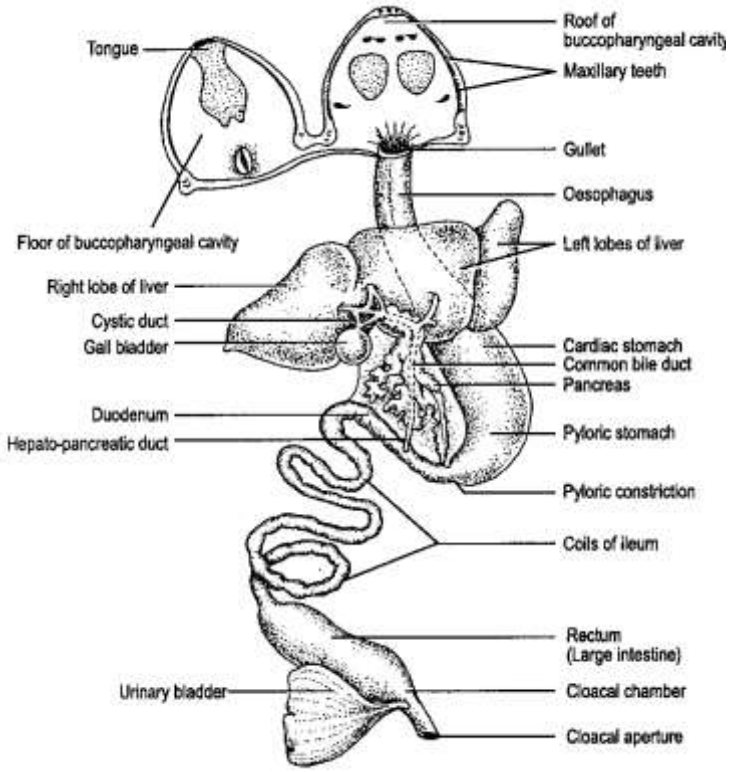
DEMONSTRATION OF FROG: DIGESTIVE SYSTEM, RESPIRATORY SYSTEM, EXCRETORY SYSTEM, MALE AND FEMALE REPRODUCTIVE SYSTEM, HEART AND BRAIN

FROG: DIGESTIVE SYSTEM

The digestive system of frog is well developed. It is suited to carnivorous diet. It starts with Ingestion, Digestion, Absorption, Assimilation and Egestion of the food material. Digestive system consists of two important parts called as

1) Alimentary canal and

2) Digestive glands



The digestive system of a frog consists of several components, including the Mouth, Esophagus, Stomach, Small Intestine, Large Intestine and Cloaca.

1. **Mouth:** The mouth is the wide anterior opening of the alimentary canal in a frog. It is surrounded by the upper immovable jaw and the lower movable jaw.
2. **Esophagus:** The esophagus is a muscular tube that extends between the mouth and the stomach in a frog. Function: The esophagus carries food from the mouth to the stomach.
3. **Stomach:** The stomach of a frog is a hollow, expandable muscular sac. It is slightly curved and has an anterior wider part called the cardiac stomach and a posterior narrow part called the pyloric stomach.

   Functions: (i) Temporary food storage (ii) Partial digestion of food occurs in the stomach.

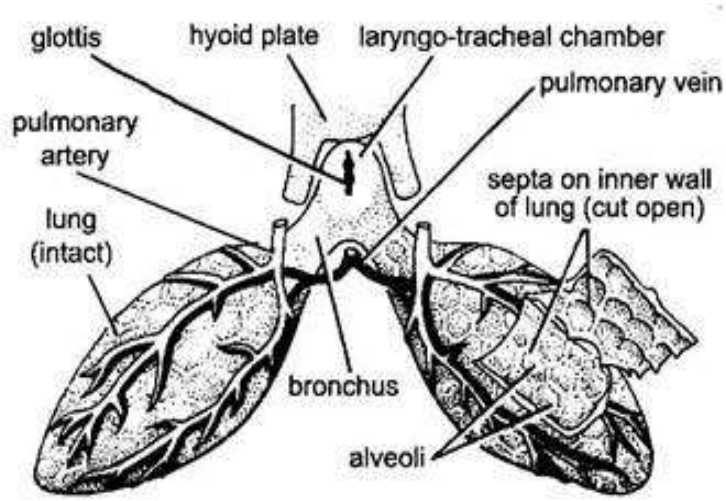
4. **Small Intestine:** The small intestine is a tube that connects the stomach to the large intestine in a frog. It has a relatively uniform diameter and is divided into two parts: the duodenum and the ileum. The intestine is held in place by a transparent sheet called the mesentery.
   (i) Production of intestinal juice by the internal lining of the small intestine. functions
   (ii) Reception of bile and pancreatic juice.
   (iii) Complete digestion of food in the small intestine.
   (iv) Absorption of digested food.
5. **Large Intestine**: Also known as the rectum, the large intestine is an expanded, short, and straight tube that connects the small intestine to the cloaca in a frog.
   Functions:
   (i) Temporary storage of undigested food.
   (ii) Absorption of water from undigested food if necessary.
   (iii) Conveyance of fecal matter to the cloacal chamber.
6. **Cloaca:** The cloaca is the posterior most chamber of the frog's alimentary canal. It receives fecal wastes, urine and reproductive products such as eggs or sperm. The cloaca opens outward as the cloacal aperture.

Associated Glands: The main associated glands in the frog's digestive system are the pancreas and the liver.

a) **Pancreas**: The pancreas is a pale yellow digestive gland located in the mesentery between the stomach and the duodenum. It surrounds the bile duct and releases its secretions into it.
   Functions:
   1) The Islets of Langerhans in the pancreas produce two hormones, namely Insulin and Glucagon.
   2) The exocrine part of the pancreas produces pancreatic juice.

b) **Liver:** The liver is the largest digestive gland in a frog and is divided into three lobes. It is associated with a thin-walled sac called the gallbladder, which is connected to the duodenum by the bile duct.
   Functions:
   1) Secretion of bile.
   2) Conversion of excess glucose into glycogen for storage in the liver.
   3) Conversion of ammonia into urea.
   4) Storage of excess vitamins.
   5) Destruction of worn-out red blood cells in the liver.

FROG: RESPIRATORY SYSTEM



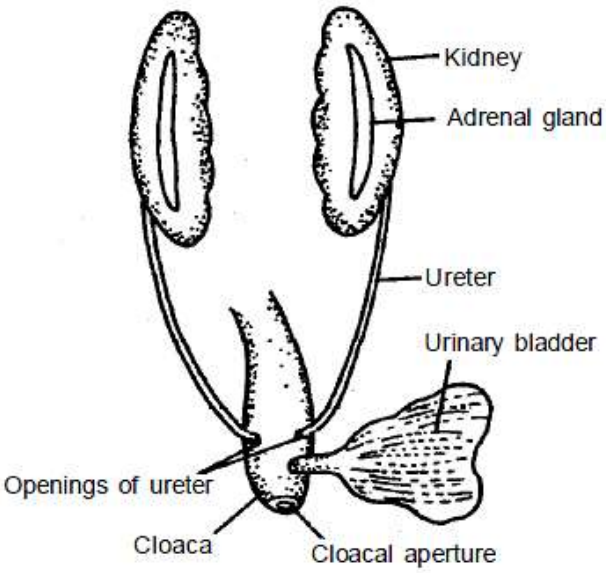
The respiratory organs of frog are pair of lungs, skin and buccopharynx. Frog respires with the lungs, buccopharynx and skin when it is on land. In water, it respires with the help of skin. Therefore, frog can live both on land and in water.

a) The paired lungs are thin walled, spongy and highly elastic sacs.
b) Lungs are suspended freely in the body cavity one on either side of heart.
c) Externally each lung is covered by peritoneum called pleura.
d) Internally lungs are having alveoli and air chambers.

Functions:

1. Atmospheric air is taken inside the lungs.
2. Gaseous exchange takes place between this and blood.
3. Impure air is given out from lungs.
4. Thus, lungs perform aerial respiration.

FROG: EXCRETORY SYSTEM



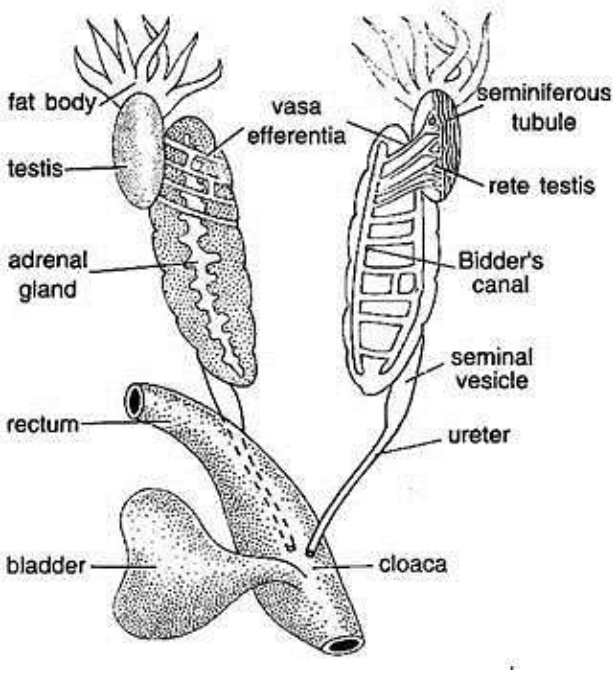
The excretory system in frogs, like in many other vertebrates, is responsible for the removal of waste products and excess substances from the body. In frogs, this system is primarily composed of the kidneys and associated structures. Here is an overview of the frog excretory system:

1. **Kidneys:** Frogs have a pair of bean-shaped kidneys located in the abdominal cavity. The kidneys are the main excretory organs responsible for filtering the blood and producing urine. They play a crucial role in maintaining the water and electrolyte balance of the body.
2. **Ureters:** Each kidney is connected to the urinary bladder by a tube called the ureter. The ureters transport urine from the kidneys to the urinary bladder, where it is stored temporarily before being expelled from the body.
3. **Urinary Bladder:** The urinary bladder is a muscular sac that stores urine until it is eliminated. When the bladder reaches its capacity, the frog excretes urine through the cloaca.
4. **Cloaca:** The cloaca is a common chamber at the end of the digestive and excretory systems in frogs. It serves as an opening for the release of both feces and urine from the body. The expelled waste, a combination of urine and feces, passes through the cloaca and is eliminated from the body.
5. **Skin:** In addition to the kidney-based excretion, frogs can also excrete certain waste products through their skin. The skin of frogs is semi-permeable, allowing some waste products, such as ammonia, to diffuse out of the body directly.

The excretory system is essential for maintaining the internal environment of the frog's body by eliminating harmful metabolic waste products and maintaining proper fluid and electrolyte balance. It is a vital component of the frog's overall physiology, ensuring the removal of toxins and waste to support proper metabolic functions and overall health.

FROG: MALE REPRODUCTIVE SYSTEM

The male reproductive system of a frog consists of organs and structures that are responsible for the production, storage and delivery of sperm. Here's an overview of the key components of the male frog's reproductive system:

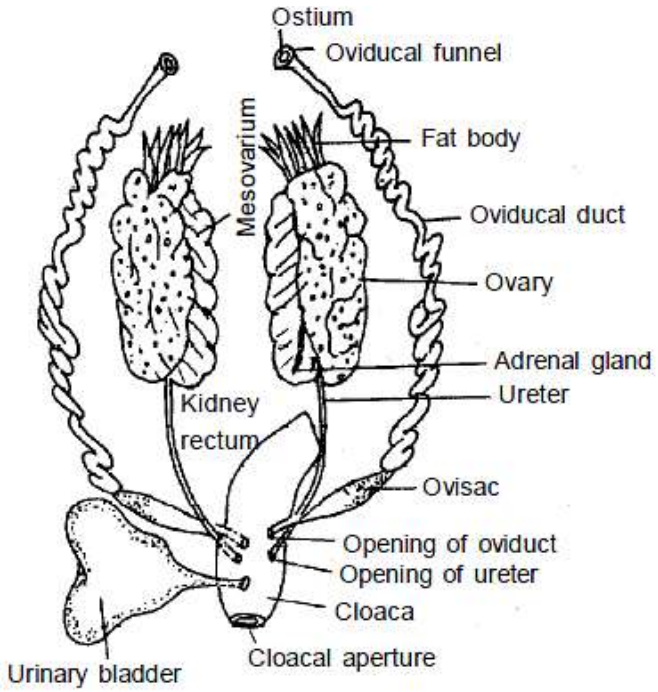


1. **Testes:** The testes are the primary male reproductive organs and frogs have a pair of them. These oval-shaped organs are located in the abdominal cavity, behind the kidneys. The testes are responsible for producing sperm through a process called spermatogenesis.
2. **Vasa Efferentia:** The sperm produced in the testes move into a series of small tubules called vasa efferentia. These tubules act as ducts to transport the sperm from the testes to the mesonephric (Wolffian) ducts.
3. **Mesonephric Ducts (Wolffian Ducts):** The mesonephric ducts are long, coiled tubes that receive the sperm from the vasa efferentia. They also serve as the exit route for sperm to leave the testes.
4. **Kidneys:** The kidneys in male frogs have a secondary function related to reproduction. They are involved in the transfer and temporary storage of sperm before it is released during mating.
5. **Cloaca:** The cloaca is a common chamber at the end of the digestive and urogenital systems in frogs. In the male reproductive system, the cloaca serves as the exit point for sperm to leave the body during mating. It is also the opening for the elimination of waste and the reception of female eggs during mating.
6. **Nuptial Pads:** Some species of male frogs develop nuptial pads on their thumbs during the breeding season. These specialized structures help them to grip onto the female's body during mating, providing better mating success.

During the breeding season, male frogs release their sperm into the water during mating, where it fertilizes the eggs released by the female. The male reproductive system is a crucial component of frog reproduction, ensuring the continuation of the species through successful fertilization of eggs.

FROG: FEMALE REPRODUCTIVE SYSTEM

The female reproductive system of a frog is responsible for the production, maturation and fertilization of eggs, as well as providing a suitable environment for the development of the embryo.



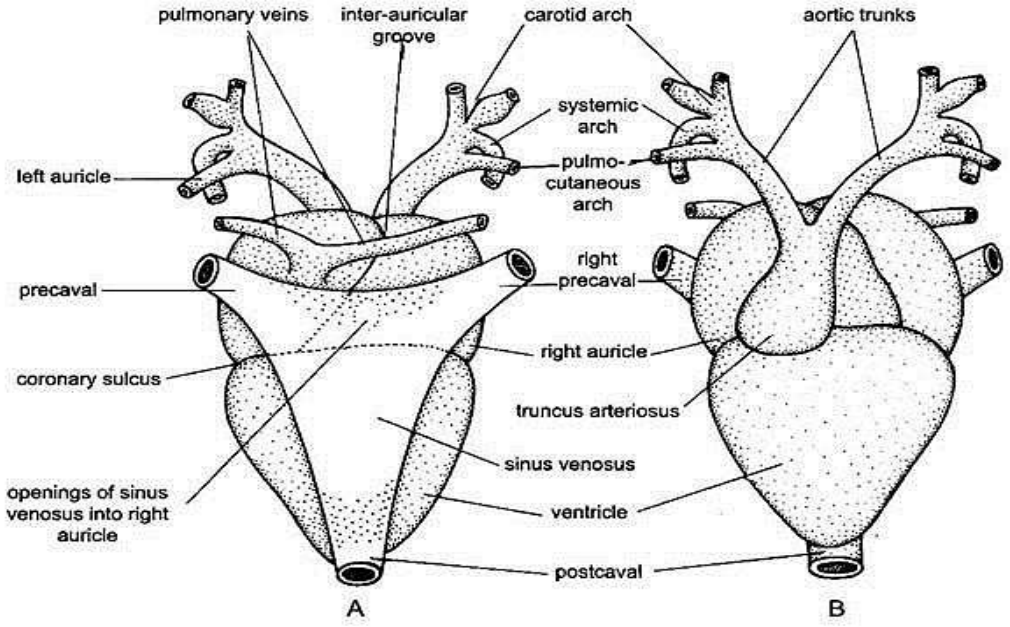
1. **Ovaries:** The female frog has a pair of ovaries, which are the primary reproductive organs. The ovaries are located in the abdominal cavity and are responsible for producing eggs (ova) through a process called oogenesis.
2. **Oviducts:** The oviducts are a pair of tubes that connect the ovaries to the cloaca. Once the eggs are matured in the ovaries, they are released into the oviducts. Fertilization of the eggs occurs in the oviducts if they come into contact with sperm.
3. **Cloaca:** The cloaca is a common chamber at the end of the digestive and urogenital systems in frogs. In the female reproductive system, the cloaca serves as the exit point for eggs to leave the body during mating. It is also the opening for the elimination of waste and the reception of male sperm during mating.
4. **Eggs:** The eggs produced by the ovaries are surrounded by a gelatinous coating, forming a mass known as a frog spawn. The female frog releases the frog spawn into the water during mating, where it can be fertilized by sperm from the male.
5. **Fertilization:** Fertilization of the eggs occurs externally in the water. As the female releases the frog spawn, the male releases his sperm, and the eggs are fertilized.
6. **Brood Pouch (In Some Species):** In some frog species, particularly those in the family Hemiphractidae, females have specialized brood pouches on their backs. After fertilization, the female places the fertilized eggs into the brood pouch, where they undergo development and hatch into tadpoles.

The female reproductive system in frogs plays a vital role in ensuring the successful reproduction and continuation of the species. By producing, fertilizing and providing a suitable environment for the development of eggs, female frogs contribute significantly to the process of reproduction in these amphibians.

FROG: HEART

Heart is the pumping organ of circulatory system. In case of frog it lays midventrally in the anterior region of thorax. It is reddish in colour & made up of special types of muscle, called as cardiac muscles. Heart is covered with transparent double membrane called pericardium. In between two pericardial layers there is a watery fluid called pericardial fluid. It protects the heart, from mechanical shocks & keeps the heart moist.

The heart of frog basically consists of three chambers, two auricles & one ventricle. Auricles are the thin walled receiving chambers of the heart. The right auricle is larger than the left. Right auricle receives deoxygenated or impure blood from the various parts of body while the left auricle receives oxygenated blood from the lungs.



DORSAL VIEW OF FROG'S HEART (A):

In the dorsal view, the frog's heart appears as a roughly triangular structure located in the upper part of the thoracic cavity, just below the skin. The heart is partially covered by the pericardium, a protective membrane.

The dorsal view allows you to see the following structures of the frog's heart:

1. **Atria:** The two upper chambers of the heart are the left and right atria. They receive deoxygenated blood from various parts of the body.
2. **Ventricle:** The single, large ventricle is the lower chamber of the heart. It receives oxygenated blood from the lungs and deoxygenated blood from the atria. The ventricle is responsible for pumping blood to the rest of the body.

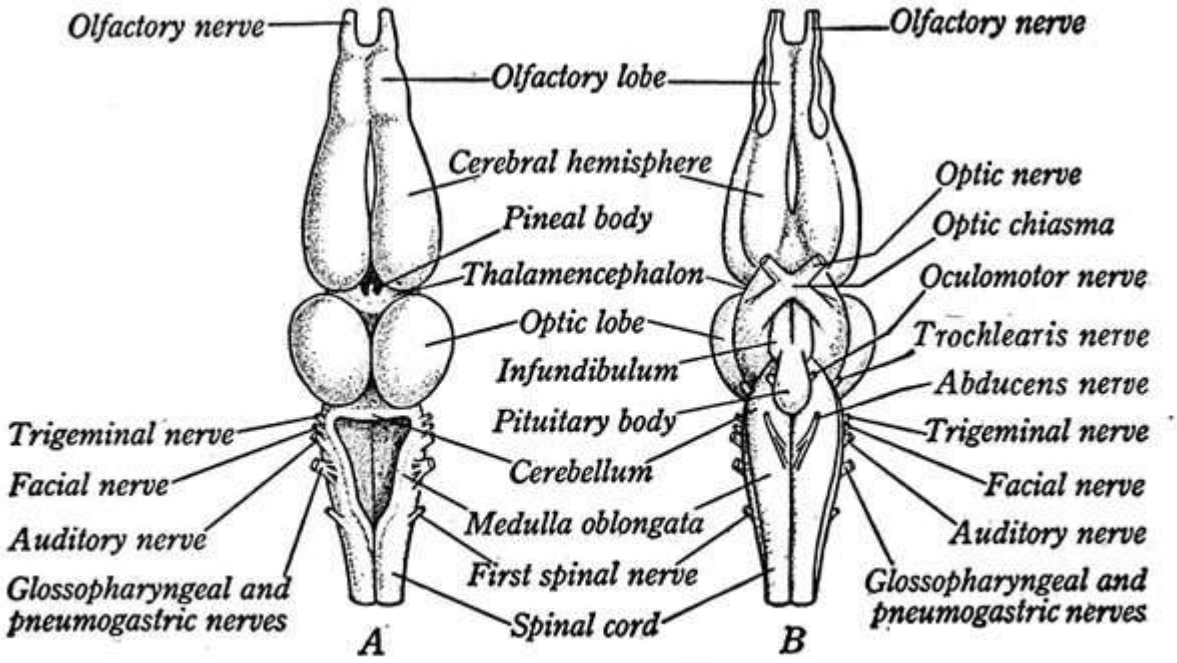
3. **Sinus Venosus:** It is a thin-walled, saclike structure located at the base of the heart. The sinus venosus acts as a collecting chamber for deoxygenated blood returning from the body before it enters the atria.

VENTRAL VIEW OF FROG'S HEART (B):

In the ventral view, the frog's heart is visible from the underside of the thoracic cavity. The ventral view allows you to see the following structures of the frog's heart:

1. **Conus Arteriosus:** This is a smooth, conical structure located at the base of the ventricle. It acts as an arterial chamber and helps to regulate the blood flow into the aorta and the pulmonary artery.
2. **Aorta:** The aorta is the large, main artery that carries oxygenated blood from the ventricle to the rest of the body.
3. **Pulmonary Artery:** This artery carries deoxygenated blood from the ventricle to the lungs for oxygenation.

FROG: BRAIN



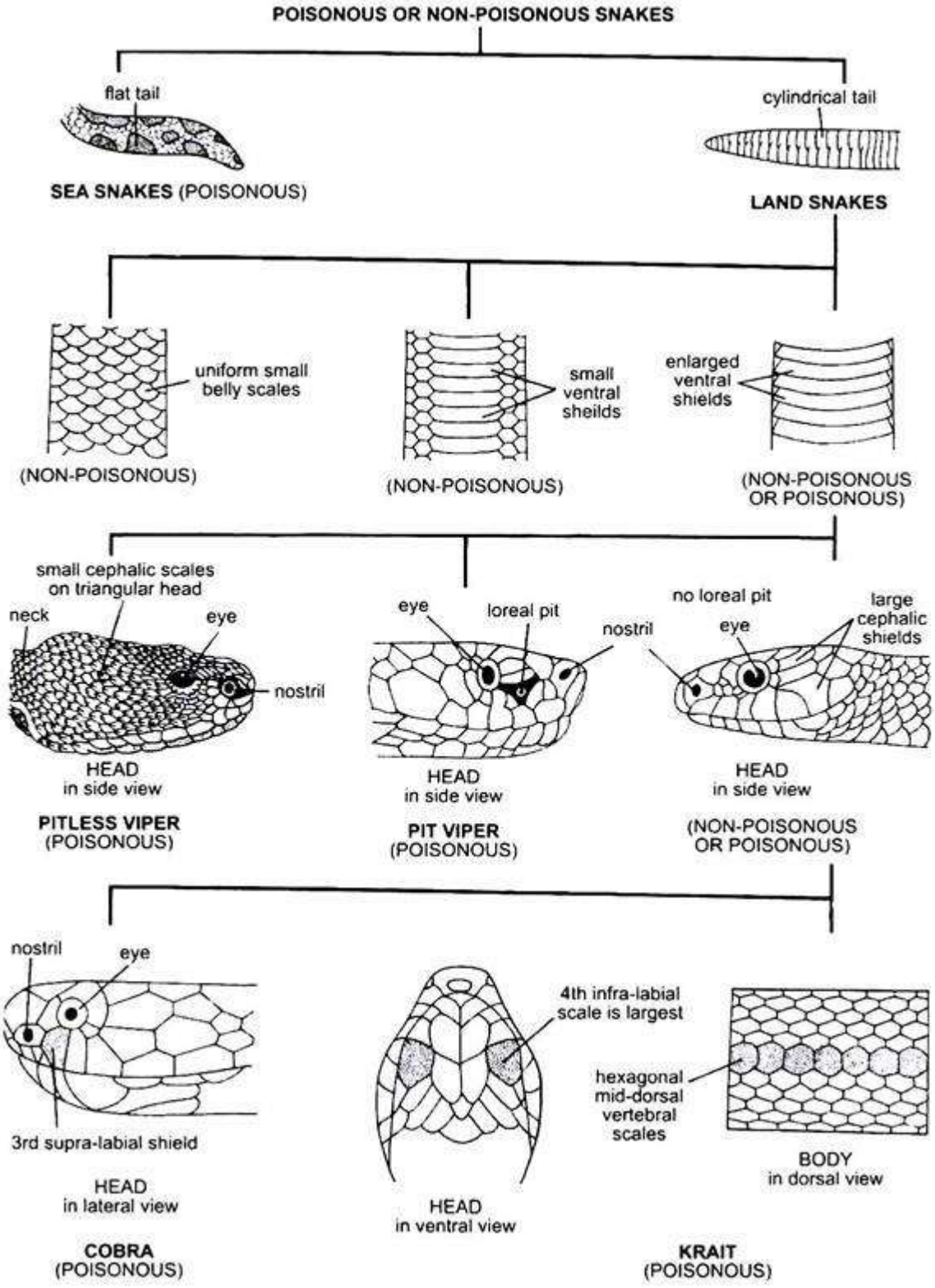
A. Dorsal View B. Ventral View

The brain is divided into three main regions: the Forebrain or Prosencephalon, the Midbrain or Mesencephalon and the Hindbrain or Rhombencephalon.

1. The forebrain consists of several components, including the olfactory lobe responsible for the sense of smell, the cerebral hemisphere which plays a crucial role in intelligence, the diencephalon dorsally which provides nourishment to the brain and the Infundibulum ventrally which regulates hormones.
2. The midbrain is composed of the optic lobes responsible for vision and the Crura-cerebri, thick nerve bands that facilitate communication between the forebrain and hindbrain.
3. The hindbrain consists of the cerebellum, which is made up of five lobes and is involved in muscular control and maintaining static equilibrium. Additionally, the hindbrain includes the medulla oblongata, which regulates involuntary activities such as respiration, digestion and excretion.
4. The spinal cord serves as the centre for spinal reflex actions and connects parts of the peripheral nervous system to the brain.

3) CHARACTERS IDENTIFYING VENOMOUS AND NON-VENOMOUS SNAKES: RUSSELL'S VIPER, SAW SCALED VIPER, COMMON KRAIT, INDIAN COBRA, SEA SNAKE, RAT SNAKE AND CHECKERED KEELBACK

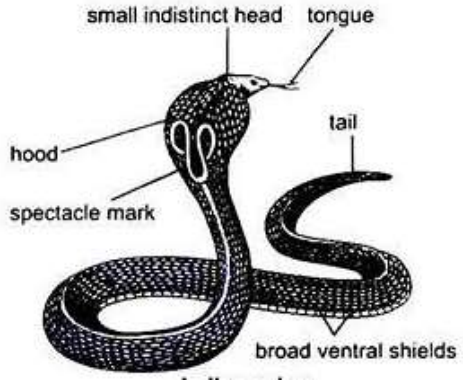
IDENTIFICATION OF VENOMOUS AND NON-VENOMOUS SNAKES



THE FOLLOWING POINTS WILL HELP YOU TO IDENTIFY THE DIFFERENCE BETWEEN VENOMOUS AND NON-VENOMOUS SNAKES

1. If the small scales are present on the belly and back, it is a non-poisonous snake.
2. If the belly scales are not broad enough to extend right across it, it is a non-poisonous snake.
3. If broad plates cover the entire width of the belly, it is poisonous or non-poisonous.
4. If small scales are present on the head, it is poisonous and a viper.
5. If small scales or shields are present on the head and a pit lies between the eye and the nostril, it is poisonous and a pit-viper.
6. If dorsal side of the head has both small scales and large shields, the snake may or may not be poisonous.
7. If the third supra labial scale touches the eye and the nostril, the snake is a cobra or a coral snake. If the neck is with hood and markings, it is cobra. If neck is without hood and coral spots are present on the belly, it is a coral snake. Both cobra and coral snakes are poisonous.
8. If vertebral (scales on the middle of the back) are hexagonal and larger than other scales over the back and the fourth infra-labial scale is the largest, it is poisonous and a Krait snake.
9. If the snake has small scales and large shields on the head but does not have the characters of cobra, coral-snake or krait, then it is non poisonous.

I. COBRA

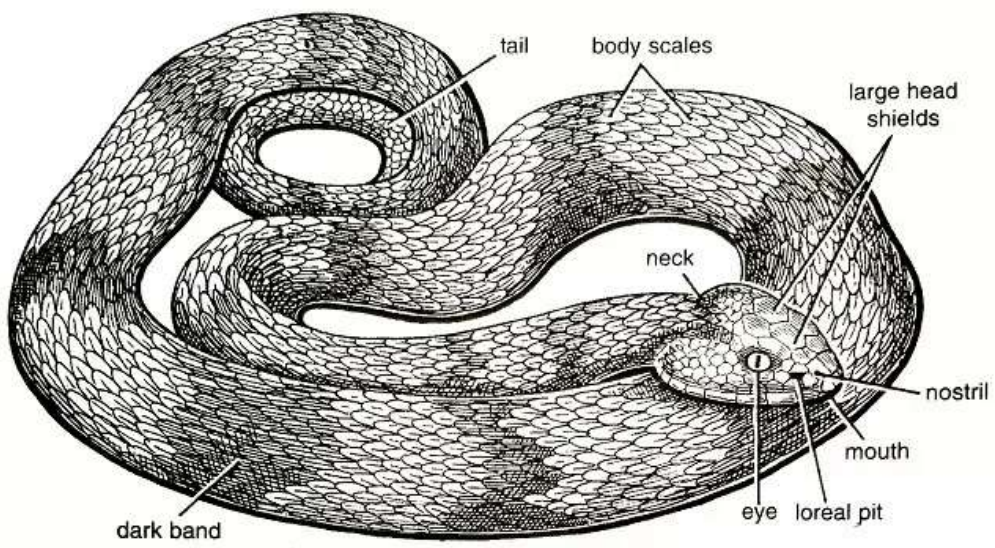


The Cobra, also known as the Indian cobra or Nag in Marathi, is a venomous snake with several distinguishing features and potent neurotoxic venom. Here are some key characteristics of the cobra:

1. **Physical Appearance:** Cobras have a brown or black body covered with smooth, oblique scales arranged in 15 – 25 rows. Their subcaudals are divided into two rows.
2. **Hood and Hissing:** One of the most recognizable features of a cobra is the ability to expand its neck and cervical ribs to form a distinctive hood when threatened or excited. During such instances, it produces a loud hissing noise as a warning or prelude to an attack.
3. **Mark of Spectacle:** Dorsal to the hood, there is a prominent bicoelous mark resembling a figure of the number "ten" or a pair of spectacles, which adds to its unique appearance.
4. **Supra-labial and Eye Connection:** The third supra-labial scale of the cobra makes contact with both the eye and the nostril.
5. **Poison Fangs**: Cobras possess two long, hollow fangs in their upper jaw, through which they inject venom into their prey or when threatened.
6. **Diet:** Cobras are carnivorous and primarily feed on frogs, lizards, rats and young birds. They are known to be oviparous, meaning they lay eggs to reproduce.
7. **Venom:** The venom of the cobra is neurotoxic, targeting the nervous system of its prey. It is potent and can cause severe pain, swelling, and irritation in humans when bitten. In some cases, a cobra bite can lead to respiratory failure and even death if not promptly treated.

The cobra holds a significant place in cultural and natural history, being both feared and revered. Its striking appearance and venomous nature make it a captivating yet potentially dangerous species in the animal kingdom.

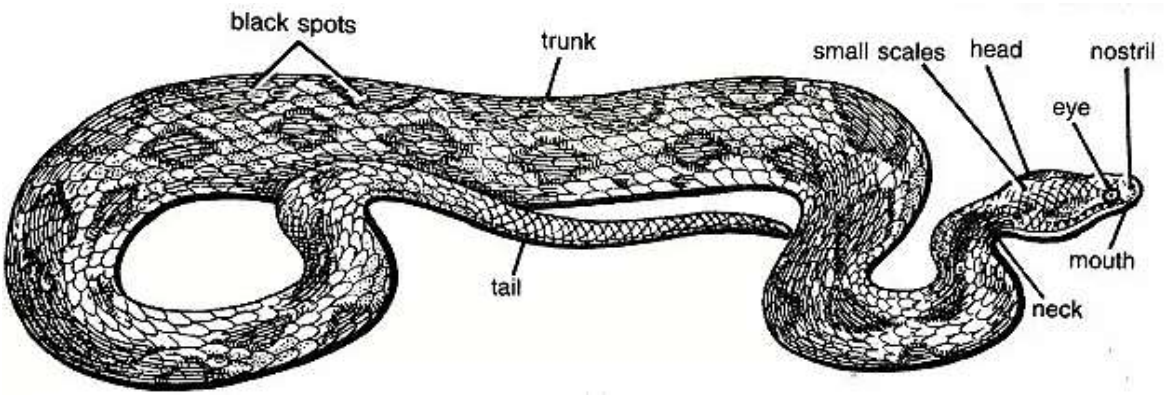
II. PIT VIPER



The Pit Viper is a relatively elusive snake, often found in concealed locations such as under stones or in crevices.

1. **Body and Appearance:** The Pit Viper's body is stout and not excessively elongated. Its distinctive head is characterized by a gray color with black spots.
2. **Loreal Pit:** A remarkable feature of the Pit Viper is the presence of a Loreal pit on each side of its head, situated between the eye and nostril. This specialized organ can detect infrared radiation, allowing the snake to sense heat emitted by warm-blooded prey and creating a thermal image.
3. **Eyes:** The Pit Viper's eyes are relatively large and possess a mesmerizing golden iris with vertical pupils, which are well-adapted for both daytime and nocturnal hunting.
4. **Tail and Reproduction:** The snake's tail is cylindrical in shape. Unlike many other snakes, the Pit Viper is viviparous, giving birth to live young instead of laying eggs.
5. **Venom and Bite:** The Pit Viper is venomous, and its poison is primarily haemotoxic, affecting the blood and tissues. When it bites, the victim experiences intense pain, swelling, and irritation at the site of the bite. In severe cases, the venom can lead to systemic effects, including possible heart failure, which can be life-threatening if left untreated.

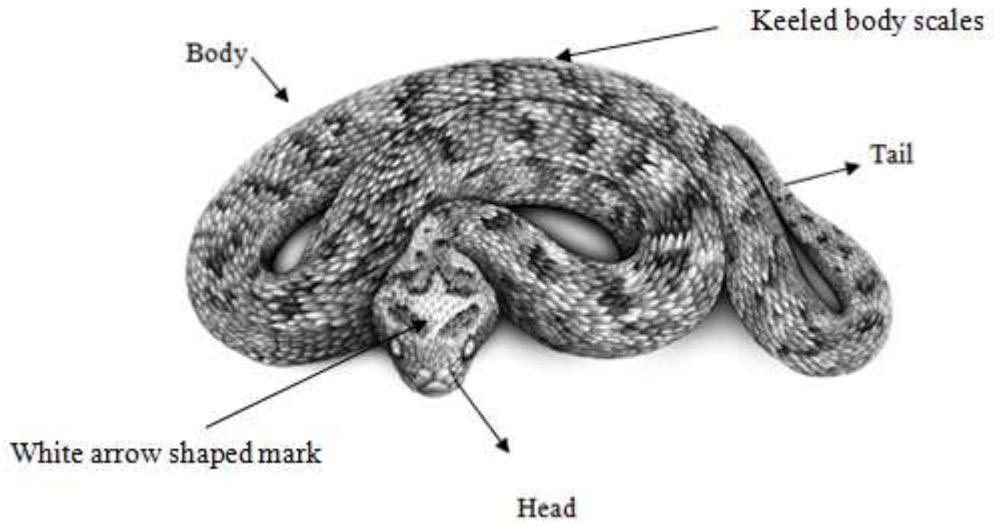
III. RUSSEL'S VIPER



The Russell's viper, a highly venomous snake, possesses distinct characteristics that make it both intriguing and dangerous.

1. **Venom and Bite:** Russell's viper is notorious for its deadly haemotoxic venom. A bite from this snake can lead to severe consequences, causing tremendous pain, swelling and irritation at the site of the bite. In some cases, the venom can also lead to systemic effects, including potential heart failure, which can be fatal if not treated promptly.
2. **Dorsal Markings:** The snake's dorsal side features three distinctive longitudinal lines, forming a diamond-shaped pattern along its back.
3. **Coloration:** Russell's viper typically displays a pale brown color on its dorsal side, while the ventral parts appear yellowish white.
4. **Head Shape and Scales:** The viper's head is triangular in shape and covered with small scales. This characteristic head shape is a key identifier for distinguishing it from other snake species.
5. **Hissing Behavior:** When provoked or threatened, Russell's viper can produce a loud hissing noise, similar to the sound of a pressure cooker. This warning signal serves as a deterrent to potential threats.
6. **Snout and Nasal Opening**: The snake's snout is angular and its nasal opening is quite prominent, contributing to its unique appearance.
7. **Eyes:** Russell's viper has striking golden eyes with an elliptical pupil, adding to its captivating yet intimidating appearance.

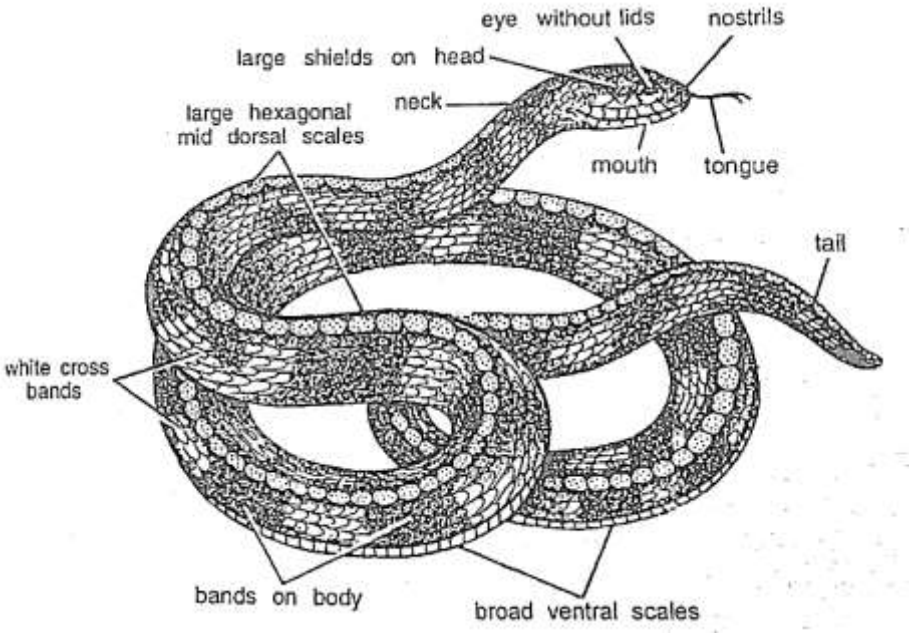
IV. SAW SCALED VIPER



The Saw-scaled Viper is a venomous snake with distinct characteristics that make it both dangerous and fascinating.

1. **Venom and Bite:** The Saw-scaled Viper's venom is potent and haemotoxic. A bite from this snake can result in severe consequences, including tremendous pain, swelling, and irritation at the bite site. In some cases, the venom can lead to systemic effects, potentially causing heart failure and even death if not promptly treated.
2. **Size:** This species is relatively small, with a maximum length of around 3 feet.
3. **Sound Production:** Unlike hissing, the Saw-scaled Viper produces a unique sound while moving. The friction between its rough scales and the ground creates a distinctive sizzling or saw-like sound, from which it derives its name.
4. **Head and Snout:** The snake's head is short, wide and pear-shaped, clearly distinct from its neck. The snout is short and rounded.
5. **Eyes:** Saw-scaled Vipers have large eyes that are positioned well forward on their head, aiding in their ability to detect movement and locate prey.
6. **Crown and Scales:** The crown of the head is covered with small, irregular imbricate scales, which may have a smooth or keeled texture. The dorsal scales on its body are keeled, providing a rough appearance.
7. **White Arrow Mark:** Behind the eyes, there is often a distinct white arrow-shaped mark on the head, which serves as a distinguishing feature.

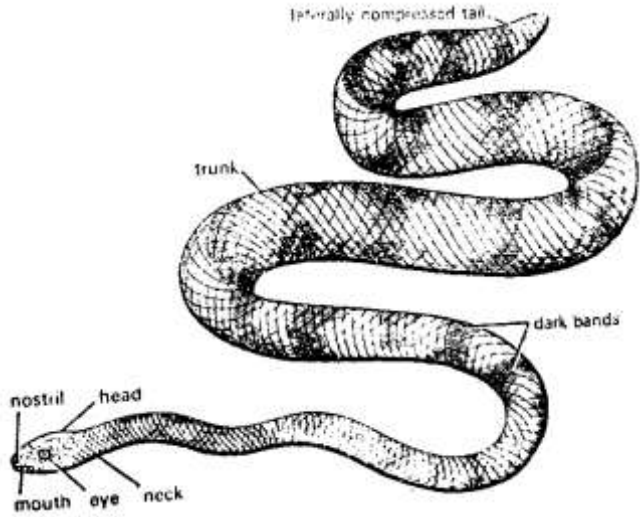
V. COMMON KRAIT



The Common Krait, scientifically known as Bangarus, is a venomous snake with several distinctive features:

1. **Size and Name:** The Common Krait typically measures about one meter in length. It belongs to the Bangarus genus and is commonly referred to as the Krait.
2. **Coloration:** The snake's coloration is a striking combination of glittering blue or black, with two narrow white crossbars running both dorsally and ventrally. The ventral side is uniformly white.
3. **Infralabial Scales**: Among the scales surrounding the lips, the fourth infralabial scale is notably the largest.
4. **Eyes:** The Common Krait has eyes of moderate size and the pupil appears narrow in shape.
5. **Scales:** The vertebral scales, extending from the neck to the tail tip, take on a hexagonal shape. On the ventral side, the scales are smooth and entire.
6. **Subcaudal Scales:** The scales on the underside of the tail are arranged in a single row.
7. **Venom and Bite:** The Common Krait is highly venomous, and its venom is primarily neurotoxic. A bite from this snake can lead to severe symptoms, including tremendous pain, swelling, and continuous blood flow from the wound. Additionally, there can be internal bleeding in organs, which may result in death due to hemorrhages.

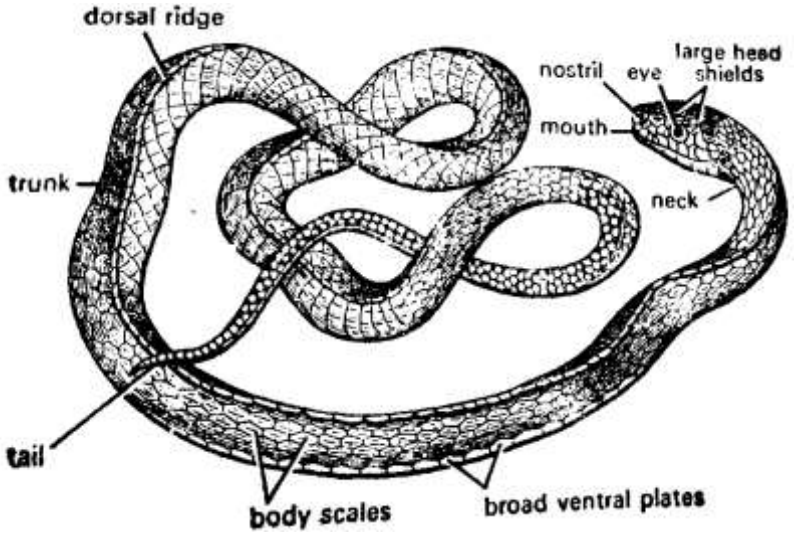
VI. SEA SNAKE



The Sea Snake is a highly venomous snake, possessing unique characteristics that are well-adapted for life in the oceanic environment.

1. **Venom and Bite:** The Sea Snake is indeed a deadly and venomous species and its venom is primarily neurotoxic. A bite from this snake can have severe effects on the nervous system and can be potentially fatal.
2. **Body and Tail:** The Sea Snake has a long and slender body, which is well-suited for swimming in water. Its tail is laterally compressed, enabling efficient propulsion through the ocean currents.
3. **Coloration:** The snake's coloration typically comprises dark olive green on the upper part of its body, adorned with yellowish crossbars. On the ventral side, the color is predominantly white, which provides camouflage in the marine environment.
4. **Ventral Scales:** Unlike some terrestrial snakes, the Sea Snake has relatively small ventral scales, which minimize drag and facilitate smooth movement through water.
5. **Eyes:** Sea Snakes have small eyes with rounded pupils, adapted to function effectively in the underwater environment.
6. Carnivorous Nature: As carnivores, Sea Snakes primarily prey on fish and other marine organisms, making them well-suited for their oceanic habitat.

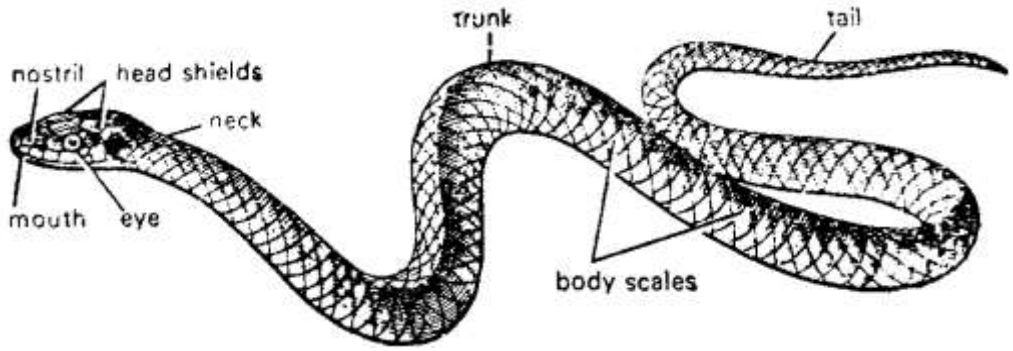
VII. RAT SNAKE / DHAMAN



The Rat Snake, also known as Dhaman, is a non-poisonous snake with several unique characteristics:

1. **Non-Poisonous:** The Rat Snake is not venomous and poses no immediate danger to humans. It is a harmless species.
2. **Size:** This snake can grow to a length of more than two meters, making it one of the larger snake species.
3. **Coloration:** Typically, the Rat Snake has a brown body with black cross bands on the posterior part of its body and tail. The under parts of the snake exhibit a faint yellow hue.
4. **Dorsal Ridge:** A notable feature of the Rat Snake is the presence of a dorsal ridge along the mid-dorsal line of its body.
5. **Head and Supralabial:** The head of the Rat Snake is distinct from its neck and the fourth and fifth supra labials (scales above the upper lip) come into contact with its eye.
6. **Reproductive Nature**: The Rat Snake is oviparous, meaning it lays eggs as part of its reproductive process.
7. **Bite Effects:** In the rare event of a bite, the Rat Snake may leave a mark from its teeth, but there is usually no continuous bleeding or significant swelling. It is essential to remember that Rat Snakes are not aggressive towards humans and usually bite only when provoked or threatened.

VIII. WATER SNAKE/ CHECKERED KEELBACK



The Water Snake, also known as the Checkered Keel back, is a non-poisonous snake with distinctive features:

1. **Body and Head:** The Water Snake has a stout body and a flat head, which is a common characteristic of snakes that inhabit aquatic environments. It is non-poisonous and poses no threat to humans.
2. **Coloration:** The snake's coloration is typically olive with black spots arranged in a chessboard-like pattern, creating an attractive and unique appearance.
3. **Scales:** The scales on the Water Snake's body are keeled and arranged in 19 rows, giving its skin a textured appearance.
4. **Ventral and Subcaudal Scales:** On the ventral side, the scales are rounded, while the subcaudal scales (found on the underside of the tail) are divided, aiding in movement through water.
5. **Supralabial Scales:** The snake has 9 supralabial scales, which are located above the upper lip and contribute to the unique patterning on its head.
6. **Diet and Reproduction:** As a carnivorous species, the Water Snake primarily preys on aquatic animals. It is oviparous, meaning it lays eggs as part of its reproductive cycle.

4) STUDY OF ANY SIX COMMON BIRDS FROM DIFFERENT ORDERS

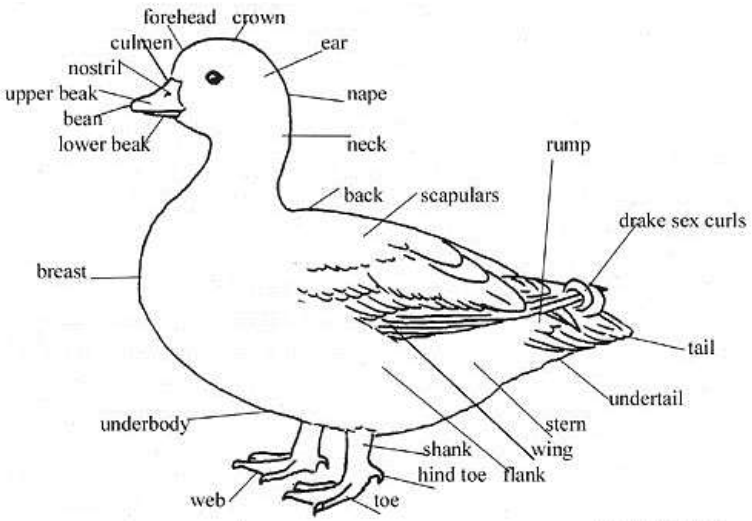
1) DUCK

PHYLUM: CHORDATA

SUBPHYLUM: VERTEBRATA

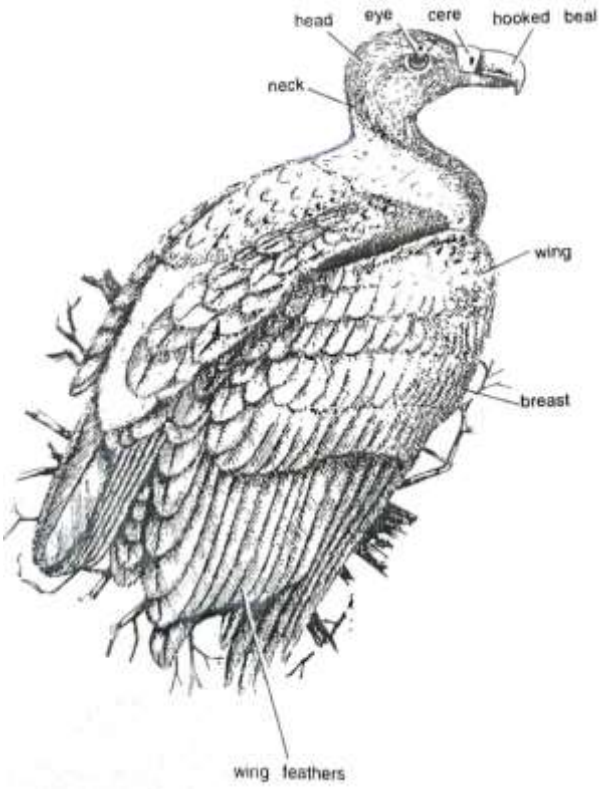
CLASS: AVES

ORDER: ANSERIFORMES



1. **Body Shape:** Ducks typically have a compact and robust body with a broad, rounded silhouette.
2. **Bill:** Ducks have a distinctive beak, which varies in size and shape among different species. The bill is generally broad and flat, equipped with lamellae, which are comb-like structures along the edges, aiding in filter-feeding.
3. **Feet:** Ducks have webbed feet that are well-adapted for swimming. The webbing between their toes allows efficient movement in water.
4. **Plumage:** Ducks exhibit a wide variety of plumage patterns, colors, and markings, which can vary significantly between male and female individuals.
5. **Neck Length:** The length of the neck can differ among species. Some ducks have long necks, while others have relatively short necks.
6. **Wing Shape and Size**: Ducks have strong wings, enabling them to fly over long distances during migration.
7. **Tail:** Ducks have a relatively short tail compared to some other bird species.
8. **Eyes:** They have well-developed eyes, located on the sides of their heads, allowing them to have a wide field of vision.
9. **Size:** Ducks vary in size depending on the species, ranging from small teal ducks to large mallards and other dabbling ducks.
10. **Sexual Dimorphism:** Many duck species exhibit sexual dimorphism, where males and females have different plumage colors and patterns. This is particularly evident in breeding plumage.
11. **Nostrils:** Ducks have prominent nostrils called nares located on the top of their bill. These nostrils allow them to breathe while their bill is submerged in water during feeding.
12. **Tail Feathers**: Ducks typically have a distinctive pattern of feathers on their tails that can vary in shape and color between species.

2) VULTURE



PHYLUM: CHORDATA

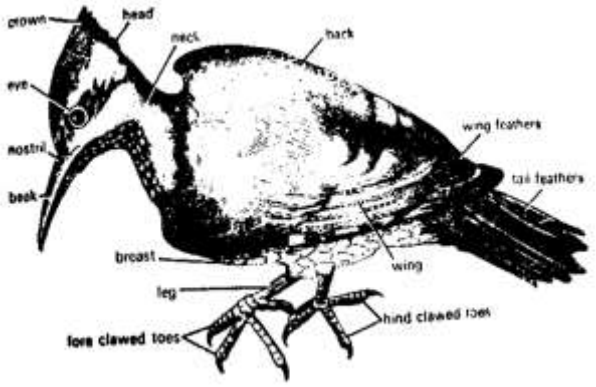
SUBPHYLUM: VERTEBRATA

CLASS: AVES

ORDER: FALCONIFORMES

1. Commonly called as Gidh (Vulture) in Hindi.
2. It is dirty, blackish brown and repulsive-looking bird with massive body, very graceful majestic when soaring and circling high up in the sky.
3. Flight is strong. White lower back visible when the bird is at rest or banks in flight. Body is divided into head, neck, back and breast and abdomen enclosed by wings.
4. Head is naked and contains large paired eyes, nostril, beak or bill. Behind head is short neck.
5. Bill stout, hooked at the tip with soft naked cere at its base, Mandible sharp edged. Beak adopted for tearing muscles from dead animals.
6. Feet usually adapted for grasping with sharp claws.
7. Vultures nest in large trees near the road or village sides. At rest wings are folded over the trunk.

3) WOODPECKER
PHYLUM: CHORDATA
SUBPHYLUM: VERTEBRATA
CLASS: AVES
ORDER: PICIFORMES



1) **Bill:** Woodpeckers have strong, chisel-like bills that are long, straight and pointed. The bill is used to excavate holes in trees to find food and create nesting sites.
2) **Feet:** Woodpeckers have zygodactyls feet, which means they have two toes facing forward and two facing backward. This foot structure provides a strong grip and helps them cling to vertical surfaces such as tree trunks.
3) **Tail:** Woodpeckers have a stiff, supportive tail, which acts as a prop while they are climbing on trees and also assists in balancing during rapid pecking.
4) **Head:** The woodpecker's head is relatively large and equipped with strong neck muscles that allow it to deliver powerful pecks without injuring itself.
5) **Crest:** Many woodpecker species have crests on their heads. These crests can be raised or lowered and often play a role in communication and courtship displays.
6) **Plumage:** Woodpeckers usually have striking plumage patterns, with bold markings and colors. Some species also have specialized features, like barred or spotted feathers, for camouflage.
7) **Tongue:** Woodpeckers have a specialized tongue that is long, extendable and sticky. This tongue is used to extract insects from crevices and holes in trees.
8) **Nostrils:** The nostrils of woodpeckers are covered with specialized feathers called nasal bristles that help protect their respiratory system from wood particles while drilling into trees.
9) **Size:** Woodpeckers come in various sizes, with some species being relatively small (e.g., downy woodpecker) and others larger (e.g., pileated woodpecker).
10) **Sexual Dimorphism:** In some woodpecker species, there can be differences in plumage between males and females, known as sexual dimorphism.
11) **Flight:** Woodpeckers have a unique flight pattern characterized by rapid wing beats and a bounding, undulating flight style.
12) **Skull and Brain:** Woodpeckers have thick skulls and specialized structures in their brains that help absorb and dissipate the shock of constant pecking.

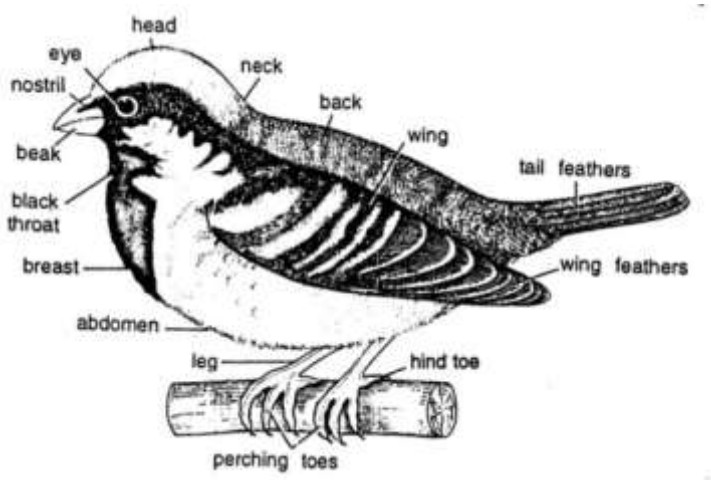
4) SPARROW

PHYLUM: CHORDATA

SUBPHYLUM: VERTEBRATA

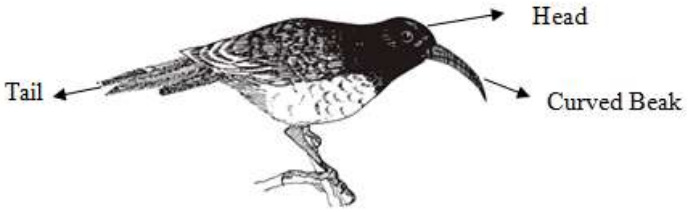
CLASS: AVES

ORDER: PASSERIFORMES



1) **Size:** House sparrows are small birds, with adult individuals typically ranging from about 14 to 16 centimeters (5.5 to 6.3 inches) in length.
2) **Plumage:** Male house sparrows have a distinctive appearance with a gray crown, black bib (throat area) and chestnut or black streaks on their sides. Females have a more subdued appearance with mostly brown plumage and a pale stripe behind the eye.
3) **Bill:** They have a conical bill, well-suited for their omnivorous diet, which includes seeds, grains, insects and scraps of human food.
4) **Eyes:** House sparrows have dark, bead-like eyes located on the sides of their heads.
5) **Legs and Feet:** Their legs are relatively short, and they have sturdy feet adapted for perching and hopping on the ground.
6) **Wing Shape**: House sparrows have rounded wings, which allow them to make quick and agile flight maneuvers.
7) **Tail:** The tail of a house sparrow is short and squared off at the end.
8) **Sexual Dimorphism:** Male and female house sparrows exhibit sexual dimorphism. Males typically have more striking plumage, as described earlier, while females are more cryptic in coloration.
9) **Vocalizations:** House sparrows are known for their chattering calls and songs, which vary between males and females.
10) **Adaptability:** House sparrows are highly adaptable and can be found in a wide range of habitats, including urban and rural areas, where they often associate with human settlements.
11) **Nesting Behavior:** House sparrows build cup-shaped nests, often in sheltered locations like building eaves, tree branches, or nest boxes. They line their nests with various materials like feathers, grass, and paper.
12) **Social Behavior**: House sparrows are gregarious birds and are often seen in small to large flocks, foraging and roosting together.

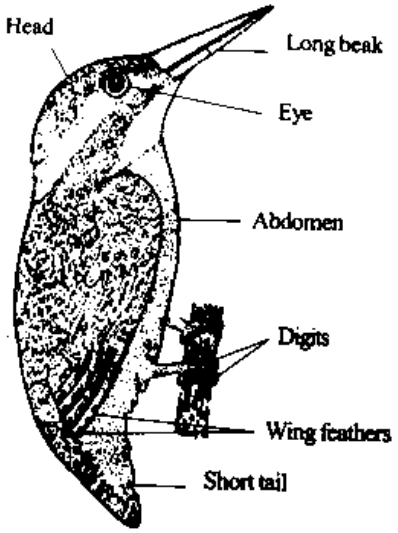
5) SUNBIRD
PHYLUM: CHORDATA
SUBPHYLUM: VERTEBRATA
CLASS: AVES
ORDER: APODIFORMES



1) **Size:** Sunbirds are small birds, with their size varying among different species. They generally range from about 9 to 15 centimeters (3.5 to 6 inches) in length.
2) **Plumage**: Sunbirds are known for their vibrant and iridescent plumage, which often reflects a dazzling array of colors, including shades of green, blue, red, orange, and purple.
3) **Bill**: Sunbirds have slender, slightly curved bills that are specialized for feeding on nectar from flowers. The bill's shape allows them to access the nectar hidden deep inside floral tubes.
4) **Feet**: They have delicate and dexterous feet with long, sharp claws, which aid in clinging to flowers and perching on slender stems.
5) **Tongue**: Sunbirds have brush-tipped tongues that they use to collect nectar from flowers. The tongue is extendable and can reach deep into floral tubes to extract nectar.
6) **Eyes**: Sunbirds have large, dark eyes with excellent vision to locate flowers and detect insects.
7) **Wings**: They have relatively short, pointed wings, which enable quick and agile flight, essential for hovering while feeding on nectar.
8) **Tail**: Sunbirds typically have long and often deeply forked tails, which assist in maneuvering during flight and foraging.
9) **Sexual Dimorphism**: Many sunbird species exhibit sexual dimorphism, where males and females have different plumage colors and patterns. Males often have more vibrant colors, while females may be more camouflaged.
10) **Habitat**: Sunbirds are primarily found in tropical and subtropical regions, inhabiting a variety of habitats, including forests, savannas, gardens, and urban areas.
11) **Feeding Behavior**: Sunbirds are nectarivores, meaning they primarily feed on nectar from flowers. However, they may also consume insects and spiders for additional nutrients, especially during the breeding season.
12) **Courtship Displays:** Male sunbirds often engage in elaborate courtship displays, showing off their colorful plumage and performing aerial displays to attract females.

Sunbirds are ecologically important pollinators, as they transfer pollen from one flower to another while feeding on nectar. Their unique morphological adaptations make them well-suited for a nectar-rich lifestyle and add to their beauty and charm

6) KINGFISHER
PHYLUM: CHORDATA
SUBPHYLUM: VERTEBRATA
CLASS: AVES
ORDER: CORACIFORMES



1) **Size**: Kingfishers vary in size, with the smallest species being around 10 centimeters (4 inches) in length, while the largest species can reach up to 45 centimeters (18 inches).
2) **Plumage**: Kingfishers often have colorful plumage, with shades of blue, green, orange and white being common. The plumage may also have metallic or iridescent sheens.
3) **Bill**: Kingfishers have long, sturdy bills that are typically sharp and pointed. The bill is an essential tool for catching fish and other aquatic prey.
4) **Eyes**: They have large, keen eyes that are positioned on the sides of their heads, providing them with a wide field of vision.
5) **Legs and Feet:** Kingfishers have short legs and strong, webbed feet, which are well-adapted for perching on branches near the water's edge and diving into the water to catch prey.
6) **Wings**: They have short, rounded wings that enable rapid and agile flight. Kingfishers often hover briefly before diving into the water.
7) **Tail**: Kingfishers typically have a short tail, which aids in flight stability.
8) **Sexual Dimorphism:** In many kingfisher species, males and females exhibit sexual dimorphism, with males having more vibrant colors or additional markings.
9) **Habitat**: Kingfishers are commonly found near water bodies such as rivers, lakes, ponds, and coastal areas. They require clear, clean water to hunt for fish and other aquatic prey.
10) **Nesting Behavior**: Kingfishers construct burrows in the banks of water bodies or use natural cavities as nesting sites. Some species may also nest in tree hollows.
11) **Fishing Behavior:** Kingfishers are excellent fishermen. They perch on branches or other elevated spots near the water and use their sharp eyes to spot prey beneath the surface. Once they spot a fish, they dive headfirst into the water to catch it with their beak.
12) **Distribution**: Kingfishers are found in various parts of the world, with different species inhabiting different regions. They can be found in both tropical and temperate climates.

The unique combination of their bill shape, eyesight, flight and fishing behavior makes kingfishers highly specialized and successful predators of aquatic prey. Their vibrant colors and remarkable fishing skills make them a delight to observe in their natural habitats.

5) DISSECTION OF BRAIN OF FOWL

The Fowl possesses a remarkably evolved brain structure, situated on the dorsal side of its head. Morphologically, the brain can be categorized into three main parts:

1. FOREBRAIN (PROSENCEPHALON):

a) **Olfactory Lobe:** Although relatively underdeveloped, this region handles the sense of smell.

b) **Cerebral Hemisphere:** Highly developed, this area serves as the seat of intelligence, willpower, memory, and control over voluntary actions.

c) **Diencephalon:** Positioned dorsally, it plays a role in providing nourishment to the brain.

d) **Infundibulum and Hypophysis:** Located ventrally, these components collectively form the pituitary body, which is responsible for hormonal and enzyme regulation.

2. MIDBRAIN (MESENCEPHALON):

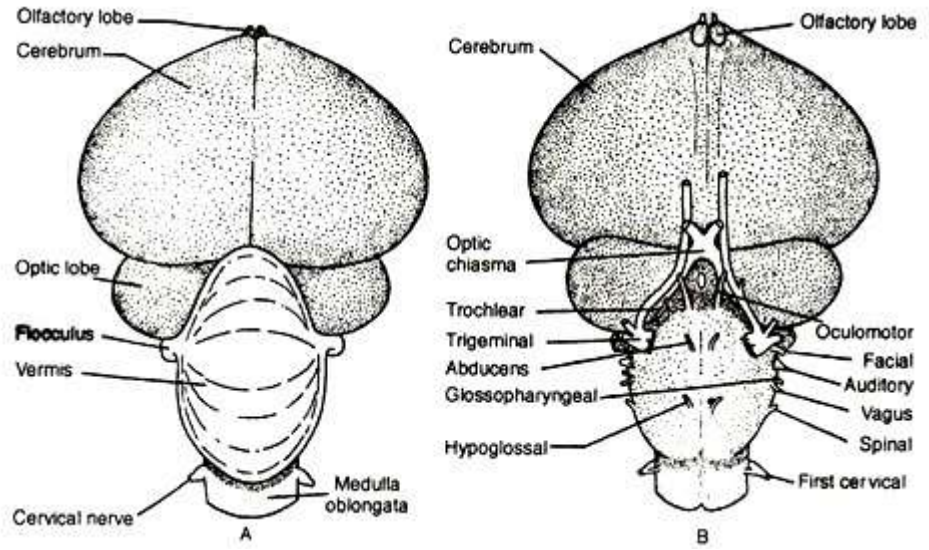
a) **Optic Lobes or Corpora Quadrigemina:** These extensively developed lobes manage the sense of sight or vision.

b) **Crura Cerebri:** Prominent nerve bands found ventrally that facilitate the transmission of information between the forebrain and hindbrain and vice versa.

3. HINDBRAIN (RHOMBENCEPHALON):

a) **Cerebellum:** Comprising five distinct lobes, the cerebellum is significantly developed and is responsible for controlling muscular activities and maintaining static equilibrium.

b) **Medulla Oblongata:** This region controls involuntary activities such as Respiration, Digestion, Heartbeat and Excretion.

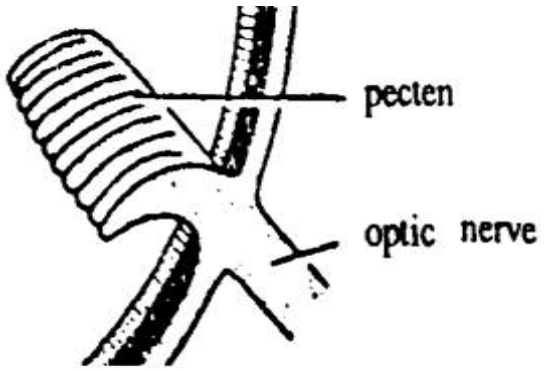


6) TEMPORARY PREPARATION OF HYOID APPARATUS, SCLEROTIC PLATES, PECTEN AND COLLUMELLA OF FOWL

PECTEN OF FOWL

The fowl Pecten is a fan-shaped, black structure located in the cavity of the eye, below the blind spot.

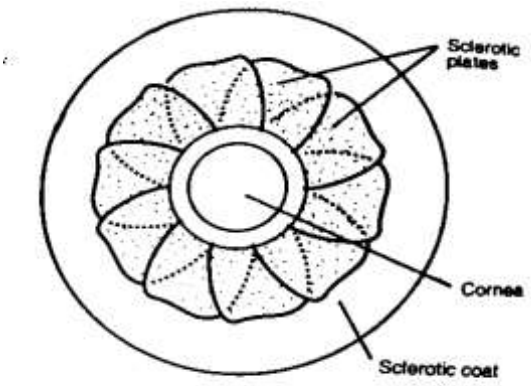
1. **Appearance**: It exhibits a fan-like shape and has a black coloration.
2. **Vascular and Pigmented:** The Pecten is richly vascularized and contains pigmentation.
3. **Nutritional Function:** Its primary function is to aid in the nutrition of the eyeball.
4. **Accommodation:** Acting as an erectile organ, it plays a role in accommodation by altering intraocular pressure, thus facilitating the change in the shape of the lens.
5. **Regulation of Pressure:** Additionally, it helps in regulating the pressure in the vitreous fluid. Moreover, it assists in the perception of object movements as the shadow of the Pecten falls on the retina.



III. SCLEROTIC PLATE OF EYE OF FOWL

The sclerotic plate is an essential part of the fowl's eye, contributing to its overall structure and function. Here are some key features of the sclerotic plate:

1. **Location:** The sclerotic plate is located at the posterior region of the eye, surrounding the pupil. It forms a protective, sturdy ring around the eye's inner structures.
2. **Composition:** This structure is mainly composed of cartilage, which provides both flexibility and strength. The cartilaginous nature allows the eye to move and adjust its position while maintaining its shape.
3. **Protection:** One of the primary functions of the sclerotic plate is to protect the delicate inner components of the eye, such as the retina and lens, from external injuries and mechanical damage.
4. **Support:** Along with the cornea and other components, the sclerotic plate helps maintain the eye's spherical shape and provides structural support to the eyeball.
5. **Muscle Attachment:** Muscles responsible for controlling eye movements attach to the sclerotic plate, allowing the eye to move smoothly in various directions.
6. **Opaque Appearance:** The sclerotic plate is relatively large and has an opaque appearance, contributing to the characteristic appearance of a fowl's eye.

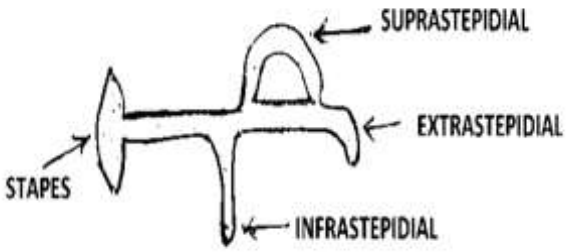


SCLEROTIC PLATE OF EYE OF FOWL

IV. COLLUMELLA OF FOWL

The Collumella is a small, delicate bone situated in the middle ear cavity of fowls or birds. It is differentiated into inner disc like bony stapes and outer three rayed extracollumella i.e. suprastepidial, infrastepidial and extrastepidial. It performs following functions.

1. **Middle Ear Connection:** It connects the tympanic membrane (eardrum) to the inner ear structures, specifically the oval window.
2. **Sound Transmission:** The Collumella plays a crucial role in transmitting sound vibrations from the eardrum to the inner ear. It acts as a bridge, converting sound waves into mechanical vibrations.
3. **Amplification:** This bone's mechanical properties allow it to amplify the sound signals, helping birds to have a more sensitive hearing and better auditory perception.
4. **Unique Design:** The collumella's structure and function differ from the mammalian middle ear, which includes three bones (ossicles) - the malleus, incus and stapes. In birds, the collumella serves a similar purpose as the stapes in mammals.



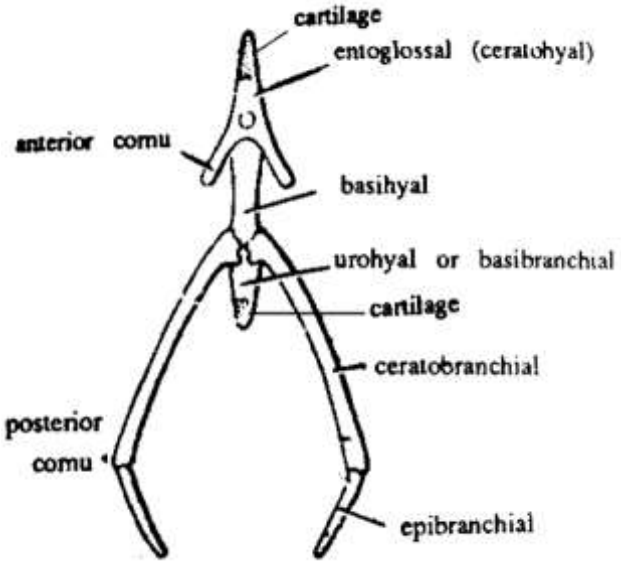
V. HYOID APPARATUS OF FOWL

The hyoid apparatus in fowl is a crucial structure located in the floor of the mouth, beneath the neck. It is composed of bones and cartilage that serve essential functions in supporting the buccal cavity, protecting the trachea and facilitating tongue movement.

1. **Location:** Situated in the floor of the mouth, ventral to the neck. The hyoid apparatus is formed by a combination of bones and cartilage.
2. **Median Body:** The central part of the hyoid apparatus has an arrow-shaped body, consisting of three bones. The anterior entaglossal or ceratohyal bears a cartilaginous process in the front, followed by the median basihyal, and the posterior urohyal, which has cartilaginous processes behind.
3. **Cornua:** The hyoid apparatus also includes two pairs of cornua. The first pair is the short anterior cornua, projecting backward and forming the entaglossal. The second pair consists of long, backwardly directed posterior cornua or ceratobranchial, arising from the sides of the body between the basihyal and urohyal, and ending with epibranchials.

Functions:

The hyoid apparatus serves several vital functions. It provides support to the floor of the buccal cavity, helping in various oral activities, including swallowing. Moreover, it plays a role in protecting the trachea during the process of swallowing. Additionally, it is essential for tongue movement and mobility, facilitating the manipulation of food during feeding.



TEMPORARY PREPARATION OF CYCLOID, CTENOID AND PLACOID SCALES IN FISHES

1. TEMPORARY PREPARATION OF CYCLOID AND CTENOID SCALES OF FISHES

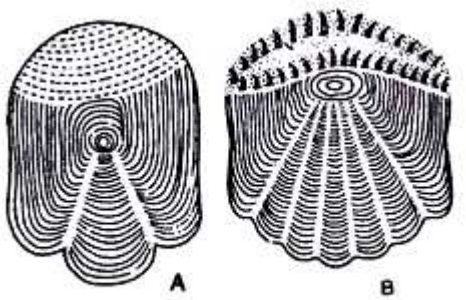
These scales are present in teleosts or bony fishes.

PREPARATION

Remove a few cycloid scales from a carp or a few ctenoid scales from a koi (Anabas) fish. Put them in a watch glass containing 10% KOH solution. Stir slowly with a needle till the covering epithelium dissolves. Wash thoroughly with water to remove the last trace of KOH. Make a temporary or stained permanent preparation, as required.

STRUCTURE

a) A thin, nearly rectangular plate of bone with a semicircular free border.
b) ii. Concentric rings representing annual growth present.



A- cycloid **B- ctenoid**

TEMPORARY PREPARATION OF PLACOID SCALE OF SHARK

Placoid scales are found in elasmobranchs.

PREPARATION

Cut a small piece of skin from the dorsal surface of a shark (Scoliodon). Put it in a hard glass test tube containing 5 to 10% KOH solution. Boil with constant stirring till the skin dissolves. Pour the contents of the test tube in a large watch glass. Allow to cool. The scales settle at the bottom. Decant the fluid. Repeat decantation with water till the last trace of KOH is removed.

Pipette a drop of water with the scales and put it on a slide. Remove the water with a piece of blotting paper and mount in glycerin. Staining, if required should be done in a small watch glass. Mount following routine procedure.

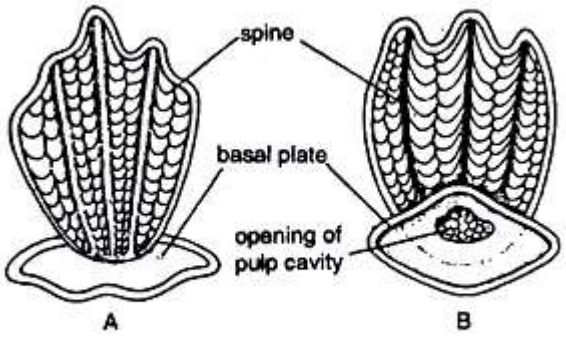
STRUCTURE

a) The scale has a base and a body.

b) The basal plate is somewhat diamond shaped with a pulp cavity on the ventral surface, at the centre.

c) The proximal end of the body attached to the basal plate is narrow. It widens distally.

d) A few spines are present in the body which project a little beyond the distal margin.



A- dorsal view B- ventral view

PRACTICAL I

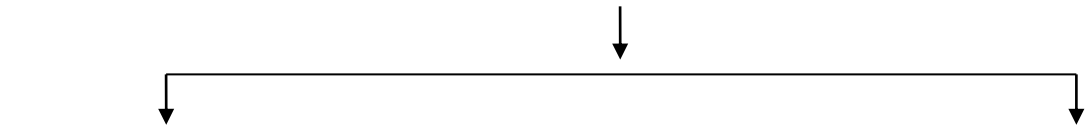
UNIT II: **BIOCHEMISTRY**

1. Biochemical tests for Glucose, Fructose, Sucrose, Lactose and Lipid.
2. Estimation of total protein in given solutions by Lowry's method.
3. Study of activity of salivary amylase under optimum conditions.
4. Effect of Temperature and pH on activity of salivary amylase.
5. Urea, urease enzyme activity

1. BIOCHEMICAL TESTS FOR GLUCOSE, FRUCTOSE, SUCROSE, LACTOSE AND LIPID

DETECTION OF UNKNOWN SOLUTION

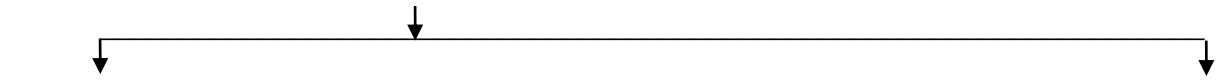
A drop of O. S. on a paper



No translucent spot — **Translucent spot**

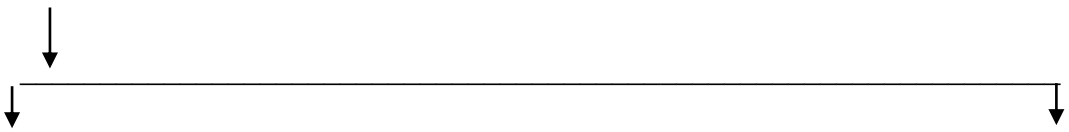
. — Oil (Lipid) is present

2 ml. O.S. + 1 ml. NaOH + 2 drops of $CuSO_4$



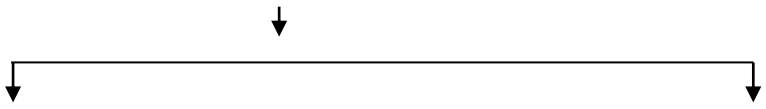
No Violet colour (Carbohydrate is present) — **Violet colour** (Protein is present)

O.S. + I_2 Solution



No Blue Colour (Mono or Di-saccharide may be present) — **Blue Colour** (Starch is present)

1 ml. O. S. + 1 ml. Benedict's reagent boil and allow cool



Yellow ppt
Glucose, fructose or
Lactose may be present
(Perform Osazone test)

No yellow ppt
Sucrose may be present

TESTS FOR OIL (LIPID)

TEST	OBSERVATION	INFERENCE
Emulsification test 2ml. O.S.+ 2 – 3 ml. of water shake well	Droplets are observed	Oil confirmed
Sudan III test 3ml.O.S. + 2 drops of Sudan III stain. Take out one to two drops on a clean and dry slide. Observe under microscope	Brick red coloured droplets observed	Oil confirmed
Saponification test 1ml O.S. + 3 ml of alc. 10% NaOH boil, cool & add excess of Na_2SO_4	Soap is formed & it rises to the surface	Oil confirmed

TESTS FOR SUCROSE

TEST	OBSERVATION	INFERENCE
Fearson's test 4ml. O.S.+ 4 drops of 10% methylamine hydrochloride boil for 30 seconds and add 5 drops of 20% NaOH solution	Yellow colour appears which turns red	Sucrose present
Seliwanoff's test 1ml.O.S. + 3 ml Seliwanoff's reagent, boil for 30 seconds	Cherry red colour	Sucrose present
Inversion test O.S. + 2 drops of conc. H_2SO4 and boil for a minute, cool under tap water, neutralize it with 40 % NaOH then perform Benedicts test	Yellow or Brick red ppt	Sucrose present and confirmed

TESTS FOR GLUCOSE, FRUCTOSE AND LACTOSE

TEST	OBSERVATION	INFERENCE
Benedict's test 1 ml. Benedict's reagent + 0.5 ml. O.S. boil & allow the test tube stand for 10 minutes.	Yellow ppt	Glucose, fructose, Lactose may be present
Tomer's test 2 ml. $CuSO_4$ + 2 ml. O.S. Mix well + 2 ml. NaOH boil	Yellow or Buff red ppt.	Fructose present
Fehling's test 1 ml. Fehling solution boil no change in colour + O.S. boil again	Brick red ppt.	Fructose present
Barford's test 1 ml. Barford's reagent + 5 ml. O.S. – boil.	Red ppt. settle at the bottom	Fructose is confirmed
C. T. FOR GLUCOSE AND FRUCTOSE		
Seliwanoff's test 1ml.O.S. + 3 ml Seliwanoff's reagent, boil for 30 seconds	Brick or Cherry red colour	Fructose present and confirmed
	If no brick or Cherry red colour	Glucose present and confirmed
Osazone test 5 ml. O.S. + 2 – 3 drops of Glacial acetic acid + a pinch of Phenyl hydrazine hydrochloride + 2 pinches of Sodium acetate, mix well, keep in boiling water bath for 5 - 20 minutes	Within 5 minutes **glucosazone** or **fructosazone** crystals forms	Glucose or fructose may be present
C. T. FOR LACTOSE		
Osazone test 5 ml. O.S. + 2 – 3 drops of Glacial acetic acid + a pinch of Phenyl hydrazine hydrochloride + 2 pinches of Sodium acetate, mix well, keep in boiling water bath for 5 - 20 minutes	**Lactososazone** crystal forms within 40-45 minutes	Lactose present and confirmed

Glucososazone: Needle-shaped crystals arranged like a broom

Lactososazone: Hedgehog or "pincushion with pins" or flower of "touch-me-not plant"

2) ESTIMATION OF TOTAL PROTEIN IN GIVEN SOLUTIONS BY LOWRY'S METHOD

Aim: To determine the total concentration of proteins by Lowry's method.

Apparatus and Glass wares required: Test tubes, Pipettes, Colorimeter, etc

PRINCIPLE

The –CO-NH- bond (peptide) in polypeptide chain reacts with copper sulphate in an alkaline medium to give a blue colored complex. In addition, tyrosine and tryptophan residues of protein cause reduction of the phosphomolybdate and phosphotungstate components of the Folin-Ciocalteau reagent to give bluish products which contribute towards enhancing the sensitivity of this method.

REAGENTS REQUIRED

1. Reagent A: 2% sodium carbonate in 0.1 N sodium hydroxide.
2. Reagent B: 0.5% copper sulphate (CuSO4.5H2O) in 1% potassium sodium tartarate. Prepare fresh by mixing stock solutions.
3. Alkaline copper solution (Reagent C): Mix 50mL of reagent A and 1 mL of reagent B prior to use.
4. Diluted Folin's reagent (Reagent D): Dilute Folin-Ciocalteau reagent with an equal volume of 0.1 N NaOH
5. Standard: Dissolve 50mg BSA in 50mL of distilled water in a volumetric flask. Take 10mL of this stock standard and dilute to 50 ml in another flask for working standard solution. One ml of this solution contains 200 μg proteins.

PROCEDURE

1. Pipette out 0.2, 0.4, 0.6, 0.8 and 1 ml of working standard in to the series of labeled test tubes.
2. Pipette out 1 ml of the sample in another test tube.
3. Make up the volume to 1 ml in all the test tubes. A tube with 1 ml of distilled water serves as the blank.
4. Now add 5 ml of reagent C to all the test tubes including the test tubes labeled 'blank' and 'unknown'.
5. Mix the contents of the tubes by overtaxing / shaking the tubes and allow standing for 10 min.
6. Then add 0.5 ml of reagent D rapidly with immediate mixing well and incubate at room temperature in the dark for 30 min.
7. Now record the absorbance at 660 nm against blank.

8. Then plot the standard curve by taking concentration of protein along X-axis and absorbance at 660 nm along Y-axis.
9. Then from this standard curve calculate the concentration of protein in the given sample.

OBSERVATIONS AND CALCULATIONS

Volume of standard BSA (ml)	**Volume of distilled water (ml)**	**Conc. of Protein (µg)**	**Volume of reagent C (ml)**		**Volume of reagent D (ml)**		AT660 nm
0.0	1.0	00	5 ml	Incubate At Room Temp for 10 min	0.5	Incubate At dark room temp. for 30 min	0.00
0.2	0.8	40	5 ml		0.5		
0.4	0.6	80	5 ml		0.5		
0.6	0.4	120	5 ml		0.5		
0.8	0.2	160	5 ml		0.5		
1.0	0.0	200	5 ml		0.5		
1.0	0.0	?	5 ml		0.5		

Result: The given unknown sample contains ----µ g protein/ml.

Graph:

UREA UREASE REACTION

Fist time urease enzyme is isolated in crystalline form from the jack beans by J. B. Summer in 1926. The kinetics of enzyme can be studied by urea – urease reaction. Urease catalyses the breakdown of urea in to CO_2 and NH_3 then it combines with H_2O to form NH_4OH (ammonium hydroxide), which can be detected by acid base indicator phenolphthalein. The enzyme has optimum pH between 7 & 8 and at room temperature.

APPARATUS:

9 test tubes, beakers, ice bath, water bath etc.

CHEMICALS:

1) Urea solution: Dissolve 2 grams of urea in 100 ml of distilled water.
2) Extraction of enzyme: Urease can be extracted by making a pulp of the germinating seeds of jack bean. Remove the seed coat and crush it in mortar and pestle. Add 2.5 ml of chilled physiological saline and allow the protein to extract for 15 minutes at low temperature. Centrifuge for 10 minutes and use the supernatant for enzyme assay, filter if necessary.
3) Phenolphthalein
4) Phosphate buffers of different pH
5) 1N HCl.
6) 1N NaOH.

PROCEDURE:

Arrange sets of test tubes as given in the table below. Subject the reactions to various working conditions. Enter your results in the same table.

SET: 1 STANDARD REACTION:

Test tube No.	Urease	Urea	Distilled water	Time in minutes	phenolphthalein	observations	Inference
1	1 ml	1 ml	0 ml	10	1-2 drops	Pink colour	+ reaction
2	1 ml	0 ml	1 ml	10	1-2 drops	No colour	No reaction
3	0 ml	1 ml	1 ml	10	1-2 drops	No colour	No reaction

SET: 2 EFFECT OF TEMPERATUR:

Test tube No.	Urease	Urea	Time in minutes	phenolphthalein	observations	Inference
1. Room temp.	1 ml	1 ml	10	1-2 drops	Pink colour	+ ve reaction
2. 60^{o}C temp.	1 ml	1ml	10	1-2 drops	No colour	No reaction
3. 4^{0}C temp.	1 ml	1 ml	10	1-2 drops	No colour	No reaction

SET: 3 EFFECT OF pH

Test tube No.	1.0 ml pH solution	Urease	Urea	Time in minutes	phenolphthalein	observations	Inference
1.	4 pH	1 ml	1 ml	10	1-2 drops	No colour	No reaction
2.	8 pH	1 ml	1ml	10	1-2 drops	Pink colour	+ ve reaction
3.	12 pH	1 ml	1 ml	10	1-2 drops	No colour	No reaction

CONCLUSION:

From the above result it is clear that enzymes are very specific in their actions. They are active only at specific pH and temperature.

3) STUDY OF ACTIVITY OF SALIVARY AMYLASE UNDER OPTIMUM CONDITIONS

Aim: Study of activity of salivary amylase under optimum conditions.

Principle: The salivary amylase is starch digesting enzyme found in saliva. The polysaccharide starch is acted by salivary amylase and broken down into dextrin and finally into disaccharides. By using iodine solution as indicator, the action of enzyme can be analyzed. As starch is broken up to dextrins, the iodine turns to a brown or red colour and it becomes pale brown of yellow when the reaction is completed.

Extraction of saliva: Clean the teeth, gargle with a mild antiseptic and rinse the mouth thoroughly with water. Hold a piece of sour foodstuff in front of the tongue. Collect the saliva from under the tongue with a pipette or medicine dropper. Filter it and use it as salivary amylase for its action.

Material: Starch solution (1%), Standard iodine solution, distilled water, test tubes, hot water bath, etc.

Procedure: As per shown in the table, label the 5 test tubes as A to E. Add original solution and other reagents as per the instructions in these test tubes. Observe the changes in colour during experiment and note down the observations. Draw the conclusion based on the action of salivary amylase.

Sr. No.	Test tube	Test	Observation	Inference
1	Test tube – A (Control)	5ml O. S. + I_2 solution	Blue colour suspension	Starch present
2	Test tube - B	5 ml O. S. + 5ml Saliva filtrate keep at room temperature and after some time add I_2 solution	Blue coloured suspension	Starch present (starch not digested)
3	Test tube - C	5ml O. S. + 5ml saliva incubate in water bath at 37 ^{0} C for 15 minutes		
4	Test tube - D	Half of the incubated solution from test tube – C + I_2 solution few drops.	No blue colour	Starch absent
5	Test tube - E	Half of the remaining incubated solution from test tube – C + 5ml Benedict's solution boil	Red ppt.	Reducing sugar present.

RESULT

1. In test tube- B Salivary amylase does not act on starch at room temperature which is indicated by blue colour of solution.
2. In test tube- D starch is digested in to reducing sugar at 37^0c by the action of salivary amylase hence the blue colour is disappeared.
3. In the test tube E – reduced sugars are present and confirmed by appearance of red ppt.

EFFECT OF TEMPERATURE, PH ON ACTIVITY OF SALIVARY AMYLASE

a) EFFECT OF TEMPERATURE ON ACTIVITY OF SALIVARY AMYLASE

Aim: Study of effect of temperature on salivary amylase.

Principle: The salivary amylase is starch digesting enzyme found in saliva. The activity of salivary amylase is optimum at specific temperature. At very low and very high temperature the enzyme denatures and lost its activity. The effect of temperature can be studied by keeping temperature variation during the activity.

Material: Starch solution (1%), Standard iodine solution, distilled water, test tubes, hot water bath, etc.

Procedure: As per shown in the table, label the 4 test tubes as A to D. Add 5 ml original solution and 5 ml saliva solution in these test tubes. Keep the test tubes at 4, 20, 37 and 50 ^{0} C and observe the changes in colour and note down the observations. Draw the conclusion based on the temperature specific action of salivary amylase.

Sr. No.	Test tube	Temperature	Observation	Inference
1	Test tube – A	4^0C	Blue coloured suspension	No enzyme action
2	Test tube - B	20^0C	Blue coloured suspension	No enzyme action
4	Test tube - C	37^0C	Blur colour disappeared	Enzyme acted
5	Test tube - D	50^0C	Blue coloured suspension.	No enzyme action

RESULT

1. In test tube- A, B and D Salivary amylase does not act on starch at 4, 20 and 50 ^{0}C temperature which is indicated by blue colour of solution.
2. In test tube- C starch is digested into reducing sugars at 37^0c by the action of salivary amylase hence the blue colour is disappeared.

b) EFFECT OF pH ON ACTIVITY OF SALIVARY AMYLASE

Aim: Study of effect of pH on salivary amylase.

Principle: The salivary amylase is starch digesting enzyme found in saliva. The activity of salivary amylase is optimum at specific pH. At very low and very high pH the enzyme denatures and lost its activity. The effect of pH can be studied by keeping pH variation during the activity.

Material: Starch solution (1%), Standard iodine solution, buffers of different pH, distilled water, test tubes, hot water bath, etc.

Procedure: As per shown in the table, label the 4 test tubes as A to D. Add 5 ml original solution and 5 ml saliva solution and add buffer solutions of different pH in these test tubes as shown in table. Keep the test tubes at 37 ^{0} C and observe the changes in colour and note down the observations. Draw the conclusion based on the pH specific action of salivary amylase.

Sr. No.	TEST TUBE	pH	OBSERVATION	INFERENCE
1	Test tube – A	2.0	Blue coloured suspension	No enzyme action
2	Test tube - B	5.0	Blue coloured suspension	No enzyme action
4	Test tube - C	7 .0	Blur colour disappeared	Enzyme acted
5	Test tube - D	10.0	Blue coloured suspension.	No enzyme action.

RESULT

1. In test tube- A, B and D Salivary amylase does not act on starch at 2, 5 and 10 pH which is indicated by blue colour of solution.
2. In test tube- C starch is digested into reducing sugars at 7.0 pH and 37^{0} C by the action of salivary amylase hence the blue colour is disappeared.

PRACTICAL-II

(Based on Reproductive Biology and Applied Zoology of Semester-IV)

UNIT I: REPRODUCTIVE BIOLOGY

1**. Study of Animal house**

d) Set up and maintenance of animal house

e) Breeding techniques

f) Care of normal and experimental animals with the help of model/photographs

2. Stages/phases of menstrual cycle.

3. Surgical techniques

c) Principles of surgery in endocrinology,

d) Ovariectomy, Tubectomy, Hysterectomy, Orchiectomy and Vasectomy in rats through Demonstration or Video

4. Examination of histological sections from photomicrographs/permanent slides of rat

Testis, Epididymis, Ovary, Fallopian Tube, Uterus (proliferative and secretary stages), Cervix and Vagina

5. Structure of human sperm and ovum

6. Detection of pregnancy by using kit.

7. Study of contraceptive devices by photographs or models.

UNIT II: APPLIED ZOOLOGY

3. Study of arthropod vectors associated with human diseases: Pediculus, Culex, Anopheles, Aedes and Xenopsylla

4. Study of insect pests through damaged products/photographs.

i) Crop pests

d. Gram pod borer (*Helicoverpa armigera*)

e. Sugarcane leaf hopper (*Pyrilla perpusilla*)

f. Lemon Butterfly (*Papilio demoleus*)

ii) Stored grains pests

d. Pulse Beetle (*Callosobruchus chinensis*)

e. Rice Weevil (*Sitophilus oryzae*)

f. Red Flour beetle (*Tribalism castaneum*)

iii) Identifying feature and economic importance of

g. *Helicoverpa armigera* (Cotton bollworm)

h. *Papilio demoleus* (Lime butterfly)

i. *Pyrilla perpusilla* (Sugarcane plant hopper)

j. *Callosobruchus chinensis* (Pulse beetle)

k. *Sitophiluso ryzae* (Rice weevil) and

l. *Tribolium castaneum* (Red flour beetle).

UNIT III: APPLIED ZOOLOGY

c. Poultry: To study the breeds of poultry birds with the help of photographs (2 Indigenous and 2 Exotic poultry birds)

d. Sericulture: To study the Life cycle of mulberry silk moth (*Bombyx mori*),

i. Types of silk moths – Muga, Tasar and Eri by photographs or specimen

e. Field trip to sericulture center or poultry farm or animal breeding centre or any suitable place to study animal diversity or any place related to theory syllabus. Submission of field trip report (Printed/Hand writings).

UNIT I: REPRODUCTIVE BIOLOGY

1**. Study of Animal house**

a) Set up and maintenance of animal house
b) Breeding techniques
c) Care of normal and experimental animals with the help of model/photographs

A) SET UP AND MAINTENANCE OF AN ANIMAL HOUSE

Setting up an animal house involves creating a controlled environment suitable for housing and studying animals. Here are the key steps involved.

a) Facility design: Design the animal house facility based on the specific requirements of the animals to be housed. Consider factors such as Temperature Control, Lighting, Ventilation, Noise Reduction, Waste Management and Bio-Security.

b) Animal housing: Provide appropriate housing systems such as cages, pens, or tanks based on the species and size of animals. Consider factors like Space Requirements, Bedding Material, Nesting Areas and Environmental Enrichment to ensure the well-being of animals.

c) Temperature and humidity control: Install heating, cooling, and humidification systems to maintain optimal environmental conditions for the animals. This may involve using heaters, air conditioners, humidifiers or exhaust systems.

d) Lighting: Establish a lighting system that replicates natural light cycles to regulate the animals' circadian rhythms. This may involve installing timers or automatic lighting systems.

e) Ventilation: Ensure proper air exchange and control of airborne contaminants to maintain air quality within the animal house. This can be achieved through the use of air filters, exhaust systems and airflow monitoring.

f) Waste management: Implement a system for proper waste disposal, including animal waste, bedding and other materials. This may involve the use of specialized waste collection and treatment methods to prevent contamination and odors.

g) Bio-security: Establish protocols to prevent the entry and spread of diseases within the animal house. This includes strict hygiene practices, quarantine procedures and monitoring for potential pathogens.

Maintenance of an animal house involves regular upkeep and monitoring to ensure a clean, safe, and healthy environment for the animals. This includes routine cleaning, sterilization of equipment, pest control measures, monitoring of temperature and humidity levels, and regular health checks for the animals.

B) BREEDING TECHNIQUES

Breeding techniques in an animal house involve methods to control and manage the reproduction of animals for various purposes, including maintaining genetic lines, studying inheritance patterns, and producing experimental animals. Here are some common breeding techniques:

a) **Natural breeding:** Allowing animals to mate naturally, either by housing males and females together or by controlled introduction for mating.
b) **Artificial insemination:** Collecting semen from a male animal and introducing it into the reproductive tract of a female, bypassing natural mating. This technique allows for controlled breeding and the use of genetically superior males.
c) **In vitro fertilization (IVF):** Collecting eggs from a female and fertilizing them with sperm outside the body, then transferring the resulting embryos to surrogate mothers.
d) **Embryo transfer:** Collecting embryos from a donor female and transferring them to recipient females for gestation and birth.
e) **Genetic engineering:** Using advanced techniques such as gene editing to modify the genetic makeup of animals, introducing or removing specific genes for research or production purposes.

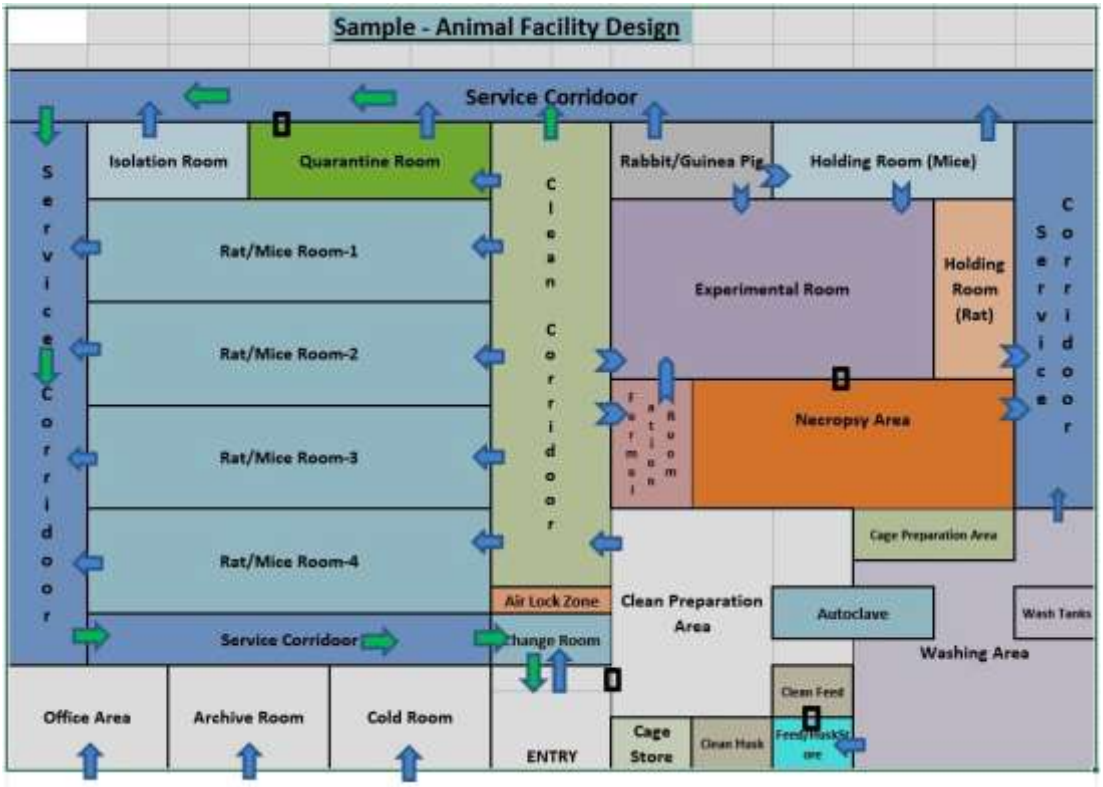
C) CARE OF NORMAL AND EXPERIMENTAL ANIMALS WITH THE HELP OF MODELS/PHOTOGRAPHS

To provide proper care for animals in an animal house, it is essential to follow established guidelines and protocols. Models and photographs can be used as educational tools to demonstrate the correct procedures and techniques. Here are some aspects of animal care:

a) **Feeding and nutrition:** Animals should be provided with appropriate diets that meet their nutritional needs. This may include commercial feeds, specialized diets, or custom-formulated diets based on the species and research requirements.
b) **Environmental enrichment:** Animals should be provided with an environment that promotes their physical and mental well-being. This may include providing toys, hiding places, climbing structures, and social interactions to prevent boredom and stress.
c) **Veterinary care:** Regular veterinary check-ups should be conducted to monitor the animals' health, detect any illnesses or injuries, and provide necessary treatment. This may involve vaccinations, parasite control, and medical interventions as required.
d) **Behavioral observation:** Animals should be monitored for their behavior and overall well-being. This may involve the use of behavioral scoring systems, video monitoring, or direct observation to identify any signs of distress or abnormal behavior.

e) Handling and restraint: Animals should be handled with care and following proper techniques to minimize stress and potential harm. This includes training personnel on appropriate handling methods and the use of appropriate equipment such as gloves or nets.

By utilizing models and photographs, researchers and caretakers can effectively communicate and demonstrate the correct procedures for animal care, ensuring that animals are treated ethically and in compliance with animal welfare regulations.



2. STAGES/PHASES OF MENSTRUAL CYCLE.

The menstrual cycle refers to the hormonal and physiological changes that occur in the reproductive system of females, primarily in humans and some other mammals. It is a recurring process that prepares the body for potential pregnancy. The menstrual cycle typically lasts around 28 days, although variations in duration are common. Here are the stages/phases of the menstrual cycle

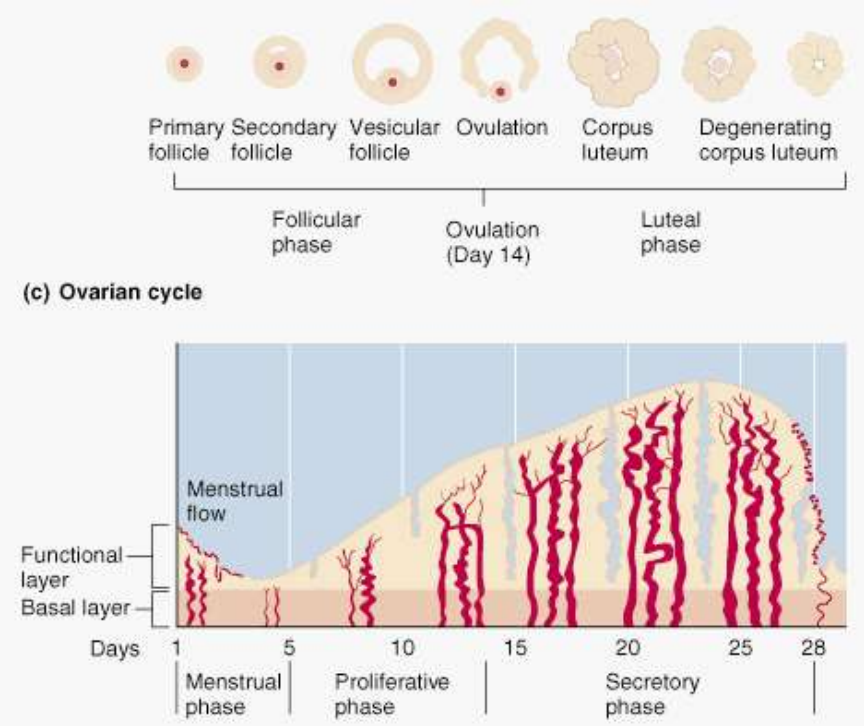
a) Menstruation (Days 1-5): The menstrual cycle begins with menstruation, also known as the menstrual period. During this phase, the lining of the uterus (Endometrium) that has built up in the previous cycle is shed. This results in bleeding from the vagina, which typically lasts for a few days.

b) Follicular Phase (Days 1-13): The follicular phase begins on the first day of menstruation and lasts until ovulation. The follicular phase is characterized by the

development of follicles in the ovaries. Follicles are fluid-filled sacs that contain immature eggs. As the follicles develop, one dominant follicle becomes the primary focus of hormonal stimulation.

c) **Ovulation (Day 14):** Ovulation is the release of a mature egg (ovum) from the ovary into the fallopian tube. It usually occurs around the midpoint of the menstrual cycle, approximately 14 days before the start of the next menstrual period. Ovulation is triggered by a surge in luteinizing hormone (LH), which causes the dominant follicle to rupture and release the egg.

d) **Luteal Phase (Days 15-28):** The luteal phase follows ovulation and lasts until the start of the next menstrual period. After the egg is released, the ruptured follicle in the ovary forms a structure called the corpus luteum. The corpus luteum produces hormones, primarily progesterone, which prepares the uterus for potential implantation of a fertilized egg. If fertilization does not occur, the corpus luteum degenerates, hormone levels drop, and the next menstrual cycle begins.



Throughout the menstrual cycle, the levels of various hormones, including estrogen and progesterone, fluctuate to regulate the changes in the uterus and other reproductive organs. These hormonal fluctuations are responsible for the characteristic changes observed in cervical mucus, basal body temperature and other physiological parameters during different phases of the menstrual cycle.

It's important to note that the duration and characteristics of the menstrual cycle can vary among individuals and can be influenced by factors such as hormonal imbalances, stress, and certain medical conditions.

3. SURGICAL TECHNIQUES

a) Principles of surgery in endocrinology,

b) Ovariectomy, Tubectomy, Hysterectomy, Orchiectomy and Vasectomy in rats through Demonstration or Video

PRINCIPLES OF SURGERY IN ENDOCRINOLOGY

Surgery in endocrinology refers to the surgical procedures performed to treat various endocrine disorders, which involve the glands and hormones of the endocrine system. The principles of surgery in endocrinology revolve around the following key aspects:

a) Preoperative Assessment: A comprehensive preoperative assessment is crucial to determine the patient's suitability for surgery and to plan the surgical approach. This includes evaluating the patient's medical history, conducting physical examinations, and performing relevant diagnostic tests such as blood work, imaging (e.g., ultrasound, CT scan) and hormone level assessments.

b) Localization: Accurate localization of the diseased endocrine gland or tumor is critical for surgical planning. This is often achieved through various imaging techniques, such as ultrasound, CT scan, MRI, or nuclear medicine scans (e.g., radioiodine scan, MIBG scan). Localization helps determine the size, location and extent of the pathology, guiding the surgical approach.

c) Minimally Invasive Techniques: Endocrine surgery has seen significant advancements in minimally invasive techniques, such as laparoscopic and robotic-assisted surgery. These approaches aim to minimize surgical trauma, reduce postoperative pain, hasten recovery and improve cosmetic outcomes. They involve making small incisions and using specialized instruments and cameras to perform the surgery.

d) Surgical Expertise: Surgery in endocrinology often requires specialized expertise and experience. Surgeons who specialize in endocrine surgery have in-depth knowledge of the anatomy and physiology of the endocrine glands, as well as the various diseases and surgical techniques specific to endocrine disorders. They stay updated with the latest advancements in the field to provide optimal care to patients.

e) Preservation of Function: Whenever possible, surgeons strive to preserve the normal function of endocrine glands while removing diseased tissue. For example, in cases of thyroid surgery, efforts are made to spare the parathyroid glands, which regulate calcium levels. Preserving these glands minimizes the risk of complications, such as hyperparathyroidism.

f) Hormone Replacement: In cases where the removal of an endocrine gland leads to hormone deficiency, the surgical team works closely with endocrinologists to ensure

appropriate hormone replacement therapy is initiated postoperatively. This is particularly important for glands like the thyroid, adrenal glands, and pituitary gland, which produce essential hormones.

g) **Postoperative Care:** Following endocrine surgery, patients require close postoperative monitoring to ensure proper healing, manage pain, and detect any complications. This involves regular follow-up visits, hormone level monitoring, and ongoing collaboration with the endocrinology team to optimize the patient's postoperative management.

h) **Multidisciplinary Approach:** Surgery in endocrinology often necessitates a multidisciplinary approach. Surgeons collaborate with endocrinologists, radiologists, pathologists, and other specialists to ensure accurate diagnosis, appropriate preoperative preparation and comprehensive postoperative care. This collaboration ensures the best outcomes for patients.

It's important to note that the principles of surgery in endocrinology may vary depending on the specific condition being treated, such as thyroid disorders, adrenal gland tumors, or pituitary gland disorders. Surgical techniques and considerations may differ based on the nature and location of the pathology within the endocrine system. Therefore, individualized patient care and a tailored approach to surgery are essential in endocrine surgery.

B) SURGICAL PROCEDURES IN RATS: OVARIECTOMY, TUBECTOMY, HYSTERECTOMY, ORCHIECTOMY, AND VASECTOMY

a) OVARIECTOMY

Overectomy is the surgical removal of the ovaries in female rats. This procedure is commonly performed to study the effects of ovariectomy on reproductive physiology, hormonal regulation, and various disease models. It is also performed to induce menopause-like conditions in rats. The surgical technique involves making an incision in the abdominal wall, locating the ovaries and carefully removing them.

Aim: "To perform Ovariectomy in a normal female rat/ mice"

Requirements: Sterilized surgical instruments, hemostat, suture needle, suture thread (catgut), ether, antiseptic powder, alcohol, dettol, ether cones, etc.

PROCEDURE

1. Carefully etherize the animal.
2. Make a small incision in the abdominal region on the ventral side just below the last rib on the lateral side.
3. Cut through the layers of muscle and connective tissue.
4. Expose the fat bodies located below the incision in this region.
5. Locate the ovary, fallopian tube and part of the uterus embedded in the fat body.
6. Carefully place the hemostat between the ovary and the fallopian tube to prevent excessive bleeding.
7. Remove the ovary using a fine angular scissor.
8. Remove the hemostat and replace the organs in the abdominal region without damaging them.
9. Suture the incision both on the inside as well as on the skin, with small sutures. Clean the area with antiseptic and place antibiotic powder.
10. Repeat the process on the other side.

Thus bilateral Ovariectomy involves removal of the ovary on both sides without damaging the other organs.

a) TUBECTOMY

Tubectomy, also known as fallopian tube ligation or sterilization, is a surgical procedure performed to prevent pregnancy in female rats. It involves the ligation or blocking of the fallopian tubes to prevent the eggs from reaching the uterus for fertilization. This procedure is reversible in some cases. The technique involves making a small incision in the abdomen, locating the fallopian tubes, and either legating them or applying clips or electrocautery to block them.

b) HYSTERECTOMY

Hysterectomy involves the surgical removal of the uterus in female rats. This procedure is performed for various reasons, including studying reproductive disorders, investigating the effects of uterus removal on hormone regulation, and reproductive toxicology studies. The surgical technique involves making an incision in the abdomen, locating the uterus, and carefully removing it while preserving the surrounding tissues.

c) ORCHIECTOMY

Orchiectomy, also known as castration, is the surgical removal of the testes in male rats. This procedure is performed to eliminate testosterone production and study the effects of castration on reproductive physiology, behavior, and various disease models. It is also used as a means of sterilization in male rats. The surgical technique involves making a small incision in the scrotum, exposing the testes, and carefully removing them.

d) VASECTOMY

Vasectomy is a surgical procedure performed in male rats to block the vas deferens, the tubes that carry sperm from the testes to the urethra. It is a form of sterilization that prevents the male rat from impregnating females while maintaining hormone production. The surgical technique involves making a small incision in the scrotum, locating the vas deferens, and either legating, cutting, or sealing them to prevent the passage of sperm.

It is important to note that these surgical procedures should be performed by trained professionals following ethical guidelines and in accordance with local regulations. Proper anesthesia, aseptic techniques and postoperative care are essential to minimize pain, distress and complications for the animals.

Figure 1
Transverse incision made on the middle part of abdomen slightly towards the right with a surgical scalpel blade. The transverse abdominal muscle is exposed after skin incision.

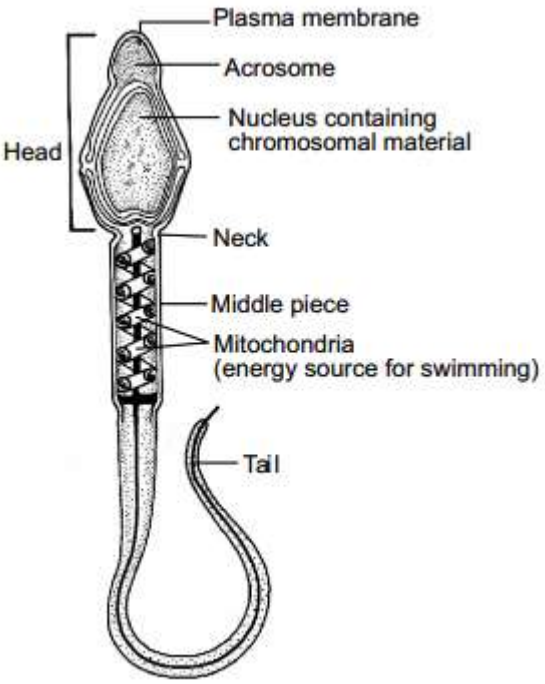
Figure 2
After the muscle dissection, the peritoneal space and adipose tissue surrounding ovary are exposed. Thick black circles show the ovary surrounded by adipose tissue.

Figure 3
Ligation at the distal uterine horn in order to completely remove the ovary, one at a time. The ovary surrounded by fat is completely removed (thick black circle).

STRUCTURE OF HUMAN SPERM

Human sperm, also known as spermatozoa, are the male reproductive cells responsible for fertilizing the female egg during sexual reproduction. Here is the structure of human sperm:

1) **Head:** The head is the front part of the sperm and contains the genetic material necessary for fertilization. It is oval-shaped and covered by a cap-like structure called the acrosome. The acrosome contains enzymes that help the sperm penetrate and fertilize the egg.

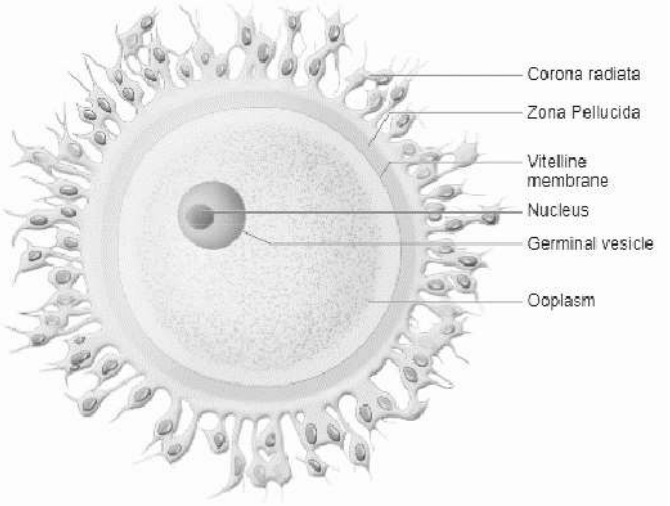


    a) **Acrosome:** The acrosome is a specialized vesicle located at the tip of the sperm head. It contains enzymes that are released during the process of fertilization to break down the protective layers surrounding the egg.
    b) **Nucleus:** The nucleus is the central part of the sperm head and contains the haploid set of chromosomes (23 chromosomes), which is the half of the genetic material required for the formation of a new individual.
2) **Neck:** The neck is a short region between the head and midpiece of the sperm.
3) **Midpiece:** The midpiece is the part of the sperm located just behind the head. It is packed with numerous mitochondria that provide the energy required for the sperm's movement.
    a) Mitochondria: Mitochondria are organelles responsible for generating energy through cellular respiration. They are abundant in the midpiece of the sperm.
4) **Tail (Flagellum):** The tail, also known as the flagellum, is a long, whip-like structure that extends from the midpiece. It is responsible for the sperm's motility, allowing it to swim through the female reproductive tract towards the egg.
5) **Basal Body:** The basal body is a small structure that anchors the tail to the sperm's head and provides structural support.

The structure of human sperm is highly specialized for its function of fertilization. When released during ejaculation, millions of sperm are present in the semen, but only a few will reach the egg. The journey of the sperm from the male reproductive system to the egg is a complex and competitive process, and only one sperm will successfully fertilize the egg to initiate the formation of a new human life.

STRUCTURE OF HUMAN OVUM

The human ovum, also known as the egg or oocyte, is the female reproductive cell responsible for sexual reproduction. Here is the structure of a human ovum:



1) **Zona Pellucida:** The zona pellucida is a thick, transparent layer that surrounds the ovum. It is composed of glycoproteins and serves as a protective barrier, helping to prevent multiple sperm from fertilizing the same egg.
2) **Cell Membrane:** Beneath the zona pellucida is the cell membrane, which is the outer boundary of the ovum. It is a semi permeable membrane that regulates the exchange of substances between the ovum and its surrounding environment.
3) **Cytoplasm:** The cytoplasm is the gel-like substance that fills the interior of the ovum. It contains various organelles, nutrients and molecules required for the initial stages of embryonic development.
4) **Nucleus:** The nucleus is the central part of the ovum and contains the genetic material in the form of chromosomes. The human ovum is haploid, meaning it contains only one set of 23 chromosomes, which is half of the genetic material needed to form a complete human being.
5) **Polar Bodies:** During oogenesis, the process of egg development, the ovum produces polar bodies. Polar bodies are small cells that contain the excess genetic material and are eventually discarded. They do not participate in fertilization but are important for reducing the ovum's genetic material to half and ensuring proper chromosome distribution during fertilization.
6) **Mitochondria:** The cytoplasm of the ovum contains numerous mitochondria, which are responsible for generating energy through cellular respiration. These mitochondria are inherited solely from the mother and play a crucial role in early embryonic development.
7) **Vesicles and Other Organelles:** The ovum's cytoplasm also contains various vesicles and organelles involved in cellular processes and early development.

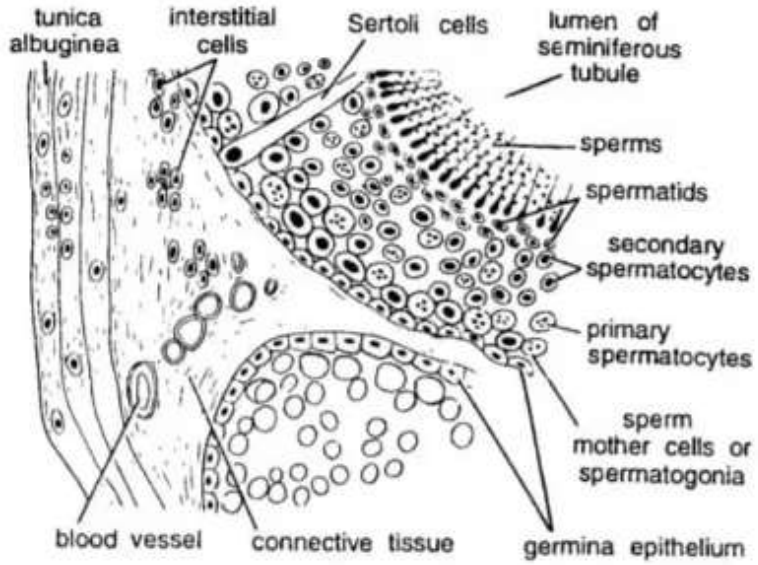
The human ovum is released from the ovary during ovulation and is transported through the fallopian tube, where it awaits fertilization by a sperm cell. If fertilization occurs, the nuclei of the sperm and ovum merge to create a zygote with a complete set of 46 chromosomes (23 from the mother and 23 from the father), initiating the formation of a new human life. If fertilization does not occur, the ovum will degenerate and be expelled from the body during menstruation.

EXAMINATION OF HISTOLOGICAL SECTIONS FROM PHOTOMICROGRAPHS/PERMANENT SLIDES OF RAT

Testis, Epididymis, Ovary, Fallopian Tube, Uterus (proliferative and secretary stages), Cervix and Vagina

HISTOLOGY OF TESTIS

1. The testis is a somewhat oval or rounded organ surrounded by the peritoneum, and it is encased by a layer of fibrous connective tissue known as the tunica albugenia.
2. Histologically, each testis exhibits a complex structure consisting of coiled seminiferous tubules. These tubules are separated from one another by intertubular connective tissue, which not only provides structural support but also houses blood vessels and interstitial cells.
3. The interstitial cells play a crucial role in the production of a hormone called testosterone, which is responsible for the development of male secondary sexual characteristics.
4. Each seminiferous tubule has an oval or rounded appearance and is surrounded by a basement membrane. These tubules are lined with germinal epithelium, where the process of spermatogenesis (sperm cell development) takes place.
5. Within the germinal epithelium, large Sertoli cells are interspersed, providing essential nourishment and support to the developing sperms during their maturation process.



HISTOLOGY OF EPIDIDYMIS

The epididymis is a highly convoluted, comma-shaped structure located on the posterior surface of the testis. It plays a crucial role in the maturation, storage, and transport of spermatozoa (mature sperm cells). Histologically, the epididymis exhibits the following key features:

1. **Epithelial Lining:** The epididymal duct is lined with pseudo stratified columnar epithelium, which consists of several cell types.
2. **Principal Cells:** The majority of the epithelial cells are called principal cells. They have stereo cilia (long microvilli) on their apical surface, which increase the surface area for absorption and secretion. These cells are responsible for reabsorbing most of the fluid and nutrients from the luminal fluid, which helps concentrate and mature the sperm.
3. **Basal Cells:** Scattered among the principal cells are basal cells, which are involved in cell renewal and replenishing the epithelial lining.
4. **Clear Cells**: Occasional clear cells are present, and they are believed to be involved in the absorption and secretion of certain substances.
5. **Connective Tissue**: The epithelium is surrounded by a layer of connective tissue containing blood vessels, nerves, and smooth muscle cells, which help in the contraction and movement of sperm along the epididymis.

The epididymis can be divided into three segments: the initial segment, the caput (head), the corpus (body), and the cauda (tail) epididymis. As sperm move through the epididymis, they undergo changes in their morphology and acquire motility, becoming capable of fertilization.

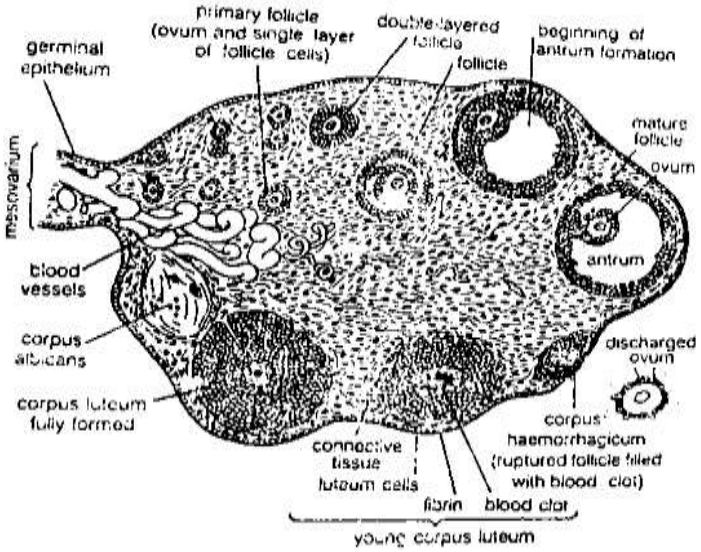
HISTOLOGY OF OVARY

The ovary is a complex organ with distinct histological features involved in the production and release of ova (eggs) and the synthesis of hormones.

1. **Germinal Epithelium:** The ovary is covered by a layer of simple cuboidal epithelium known as the germinal epithelium, which is surrounded by a layer of connective tissue called the tunica albugenia.
2. **Ovarian Stroma:** The main bulk of the ovary is composed of the ovarian stroma, a supportive tissue rich in elastic fibers, and containing large blood vessels, lymphatics, and nerves.
3. **Follicles and Oocyte:** Within the stroma, various stages of egg cells, called oocytes, can be found. Each oocyte is enclosed by supporting cells, forming structures known as

follicles. The follicles provide nourishment to the developing oocytes and also contribute to the production of hormones.

4. **Follicular Development:** The ovary exhibits different stages of follicular development, including:
5. **Primordial Follicles**: These are the earliest stage of follicles and are found in the ovarian cortex, derived from the germinal epithelium.
6. **Primary Follicles:** Primordial follicles can develop into primary follicles, consisting of a single layer of follicle cells surrounding the oocyte.
7. **Secondary Follicles:** Primary follicles further mature into secondary follicles with multiple layers of follicle cells.
8. **Mature Follicles (Graafian Follicles):** The most developed follicles are known as mature or Graafian follicles. They have a fluid-filled cavity called the antrum, which separates the oocyte and its surrounding cells from the rest of the follicle.
9. **Ovulation and Corpus Luteum:** Upon maturation, a mature follicle releases the oocyte during ovulation, making it available for fertilization. The remaining part of the mature follicle transforms into a structure called the corpus luteum. The corpus luteum is responsible for producing hormones, particularly progesterone, which is essential for maintaining a potential pregnancy.
10. Corpus Albicans: If fertilization does not occur, the corpus luteum regresses, and the structure is eventually replaced by fibrous tissue known as the corpus albicans



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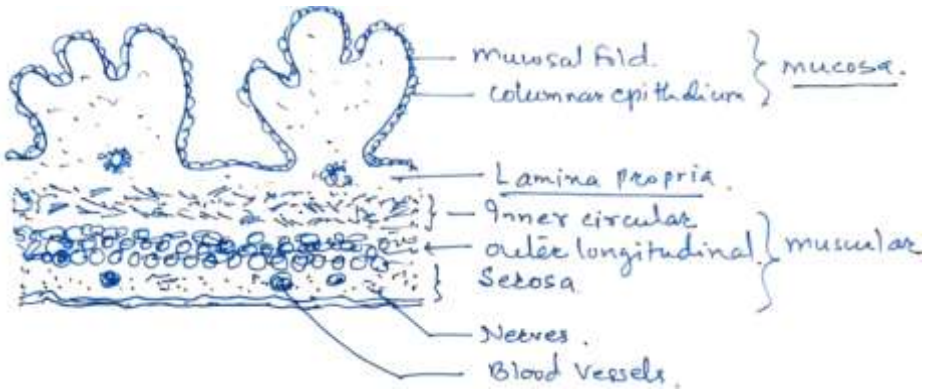
HISTOLOGY OF FALLOPIAN TUBE

The fallopian tubes, also known as uterine tubes or oviducts, are a pair of slender, tubular structures in the female reproductive system. They extend from the upper lateral corners of the uterus and are essential for the transport of eggs (oocytes) from the ovaries to the uterus. Additionally, they are the site of fertilization, where sperm and egg meet. Let's explore the histology of the fallopian tube:



Mucosa (or Mucous Membrane):

The innermost layer of the fallopian tube is the mucosa, which is composed of simple columnar epithelium. The epithelium is lined with cilia, hair-like structures that beat in a coordinated manner towards the uterus. The cilia create currents in the fluid within the fallopian tube, helping to move the egg and captured sperm toward the uterus. The mucosa also contains secretary cells that produce nourishing fluids to support the oocyte and early embryo.

Lamina Propria:

The mucosa is supported by a thin layer of connective tissue called the lamina propria, which contains blood vessels, lymphatics and nerves.

Muscularis:

Surrounding the lamina propria is the muscularis layer, consisting of smooth muscle fibers. The muscularis layer exhibits peristaltic contractions, which aid in the movement of the egg and embryo through the fallopian tube.

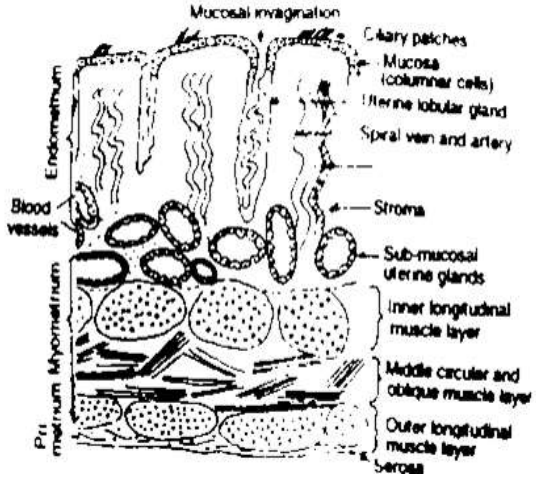
Serosa (or Adventitia):

The outermost layer of the fallopian tube is either a Serosa (if covered by peritoneum) or an adventitia (if covered by connective tissue). The Serosa/adventitia provides structural support and allows the fallopian tube to be anchored within the pelvic cavity.

The fallopian tubes histological features, particularly the ciliated epithelium and smooth muscle layer, play a crucial role in the transport of the oocyte and sperm, as well as the early stages of embryonic development. Fertilization typically occurs within the ampulla of the fallopian tube, where the sperm encounter the mature egg. After fertilization, the resulting zygote undergoes rapid cell divisions (cleavage) as it travels through the fallopian tube toward the uterus, where it eventually implants and develops into an embryo.

HISTOLOGY OF UTERUS

The uterus is an important organ in the female reproductive system, located between the vagina and the fallopian tubes. Histologically, the wall of the uterus can be divided into three layers:



1. **Perimetrium or Serosa:** This is the outermost protective layer that forms part of the broad ligament. It provides support and allows blood vessels, lymphatics and nerves to reach the uterus.
2. **Myometrium or Muscularis:** The myometrium constitutes the middle muscular layer of the uterus. It is a thick layer consisting of smooth muscle fibers, connective tissue, and large blood vessels. The muscular contractions of this layer are essential during childbirth and menstruation.
3. **Endometrium or Mucosa:** The endometrium is the innermost layer of the uterus and is a mucous membrane. It is composed of a columnar epithelium and a supportive layer called the lamina propria. The endometrium undergoes cyclical changes throughout the menstrual cycle.
4. The stroma of the uterine wall contains simple tubular uterine glands. The endometrium can be further divided into two zones based on changes during menstruation:

a) **Endometrium Functionalis:** This is the functional layer of the endometrium that undergoes cyclical changes in response to hormonal fluctuations. It is the part that thickens during the menstrual cycle and is periodically shed during menstruation.

b) **Endometrium Basalis:** The endometrium basalis is the deeper layer that remains relatively unchanged during the menstrual cycle. It serves as the source of new endometrial tissue after menstruation.

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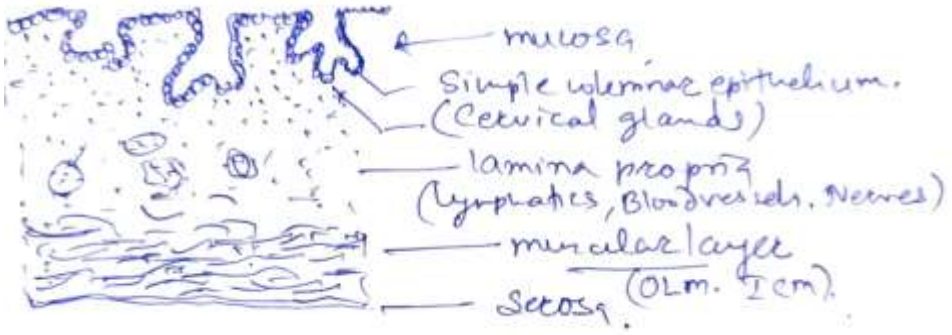
HISTOLOGY OF CERVIX

The cervix is the lower part of the uterus that connects to the upper part of the vagina. It plays a crucial role in the female reproductive system by facilitating the passage of menstrual blood and sperm, and it also serves as a protective barrier during pregnancy. Let's explore the histology of the cervix:



Cervical Canal Epithelium:

The cervical canal is the passageway that extends through the center of the cervix. The lining of the cervical canal is characterized by two types of epithelium:

a. **Simple Columnar Epithelium:** This type of epithelium lines the cervical canal's inner portion, also known as the endocervix.
b. **Stratified Squamous Epithelium:** This epithelium lines the portion of the cervix that protrudes into the vagina, known as the ectocervix or exocervix.

The boundary between the two types of epithelium is called the transformation zone. This zone can shift during a woman's life, and its position is significant in cervical cancer screening.

Cervical Glands:

The cervix contains numerous glands that secrete mucus. These glands are mainly located in the endocervix and extend into the underlying cervical stroma. The mucus produced by these glands varies in consistency during the menstrual cycle, influenced by hormonal changes. This mucus plays a vital role in fertility and acts as a barrier against infections.

Cervical Stroma:

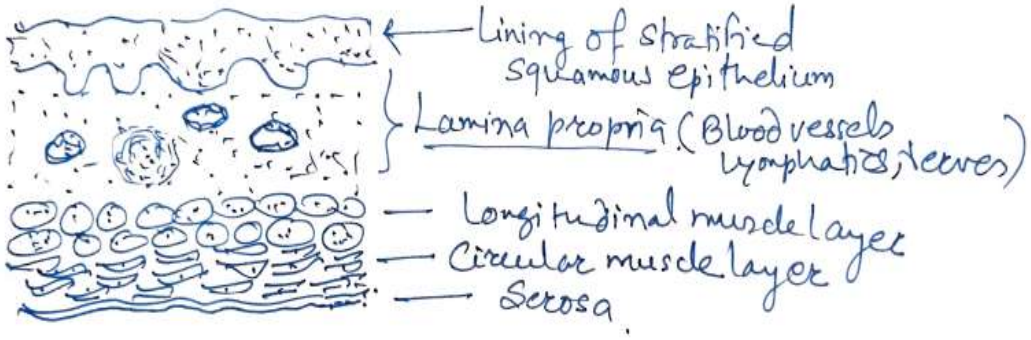
The stroma refers to the connective tissue matrix that supports the epithelial layers and glands of the cervix. It contains fibroblasts, collagen fibers, and blood vessels, providing structural support to the cervix.

Ligaments and Supportive Structures:

The cervix is supported by several ligaments and connective tissues that anchor it to the surrounding pelvic structures**.**

HISTOLOGY OF VAGINA

The vaginal wall is composed of several layers, each with specific characteristics:



Mucosa (or Mucous Membrane):

The innermost layer of the vaginal wall is the mucosa, which is lined with non-keratinized stratified squamous epithelium. This epithelium is designed to withstand friction and acidic environments and serves as a protective barrier against infection. The surface cells are constantly being shed and replaced, maintaining the integrity of the mucosal layer.

Lamina Propria:

Beneath the epithelial layer is the lamina propria, which consists of connective tissue containing blood vessels, nerves, and lymphatics. It also contains elastic fibers that allow the vaginal wall to stretch during intercourse and childbirth.

Muscularis:

The muscularis layer is composed of smooth muscle fibers arranged in inner circular and outer longitudinal layers. These muscles contribute to the contractility and elasticity of the vagina.

Adventitia (or Serosa):

The outermost layer of the vaginal wall is the adventitia, which consists of connective tissue and collagen fibers. It provides support and connects the vagina to the surrounding structures, such as the pelvic floor.

DETECTION OF PREGNANCY BY USING KIT

Title: Pregnancy Detection Using a Home Pregnancy Test Kit

Objective:

The objective of this practical is to familiarize students with the process of using a home pregnancy test kit to detect pregnancy. Students will learn the principles behind pregnancy test kits and how to perform the test accurately.

Materials Required:

1. Home pregnancy test kit (readily available at pharmacies or online)
2. A clean container to collect urine
3. Timer or stopwatch
4. Disposable gloves (optional but recommended)
5. Pen and paper for recording observations

Procedure:

Step 1: Introduction to the Home Pregnancy Test Kit

Start by introducing the concept of a home pregnancy test kit and explaining its significance in detecting pregnancy. Discuss the principle behind the test, which is based on detecting the presence of the hormone human chorionic gonadotropin (hCG) in the urine, which is produced during pregnancy.

Step 2: Preparing for the Test

Ensure that the students have clean hands before handling the kit to avoid contamination. Familiarize the students with the components of the kit, typically a test stick or strip and an instruction leaflet. Emphasize the importance of reading and following the instructions carefully.

Step 3: Collecting the Urine Sample

Instruct the students on the proper method of collecting a urine sample. It's best to use the first-morning urine sample for higher accuracy, but any urine sample collected after holding the urge to urinate for at least a few hours will suffice. If possible, provide each student with a clean container to collect their urine samples.

Step 4: Performing the Test

Direct the students to carefully follow the instructions provided with the pregnancy test kit. The steps typically include:

1. Removing the test strip from its packaging and exposing the testing area.
2. Holding the test strip in a way that the testing end is submerged in the collected urine.
3. Allowing the strip to absorb the urine for the specified time mentioned in the instructions (usually a few seconds).

4. Placing the test strip on a flat surface and waiting for the stipulated time for the results to develop.

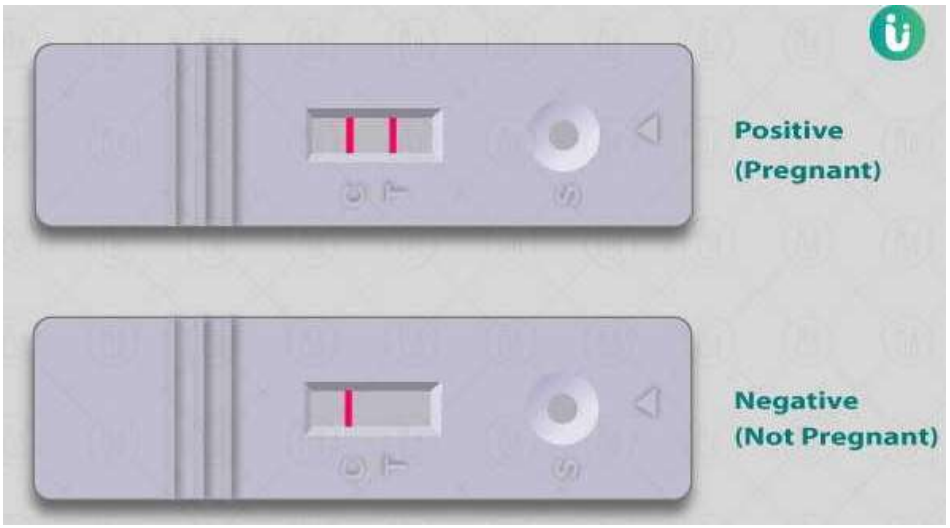
Step 5: Reading the Results

Explain how to interpret the results correctly:

1) Two lines usually indicate a positive result (pregnant).

2) One line indicates a negative result (not pregnant).

3) No lines or an invalid control line means the test is invalid and the test should be repeated.



Step 6: Recording Observations

Ask the students to record their observations, including the date and time of the test and the test results.

Step 7: Discussion and Conclusion

Lead a discussion on the accuracy and limitations of home pregnancy test kits. Emphasize the importance of following instructions and interpreting results correctly. Conclude the practical by summarizing the key points learned and their real-world applications.

Note: While this practical activity simulates the process of using a home pregnancy test kit, it is essential to remind students that the actual determination of pregnancy should be done under the guidance of a healthcare professional for confirmation and further care.

STUDY OF CONTRACEPTIVE DEVICES BY PHOTOGRAPHS OR MODELS

The prevention of pregnancy or conception is called contraception. The devices used for contraception are called contraceptives. Following are the methods of contraception with their contraceptives.

CONTRACEPTIVE METHOD USED

1. Natural method
   a) Total abstinence of coitus.
   b) Interrupted coitus.
   c) Rhythm.
2. Mechanical method: Diaphragm, cervical cap, condom/sheath {Nirodh}
3. Chemical method: Foam tablets, Jellies and creams
4. Intra-uterine devices {IUD}: Copper-T and Loop
5. Oral contraceptives Pills/Tablets.
6. Sterilization operations: a] Male sterilization- Vasectomy
   b] Female sterilization or Tubectomy/ Tubal ligation.
7. Abortion Medical pregnancy termination- MTP.

1) NATURAL METHOD

A] TOTAL ABSTINENCE OR COITUS

Conception is prevented when the couple obtains from intercourse. One can apply this method with full understanding of the partner. This is the real, sure way of preventing conception.

B] INTERRUPTED COITUS

This is the earliest form of birth control. It needs knowledge of reproductive process. Conception requires not only sexual union but also ejaculation of semen into female tract. During sexual intercourse one has to withdraw the penis from the vagina before ejaculation. Failure in this method is either due to pre ejaculatory escape of fluid containing sperm or failure to withdraw before ejaculation

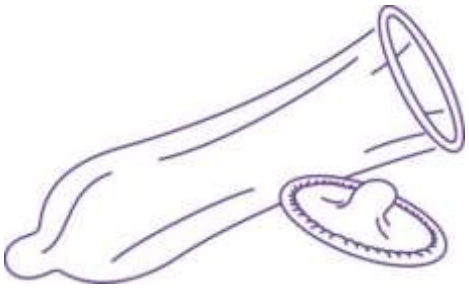
C] RHYTHUM/CALENDAR METHOD

In this method one must have the knowledge of reproductive physiology that ovum can be fertilized only during a period of 3-5 days in each menstrual cycle. Those days are 3 days before ovulation {11, 12, and 13}. The day of ovulation {14th day} and three days after ovulation ie {15, 16, & 17}. During these mentioned days couple must retain from intercourse effectiveness of such rhythm method for birth control is poor because all ladies will not have regular cycle. Couple is instructed to know and understand rhythm of their sexual cycle.

2] MECHANICAL METHOD

In this method a barrier is created between the male organ and the interior of the female passage. The barrier is purely mechanical like condom diaphragm, cervical cap etc.

A] CONDOM

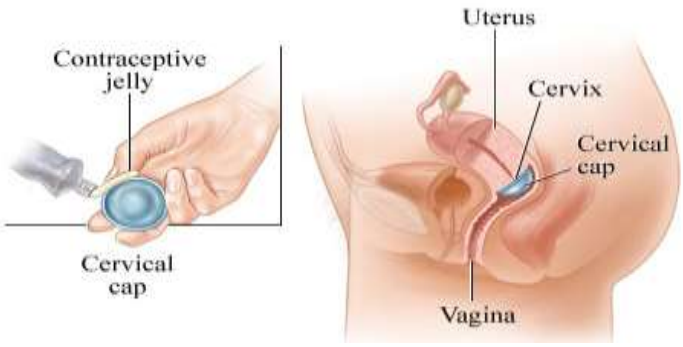


Condoms are of two types like Male condoms and Female condoms. In male it is placed over penis and hence it prevents the deposition of sperms in the vagina. Male condom is a elastic pouch rolled and placed in a safe packet. Before intercourse it is taken out of packet to place on the erect penis, leaving space at the tip. Unrolling is then done gradually covering the whole penis. This method also prevents various STD infections {sexual transmitting diseases} and it is the only contraceptive to prevent AIDS infection too. In female condom is inserted to fit over the cervix. It is essential to do the proper use of condoms during each sexual intercourse.

B] DIAPHRAGM

It is dome shaped rubber structure that fits over cervix. Diaphragm prevents the sperms from passing into the cervix. It is generally used with spermicidal that kill the sperms. Diaphragm should be fitted by physician.

C] CERVICAL CAPS



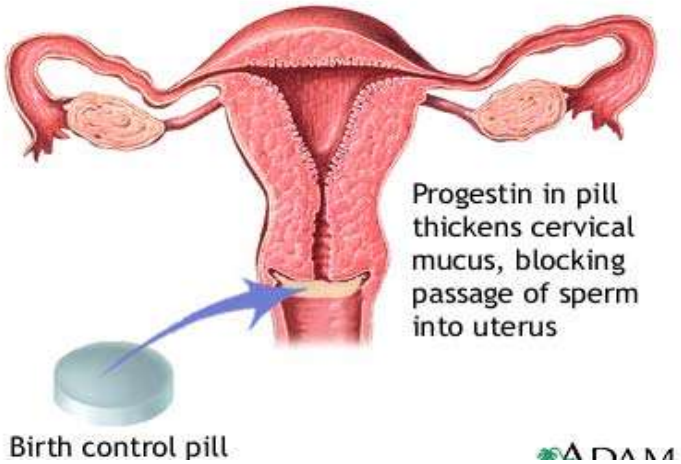
It is a plastic cap of 4cm diameter. It fits snugly over the cervix and it is held in position by suction. It is also fitted by physician.

3] CHEMICAL METHOD

Use of foam tablets, jellies and creams are the chemical method of contraception.

A] FOAM TABLETS

These are the tablets which produces foam when they are moistened. They are used one at a time. A tablet is moistened and placed deep in vagina before the intercourse. The foam produced destroys the sperm during intercourse.



B] JELLY

This is available in the market in a tube along with its applicator and its operation is to be done carefully. One has to fix the applicator to jelly tube. If jelly tube is pressed the applicator naturally gets filled with felly. Such applicator full of jelly is then inserted into the vagina. If plunger is pressed slowly while taking out the applicator the jelly will be released into the vagina. Jelly destroys the sperms during intercourse.

C] CREAMS

Various creams are also used as the contraceptives. They are applied to vagina before the intercourse. These creams are spermicidal in their actions to kill the sperms in vagina.

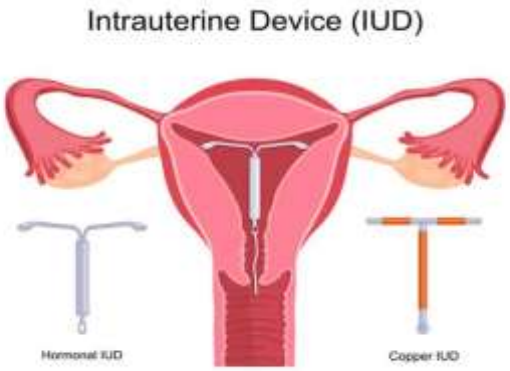
4] INTRA UTERINE DEVICES {IUD}

The commonly used IUDs are copper-T and Lippies loop. They are small objects made of copper, stainless steel and plastic. Plastic Loop is not commonly used but copper-T is in best use. Plastic Loop is device made of polyethylene. It is relatively permanent method.

COPPER-T

It is a permanent method of contraception for a relatively long period. Once it is introduced into the uterus it does not allow the egg to implant and thus pregnancy is prevented.

Copper-T is to be introduced into the uterus by doctors. One has to change or replace old by new one after 3 years. Loops also prevent a fertilized egg from being implanted into the uterus. Following are the some advantage and dis advantage of copper-T



ADVANTAGES OF COPPER-T

a) It is effective {100%}
b) It is aesthetic and reversible.
c) It is non-interfering and reversible.
d) Its association is painless.
e) No problems of storage and disposal.
f) It provides opportunity for gynecological examination

DISADVANTAGES OF COPPERT

a) Sometimes they can cause cramp like pain. Back ache, menstrual bleeding, spotting etc.
b) These side effects are not serious usually disappears after few months.

5] ORAL CONTRACEPTIVES {O.C./Pills}

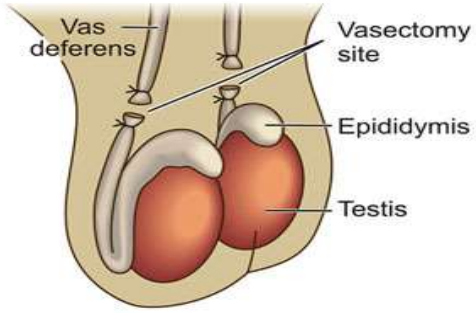
Pregnancy can be prevented by suppressing ovulation. This is done by some oral contraceptive agents, which are available in the form of tablets or capsules/pills. Contraceptive pills work by inhibiting the release of an egg from the ovaries during the menstrual cycle, thus preventing fertilization by sperm. The tablets should be taken for 21 days continuously starting on 5th day of the menstrual cycle and finishing on the 25th day. Bleeding usually occurs on the 28th day. The next course of tablet should begin again on the 5th day of the next cycle.

6] STERILIZATION OPERATIONS:

It is the popular method of birth control. By this method relatively permanent infertility is achieved. In case of male it is called Vasectomy and in Female it is called Tubectomy.

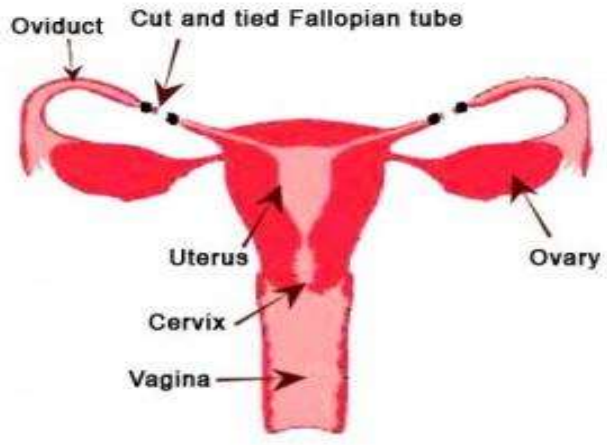
A] VASECTOMY

It is a surgical operation done is male. In male vasectomy, the vas deferens is cut on the sides of testis. The cut ends are made into knots. This operation is simple and is completed within 20 minutes.



B] TUBECTOMY

It is also called Tubal ligation. In Tubectomy the fallopian tubes are cut and cut ends are made into knots. So that the passage of sperms into the tubes is blocked therefore there will not be any fertilization as such after separation she should not carry weights or do not heavy manual work for at least one month.



7] ABSORTION

Abortion is the expulsion of conception products from the uterus. It is done by a physician. It is a birth control method and should be done before the 20th week of gestation. In the medical field, abortion is called MTP {Medical termination of pregnancy}, D & C{Dilation and surgical curettage}.In MTP the cervix is dilated with instrument & embryo is sucked out.

PRACTICAL II

UNIT II: APPLIED ZOOLOGY

5. Study of arthropod vectors associated with human diseases: Pediculus, Culex, Anopheles, Aedes and Xenopsylla
6. Study of insect pests through damaged products/photographs.

i) Crop pests

g. Gram pod borer (*Helicoverpa armigera*)

h. Sugarcane leaf hopper (*Pyrilla perpusilla*)

i. Lemon Butterfly (*Papilio demoleus*)

ii) Stored grains pests

g. Pulse Beetle (*Callosobruchus chinensis*)

h. Rice Weevil (*Sitophilus oryzae*)

i. Red Flour beetle (*Tribalism castaneum*)

iii) Identifying feature and economic importance of

m. *Helicoverpa armigera* (Cotton bollworm)

n. *Papilio demoleus* (Lime butterfly)

o. *Pyrilla perpusilla* (Sugarcane plant hopper)

p. *Callosobruchus chinensis* (Pulse beetle)

q. *Sitophiluso ryzae* (Rice weevil) and

r. *Tribolium castaneum* (Red flour beetle).

STUDY OF ARTHROPOD VECTORS ASSOCIATED WITH HUMAN DISEASES: PEDICULUS, CULEX, ANOPHELES, AEDES AND XENOPSYLLA

A) PEDICULUS

Classification

Phylum: Arthropoda – Jointed appendages.

Class: Insecta – Abdominal appendages absent.

Sub-class: Pterygota **–** Winged insects with complete or incomplete metamorphosis.

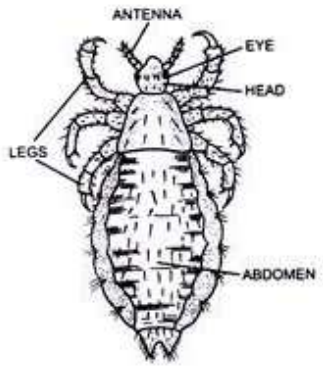
Division: Exopterygota- Wings externally originated with simple metamorphosis.

Order: Pthiraptera–Mouth parts piercing and sucking, ectoparasite without metamorphosis.

Genus: *Pediculus humanus*

COMMENTS

1. The Pediculus louse is a cosmopolitan ectoparasite that infests humans and is also found in apes and monkeys.
2. This louse has a dorsoventrally flattened body and measures about 1-3mm in length.
3. It possesses a pointed head with two lateral compound eyes and a pair of small antennae.
4. The mouth-parts are highly modified for piercing and sucking blood.
5. The thorax is small, unsegmented, and wingless.
6. It has three pairs of clawed legs on the thorax, which are strong and equipped with movable claws that allow it to firmly grasp onto the host's hair.
7. The abdomen is narrow at the anterior end but broadens out posteriorly.
8. The abdomen is divided into nine segments.
9. In males, the posterior end is turned upwards, while in females, it does not exhibit this upward curvature.
10. Pediculus lice not only cause itching and hair loss but can also act as carriers of diseases such as typhus, relapsing fever, and trench fever, as they transmit these diseases to the host through their excreta when puncturing the host's skin



B) CULEX

Phylum: Arthropoda – Jointed appendages.

Class: Insecta – Abdominal appendages absent.

Sub-class: Pterygota **–** Winged insects with complete or incomplete metamorphosis.

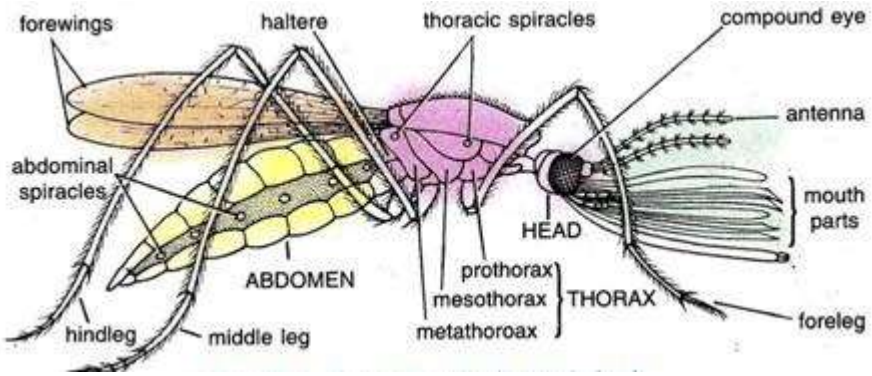
Division: Endopterygota- Wings internally originated with simple complete metamorphosis.

Order: Diptera–Mouth parts piercing and sucking.

Genus: *culex*

COMMENTS

1. The Culex mosquito has a small and soft body covered with tiny scales.
2. Culex mosquitoes measure approximately 3 to 4 mm in length and have a grey-black body color.
3. They have a freely movable head on a slender neck, large black compound eyes and antennae.
4. Female Culex mosquitoes have exceedingly small maxillary palps and antennae with a few short hairs at the joints.
5. Their mouthparts are of the piercing and sucking type.
6. The maxillary palps and labium contain tactile hairs, forming a proboscis sheath.
7. Culex mosquitoes are known for transmitting diseases such as elephantiasis



C) ANOPHELES

Phylum: Arthropoda – Jointed appendages.

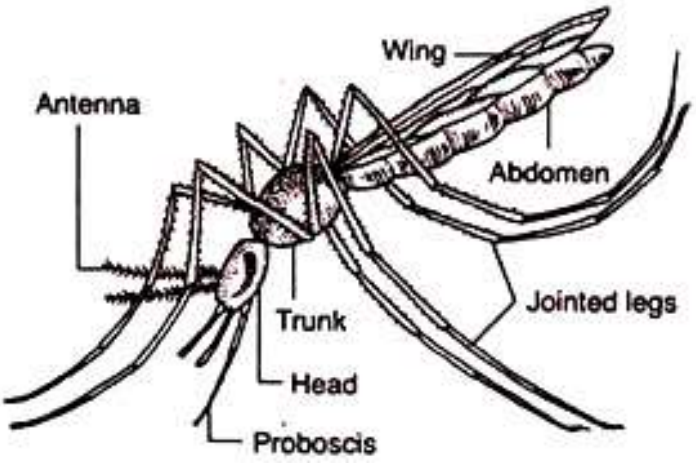
Class: Insecta – Abdominal appendages absent.

Sub-class: Pterygota **–** Winged insects with complete or incomplete metamorphosis.

Division: Endopterygota- Wings internally originated with simple complete metamorphosis.

Order: Diptera–Mouth parts piercing and sucking.

Genus: *Anopheles*



COMMENTS

1. The Anopheles mosquito has a head that is freely movable on a slender neck, featuring large black compound eyes and antennae.
2. Its antennae possess a few short hairs at the joints.
3. The mouthparts of the Anopheles mosquito are of the piercing and sucking type, consisting of the labrum, epipharynx, needle-shaped mandibles and maxillae, hypopharynx, maxillary palps, and labium.
4. The maxillary palps are simple and equal in length to the labium or proboscis.
5. Anopheles mosquitoes are known to transmit malaria and they also act as intermediate hosts for the Plasmodium parasite.

D) AEDES

Phylum: Arthropoda – Jointed appendages.

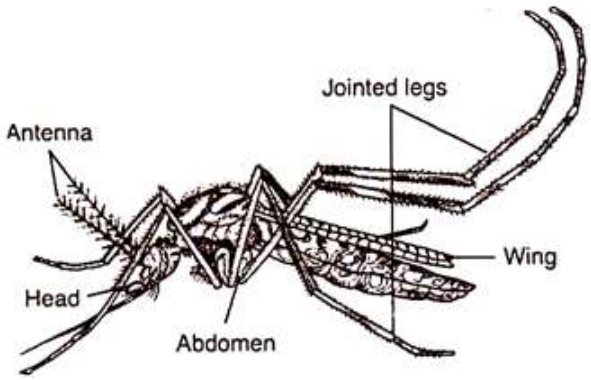
Class: Insecta – Abdominal appendages absent.

Sub-class: Pterygota **–** Winged insects with complete or incomplete metamorphosis.

Division: Endopterygota- Wings internally originated with simple complete metamorphosis.

Order: Diptera–Mouth parts piercing and sucking.

Genus: *Aedes aegypti*



COMMENTS

1. The Aedes mosquito's head is characterized by its free movement on a slender neck, along with large black compound eyes and antennae.
2. They possess large and thick wings with distinctive black and white bands.
3. The antennae are covered in dark and dense hairs.
4. Both the body and legs of Aedes mosquitoes are comparatively broad.
5. Aedes mosquitoes produce less sound during flight compared to other mosquito species.
6. The eggs of Aedes mosquitoes are small and are laid in large numbers, forming a raft-like structure on the water's surface.
7. The larva of Aedes floats obliquely with its head facing downwards.
8. The pupa is colorless and features a medium-sized tail fin.
9. Aedes mosquitoes are visually distinctive due to noticeable black and white markings on their bodies and legs.
10. Unlike most other mosquitoes, they are active and primarily bite during the daytime, with peak biting periods early in the morning and in the evening.
11. Members of the Aedes genus are known vectors for numerous viral infections. The most prominent species, A. aegypti and A. albopictus, transmit viruses responsible for diseases such as dengue fever, yellow fever, West Nile fever, chikungunya, eastern equine encephalitis, Zika virus, along with many other, less notable diseases.

E) XENOPSYLLA

Classification

Phylum: Arthropoda – Jointed appendages.

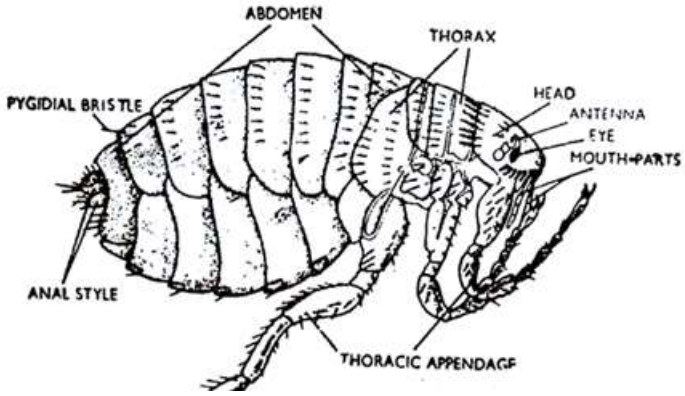
Class: Insecta – Abdominal appendages absent.

Sub-class: Pterygota **–** Winged insects with complete or incomplete metamorphosis.

Division: Endopterygota- Wings internally originated with simple complete metamorphosis.

Order: Siphoneptera–Mouth parts piercing and sucking, ectoparasite without wings.

Genus: *Xenopsylla (Rat flea)*



COMMENTS

1. Commonly known as the "rat flea" or "Pissu," this flea is prevalent in tropical regions.
2. It is an ectoparasite that infests rats and other mammals, acting as a disease vector for the plague.
3. The flea's body is laterally compressed, allowing it to glide easily between the hairs and feathers of its hosts. It is divided into three sections: head, thorax and abdomen.
4. The head is broadly jointed to a relatively small thorax and the abdomen consists of ten segments.
5. The head contains ocelli (compound eyes), antennae and mouthparts of the piercing and sucking type.
6. The body is covered with backwardly directed bristles.
7. The flea's legs are long and powerful, with remarkably developed coxae, along with five tarsi.
8. Fleas do not have wings.
9. Fleas are significant carriers of two diseases of outstanding importance: i) plague and ii) endemic typhus.
10. In addition to plague and endemic typhus, fleas also transmit Tularemia in rodents and Myxomatosis in rabbits

7. STUDY OF INSECT PESTS THROUGH DAMAGED PRODUCTS/PHOTOGRAPHS.

i) Crop pests

a) Gram pod borer (*Helicoverpa armigera*)

b) Sugarcane leaf hopper (*Pyrilla perpusilla*)

c) Lemon Butterfly (*Papilio demoleus*)

a) Crop pest: Gram pod borer (*Helicoverpa armigera*)

The Gram pod borer (Helicoverpa armigera) is a highly destructive insect pest that poses a significant threat to various crops, especially legumes such as Chickpea (Gram), Pigeon Pea and Soybean. It is widely distributed in many parts of the world and is known by various names, including the corn earworm, cotton bollworm and tomato fruit worm.

The role of the Gram pod borer as a crop pest is as follows:

1) **Feeding on Plant Parts:** The Gram pod borer larvae primarily feed on different parts of the host plants. They are voracious feeders and can cause considerable damage to crops by consuming leaves, flowers, pods and seeds.
2) **Reduction in Crop Yield:** Infestations of Gram pod borer can lead to significant yield losses in affected crops. Since they feed on reproductive structures like pods and seeds, the damage can directly affect the quantity and quality of the harvested produce.
3) **Secondary Infections:** The entry points created by Gram pod borer larvae while feeding can serve as entry points for pathogens, leading to secondary infections that further damage the plants.
4) **Widespread Host Range:** The Gram pod borer has a broad host range, affecting several economically important crops, which makes it a significant threat to agricultural production and food security.

5) **Resilience to Pesticides:** The Gram pod borer has shown a remarkable ability to develop resistance to many chemical pesticides used for control. This has led to challenges in managing infestations and controlling their populations effectively.
6) **Seasonal Outbreaks:** The population dynamics of Gram pod borer can be unpredictable, leading to sudden and severe outbreaks in certain years or regions. During outbreaks, the damage to crops can be especially severe.

Farmers employ various methods to manage Gram pod borer infestations, including cultural practices such as crop rotation, intercropping, and the use of resistant varieties. Biological control using natural enemies like predators and parasitoids is also commonly used to reduce the pest population. Additionally, integrated pest management (IPM) approaches that combine different control methods, including judicious use of insecticides are employed to minimize crop losses while reducing the risk of resistance development.

Effective management of the Gram pod borer requires continuous monitoring of pest populations and the adoption of sustainable and environmentally friendly pest control strategies to mitigate its impact on crops and agricultural productivity.

b) Crop pest: Sugarcane leaf hopper (*Pyrilla perpusilla*)

The Sugarcane leafhopper (*Pyrilla perpusilla*) is a notorious insect pest that affects sugarcane crops, causing significant economic losses to sugarcane growers. It is a sap-sucking insect that feeds on the leaves of sugarcane plants. The role of the Sugarcane leafhopper as a crop pest includes the following:

1. **Feeding Damage:** Sugarcane leafhoppers feed by inserting their needle-like mouthparts into the plant tissues and sucking out the plant sap. This feeding activity weakens the plant and reduces its photosynthetic capacity, leading to stunted growth and reduced yield.
2. **Direct Crop Damage:** The direct damage caused by Sugarcane leafhoppers leads to the formation of chlorotic spots on the leaves and the appearance of "Hopper Burn," a characteristic condition where leaves dry up and wither due to excessive sap removal.
3. **Transmission of Pathogens:** The leafhoppers can act as vectors for plant pathogens, including viruses and phytoplasmas. When they feed on infected plants, they can pick up the pathogens and transmit them to healthy sugarcane plants during subsequent feedings, leading to the spread of diseases.
4. **Honeydew Production:** Like many sap-sucking insects, Sugarcane leafhoppers excrete honeydew, a sugary substance. The honeydew provides a medium for the growth of sooty mold, which can further reduce the plant's ability to photosynthesize and contribute to reduced plant vigor.
5. **Crop Yield Losses:** Severe infestations of Sugarcane leafhoppers can result in substantial yield losses, affecting both cane tonnage and sucrose content in the harvested sugarcane.

6. **Disruption of Plant Growth:** The feeding activity of the leafhoppers can disrupt the normal physiological processes of the sugarcane plant, affecting its overall growth and development.

To manage Sugarcane leafhopper infestations, sugarcane growers employ a combination of cultural, biological and chemical control strategies. These may include:

1) **Monitoring and Early Detection:** Regular monitoring of sugarcane fields allows growers to detect leafhopper infestations early and take timely action.
2) **Cultural Practices:** Crop rotation, planting resistant varieties and maintaining good field hygiene can help reduce leafhopper populations.
3) **Biological Control:** Natural enemies, such as predatory insects and parasitoids, can help control leafhopper populations and are often integrated into pest management programs.
4) **Insecticides**: Chemical control measures, such as the judicious use of insecticides, are sometimes necessary to manage severe infestations. Integrated pest management (IPM) approaches aim to minimize the use of insecticides while maximizing their effectiveness.
5) **Tolerant Varieties:** Developing and planting sugarcane varieties with some level of tolerance to leafhopper feeding can help mitigate the impact of infestations.
6) **Neem-Based Products:** The use of neem-based insecticides has shown promise in controlling sugarcane leafhoppers while being less harmful to beneficial insects.

It is essential for sugarcane growers to implement a holistic approach to manage sugarcane leafhopper infestations effectively. This includes combining cultural practices, biological control and judicious use of insecticides to minimize crop damage and ensure sustainable sugarcane production.

c) Crop pest: Lemon Butterfly (*Papilio demoleus*)

The Lemon Butterfly (Papilio demoleus) also known as the Common Lime Butterfly or Citrus Swallowtail, is a pest that can cause damage to certain crops, particularly plants in the citrus family. Its role as a crop pest is as follows:

1) **Feeding on Leaves and Fruits:** The Lemon Butterfly larvae (caterpillars) feed on the leaves of various host plants, including citrus trees such as lemon, lime, orange and other related species. They can consume large quantities of foliage, leading to defoliation and weakening of the plant.
2) **Damage to Young Shoots:** The caterpillars may also feed on young shoots and tender plant parts, affecting the growth and development of the citrus trees.
3) **Reduction in Crop Yield:** Severe infestations of Lemon Butterfly caterpillars can cause substantial damage to citrus crops, resulting in reduced fruit production and lower quality fruits.
4) **Transmitting Plant Diseases**: While the Lemon Butterfly itself is not a vector for plant diseases, its feeding activity can create entry points for pathogens, making the plants more susceptible to infections.
5) **Indirect Damage:** In addition to direct feeding damage, the presence of caterpillars can attract predators and parasites that may further affect the crop's health and productivity.
6) **High Reproductive Rate:** The Lemon Butterfly has a high reproductive rate, and its population can quickly increase under favorable conditions, leading to higher pest pressure on citrus crops.

To manage Lemon Butterfly infestations and reduce crop damage, several control measures can be employed:

1) **Cultural Practices:** Maintaining good field hygiene, pruning affected plant parts and removing egg masses and caterpillars can help reduce population levels.
2) **Biological Control:** Natural predators and parasitoids, such as birds, wasps, and spiders, can provide natural control of Lemon Butterfly populations.

3) **Chemical Control:** In severe infestations, the judicious use of insecticides may be necessary. However, care should be taken to follow Integrated Pest Management (IPM) practices and avoid harming beneficial insects and pollinators.
4) **Resistant Varieties:** Planting citrus varieties that are less preferred by Lemon Butterflies can help minimize damage.
5) **Trap Crops:** Growing trap crops that attract Lemon Butterflies away from the main citrus crop can be effective in reducing direct damage to the main crop.

It's important to note that while the Lemon Butterfly can be a pest for citrus crops, it also serves as a pollinator for various plants and plays a role in the ecosystem. Therefore, the management of this pest should be carried out carefully, with consideration for its ecological impact and the use of sustainable pest management practices.

II) STORED GRAINS PESTS

a) Stored grains pest: Pulse Beetle (*Callosobruchus chinensis*)

The Pulse Beetle (*Callosobruchus chinensis*), also known as the Cowpea Weevil or Grain Beetle, is a significant pest of stored grains, particularly pulses such as Chickpeas, Lentils, Mung Beans and Cowpeas. This beetle is a serious threat to stored grain commodities and its role as a stored grain pest includes the following:

1) **Infestation of Stored Grains:** Adult Pulse Beetles lay eggs on or inside the grains, especially in cracks or damaged seeds. The larvae (grubs) hatch from these eggs and bore into the grains to feed on the internal contents.
2) **Damage to Grains:** The feeding activity of the Pulse Beetle larvae inside the grains can cause extensive damage. They consume the endosperm, reducing the nutritional value of the grain and leading to a decrease in grain quality.
3) **Spoilage of Grains:** As the larvae feed and develop inside the grains, they produce frass (excrement) and secretions, which can lead to mold growth and contamination of the stored grains. This can render the grains unfit for human or animal consumption.
4) **Reproduction and Population Growth:** Pulse Beetles have a rapid reproductive rate, and a small infestation can quickly multiply into a large population, leading to widespread damage in stored grain facilities.
5) **Resistance to Insecticides:** The Pulse Beetle has shown the ability to develop resistance to various chemical insecticides used for pest control. This can make management challenging and requires the use of integrated pest management (IPM) strategies.
6) **Longevity and Survival:** Adult Pulse Beetles have a relatively long lifespan, and they can survive for extended periods in storage facilities, allowing them to infest multiple batches of stored grains.

To manage the infestation and prevent damage caused by Pulse Beetles in stored grains, the following control measures are often employed:

1) **Sanitation and Hygiene:** Regular cleaning of storage facilities to remove debris, damaged grains and residues helps reduce the beetle's breeding sites.

2) **Temperature and Moisture Management:** Maintaining proper temperature and moisture levels in storage can help prevent insect development and reproduction.
3) **Fumigation:** Controlled application of fumigants in storage facilities can be effective in controlling Pulse Beetle populations. However, fumigants should be used with caution, following safety guidelines and regulations.
4) **Use of Insect-Resistant Packaging:** Using insect-resistant storage containers or bags can help prevent the entry of adult beetles and reduce infestations.
5) **Monitoring and Early Detection:** Regular monitoring of stored grains for signs of infestation allows for early detection and timely intervention.
6) **Natural Enemies:** Natural predators and parasitoids can provide biological control of Pulse Beetle populations and help suppress their numbers.

By implementing these management strategies, farmers and grain storage facilities can reduce losses caused by Pulse Beetles and maintain the quality of stored grains. Additionally, preventing infestations is essential for ensuring food security and preserving grain supplies for human and animal consumption.

b. Stored grains pest: Rice Weevil (*Sitophilus oryzae*)

The Rice Weevil (*Sitophilus oryzae*) is one of the most common and destructive pests of stored grain, particularly rice, but it can also infest other grains such as Wheat, Barley, Oats, and Corn. As a stored grain pest, the Rice Weevil plays the following roles:

1) **Infestation of Stored Grains:** Adult Rice Weevils lay their eggs inside the grain kernels, making small holes to deposit them. The developing larvae (grubs) feed on the internal contents of the grains, causing damage.
2) **Damage to Grains:** The feeding activity of the Rice Weevil larvae and adults inside the grains leads to a reduction in grain quality. They consume the endosperm, causing a loss of nutritional value and making the grains unfit for consumption.
3) **Spoilage of Grains:** As the Rice Weevil larvae feed and develop inside the grains, they produce frass (excrement) and secretions, leading to mold growth and contamination of the stored grains. This can further reduce the quality and market value of the grains.
4) **Reproduction and Population Growth:** The Rice Weevil has a rapid reproductive rate, and a single female can lay hundreds of eggs during her lifetime. This allows for quick population growth and widespread infestations in storage facilities.
5) **Resistance to Insecticides:** The Rice Weevil has developed resistance to many chemical insecticides commonly used for pest control. This makes managing infestations more challenging and necessitates the use of integrated pest management (IPM) strategies.
6) **Longevity and Survival**: Adult Rice Weevils have a relatively long lifespan and can survive for extended periods in storage facilities, even under adverse conditions, allowing them to persist and infest multiple batches of stored grains.

To manage infestations and prevent damage caused by Rice Weevils in stored grains, the following control measures are typically employed:

1) **Sanitation and Hygiene:** Regular cleaning of storage facilities to remove spilled grains, dust and debris helps reduce the weevils' breeding sites.

2) **Temperature and Moisture Management:** Maintaining proper temperature and moisture levels in storage can help prevent insect development and reproduction.
3) **Fumigation:** Controlled application of fumigants in storage facilities can be effective in controlling Rice Weevil populations. However, fumigants should be used with caution, following safety guidelines and regulations.
4) **Use of Insect-Resistant Packaging:** Using insect-resistant storage containers or bags can help prevent the entry of adult weevils and reduce infestations.
5) **Monitoring and Early Detection:** Regular monitoring of stored grains for signs of infestation allows for early detection and timely intervention.
6) **Natural Enemies:** Natural predators and parasitoids can provide biological control of Rice Weevil populations and help suppress their numbers.

By implementing these management strategies, farmers and grain storage facilities can minimize losses caused by Rice Weevils and preserve the quality of stored grains. Proper pest management practices are essential for ensuring food security and preventing economic losses due to stored grain pests.

c) Stored grains pest: *Helicoverpa armigera* (Cotton Bollworm):

Identifying Features:

Helicoverpa armigera, commonly known as the Cotton Bollworm or Corn Earworm, is a highly destructive pest that primarily targets agricultural crops, including Cotton, Corn, Soybeans and various other crops. While it is mainly recognized as a pest of field crops, it can also be a significant problem in stored grain facilities. Here's the role of Helicoverpa armigera as a stored grain pest:

1) **Infestation of stored grains:** After feeding on mature crops in the field, adult moths of Helicoverpa armigera can migrate to nearby storage facilities, where they lay eggs on stored grain products. The larvae, commonly known as bollworm or corn earworm caterpillars, hatch from these eggs and start feeding on the stored grains.
2) **Crop residue as breeding sites**: Leftover crop residues in storage areas can provide suitable breeding sites for the moths. The presence of crop debris allows the moths to continue their life cycle and lay eggs, leading to increased infestation levels in the stored grain.
3) **Economic losses:** Helicoverpa armigera infestations in stored grain can cause substantial economic losses. The larvae feed on the grain, contaminating it with their excreta and webbing, making it unsuitable for human consumption or lowering its market value.
4) **Quality degradation:** The feeding activity of H. armigera larvae damages the stored grains, leading to a decrease in grain quality. This can result in reduced nutritional value, germination capacity and potential fungal growth due to increased moisture levels from larval feeding and excreta.
5) **Cross-infestation:** Stored grain facilities in close proximity to infested fields are at a higher risk of infestation. Adult moths can easily move from the fields to the storage areas and lay eggs on stored grains, leading to cross-infestation.
6) **Pesticide resistance**: Helicoverpa armigera has a reputation for developing resistance to various insecticides, which can make control measures challenging. Pesticide resistance can further exacerbate the problem of managing infestations in stored grain facilities.
7) **Need for effective management:** To prevent or control infestations of Helicoverpa armigera in stored grains, it is essential to implement integrated pest management (IPM) strategies. These may include good hygiene practices, proper grain storage techniques, fumigation, monitoring with pheromone traps and if necessary, the use of insecticides (with consideration for resistance management).

iii) Identifying feature and economic importance of

- **a.** *Helicoverpa armigera* (Cotton bollworm)
- **b.** *Papilio demoleus* (Lime butterfly)
- **c.** *Pyrilla perpusilla* (Sugarcane plant hopper)
- **d.** *Callosobruchus chinensis* (Pulse beetle)
- **e.** *Sitophiluso ryzae* (Rice weevil) and
- **f.** *Tribolium castaneum* (Red flour beetle).

***a. Helicoverpa armigera* (Cotton bollworm)**

Helicoverpa armigera, the Cotton Bollworm, is a highly destructive pest with a broad host range and global distribution. Its feeding activities cause substantial damage to a wide range of crops, leading to economic losses, food safety concerns and challenges in pest management.

Identifying features of Helicoverpa armigera (Cotton Bollworm)

1) **Adult moths:** The adult Helicoverpa armigera moths have a wingspan of about 3-4 centimeters. They have a mottled appearance with various shades of brown and grey, often resembling camouflage patterns. The forewings typically have a dark spot or crescent-shaped mark near the center.
2) **Caterpillars:** The larvae (caterpillars) of Helicoverpa armigera are known as bollworms or corn earworms. They have a cylindrical body with distinct longitudinal stripes and a range of colors, including green, brown or pinkish, depending on their developmental stage and diet. The caterpillars have a characteristic black or brown head capsule.

Economic Importance of Helicoverpa armigera (Cotton Bollworm):

1) **Crop damage:** Helicoverpa armigera is a highly polyphagous pest, which means it feeds on a wide variety of host plants. It is a major threat to many economically important crops, including Cotton, Corn, Soybeans, Tomatoes, Sorghum and Chickpeas. The larvae feed on reproductive structures such as flower buds, flowers and developing fruits, causing significant yield losses.

2) **Global distribution:** Helicoverpa armigera has a wide distribution across different continents, including Africa, Asia, Europe and Australia. Due to its broad host range and rapid adaptability, it has become a globally significant agricultural pest.
3) **Insecticide resistance:** The bollworm has shown a remarkable ability to develop resistance to various classes of insecticides. This resistance presents a challenge for pest control efforts, as it reduces the effectiveness of chemical interventions.
4) **Quarantine risk:** The presence of Helicoverpa armigera in countries or regions where it is not native can lead to quarantine measures and restrictions on the export of agricultural commodities. Its introduction into new areas can result in devastating impacts on local crops and ecosystems.
5) **Food safety concerns:** The presence of bollworm larvae in harvested crops can lead to food safety concerns. Their feeding activities can introduce contaminants and promote the growth of molds and other microorganisms, making the affected produce unsuitable for human consumption or processing.
6) **Impact on farmers' livelihoods:** The economic losses caused by Helicoverpa armigera infestations can have a significant impact on farmers' livelihoods, leading to reduced income and increased production costs due to the need for pest management measures.
7) **Research focus:** Given the economic importance and widespread distribution of Helicoverpa armigera, it has become a subject of extensive research in entomology and pest management. Scientists and agricultural experts continuously work on developing effective control strategies, including biological control agents, cultural practices and integrated pest management approaches.

b. *Papilio demoleus* (Lime Butterfly):

Identifying Features:

Papilio demoleus, commonly known as the Lime Butterfly or Citrus Swallowtail, is a species of butterfly found in various parts of the world, including Asia, Africa and Australia. Here are some identifying features of Papilio demoleus:

a. **Appearance:** The adult Lime Butterfly has a wingspan ranging from 7 to 9 centimeters. The upper side of the wings is predominantly yellow with black markings and veins. The forewings have a black apex, while the hind wings display a black marginal band. The undersides of the wings are pale yellow with intricate green and black patterns.
b. **Mimicry:** Papilio demoleus exhibits a remarkable form of mimicry known as Müllerian mimicry. It closely resembles other distasteful or toxic butterfly species, such as the Common Mormon (Papilio polytes) and the Common Rose (Pachliopta aristolochiae), which share similar coloration and patterns. This mimicry helps deter predators by associating the Lime Butterfly with unpalatable or harmful prey.
c. **Host Plants:** The larvae (caterpillars) of Papilio demoleus feed on plants belonging to the Rutaceae family, including citrus trees such as Lime, Lemon, Orange and other related species.

Economic Importance:

The Lime Butterfly (Papilio demoleus) has both positive and negative economic implications. Here are some key points regarding its economic importance:

a. **Pollination:** As a pollinator, the Lime Butterfly plays a role in the reproduction of various plant species, including flowering plants in the Rutaceae family. By transferring pollen from male to female flowers, it contributes to fruit set and seed production.
b. **Pest of Citrus Crops:** While Papilio demoleus can act as a pollinator for citrus trees, its larvae are considered pests of citrus crops. The caterpillars feed on the leaves of citrus trees, which can lead to defoliation and reduced photosynthetic activity. Severe infestations can cause significant damage to citrus orchards and affect fruit production.
c. **Disease Transmission:** The Lime Butterfly has been known to act as a vector for certain plant diseases, particularly citrus greening disease or Huanglongbing (HLB). HLB is a

devastating bacterial disease that affects citrus trees, leading to reduced yields, poor fruit quality, and eventual decline and death of the trees. The Lime Butterfly can transmit the bacteria responsible for HLB from infected trees to healthy ones.

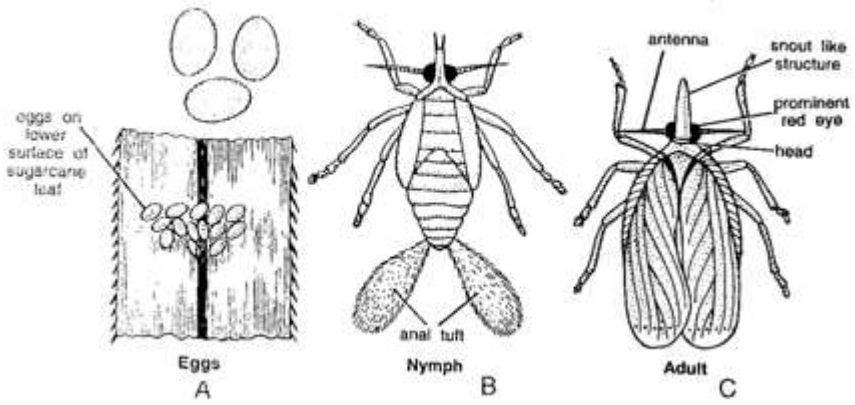
d. **Ecotourism and Education:** The attractive appearance of the Lime Butterfly, along with its mimicry and ecological interactions, makes it a subject of interest for ecotourism, nature enthusiasts and educational purposes. Observing and learning about the Lime Butterfly's life cycle, mimicry and ecological role can promote awareness and appreciation of butterflies and their habitats.

It's important to note that while Papilio demoleus can cause damage to citrus crops, the overall impact of this butterfly species on agricultural systems may vary depending on the specific geographic region, prevailing pest management practices and the presence of natural enemies that help regulate its population. Integrated pest management approaches, including cultural practices, biological control and targeted insecticide use are implemented to manage *Papilio demoleus* populations and minimize its negative impact on citrus production.

c. *Pyrilla perpusilla* (Sugarcane Plant Hopper):

Identifying Features:

Pyrilla perpusilla, commonly known as the Sugarcane Plant Hopper, is an insect pest that specifically affects sugarcane crops.



Identifying features of *Pyrilla perpusilla*:

- **a. Appearance:** The adult *Pyrilla perpusilla* is a small insect, measuring around 5-6 millimeters in length. It has a slender body with a whitish to yellowish coloration. The wings are transparent and have distinctive veins, giving them a lace-like appearance. The nymphs (immature stages) resemble the adults but lack fully developed wings.
- **b. Wing Position**: When at rest, *Pyrilla perpusilla* holds its wings in a tent-like manner over its body, forming a distinctive roof-like structure.
- **c. Mobility:** *Pyrilla perpusilla* possesses strong jumping abilities due to its powerful hind legs, which allow it to quickly move between plants and evade threats.
- **d. Feeding Behavior:** The Sugarcane Plant Hopper feeds by sucking sap from the sugarcane plant's vascular tissues. This feeding behavior can lead to significant damage and yield losses in sugarcane crops.

Economic Importance:

Pyrilla perpusilla, the Sugarcane Plant Hopper, holds significant economic importance due to its impact on sugarcane production.

- **a. Damage to Sugarcane Crops:** *Pyrilla perpusilla* infestations can cause substantial damage to sugarcane crops. The insect's feeding activities result in the removal of sap from the plant, leading to the wilting and drying of leaves, stunted growth, reduced photosynthetic activity and ultimately reduced yields.
- **b. Sugarcane Quality:** Besides yield losses, infestations of *Pyrilla perpusilla* can also affect the quality of sugarcane. The insect's feeding can result in the accumulation of

honeydew, a sticky substance excreted by the insect, on the sugarcane stalks. This sticky residue can serve as a medium for the growth of fungi, including the sooty mold, which further reduces the market value and quality of the sugarcane.

c. **Spread of Diseases:** *Pyrilla perpusilla* can act as a vector for sugarcane diseases, including the transmission of the sugarcane grassy shoot disease. This disease can cause significant damage to sugarcane crops and further impact productivity and quality.

d. **Control Measures:** The management of *Pyrilla perpusilla* requires the implementation of integrated pest management (IPM) strategies. These strategies may include cultural practices, such as the use of resistant varieties, timely planting, and proper sanitation. Additionally, biological control agents, such as natural enemies (predators and parasitoids), and targeted insecticide applications are employed to suppress the population of *Pyrilla perpusilla* and reduce crop damage.

Efficient monitoring and timely control measures are crucial to minimizing the economic losses caused by *Pyrilla perpusilla* infestations. Regular surveillance, prompt detection and the implementation of appropriate management practices are essential for maintaining the productivity and quality of sugarcane crops.

d. *Callosobruchus chinensis* (Pulse Beetle):

Identifying Features:

Callosobruchus chinensis, commonly known as the Pulse Beetle or Adzuki Bean Beetle, is an insect pest that primarily infests pulses and legume crops. Here are some identifying features of *Callosobruchus chinensis*:

a. **Appearance:** The adult *Callosobruchus chinensis* is a small beetle, measuring about 2-3 millimeters in length. The body is usually dark brown or black, elongated, and covered in fine hairs. It has a cylindrical shape with a rounded head and prominent antennae.
b. **Elytra:** The wing covers, known as elytra, are hardened and protective in nature. In *Callosobruchus chinensis*, the elytra are usually dark in color and cover the membranous hind wings.
c. **Abdominal Segments:** The abdomen of *Callosobruchus chinensis* consists of overlapping segments, giving it a segmented appearance. The segments may display slight variations in coloration.
d. **Antennae:** The antennae of *Callosobruchus chinensis* are long and slender, consisting of multiple segments. They are used for sensory perception and detection of food sources.

Economic Importance:

Callosobruchus chinensis, the Pulse Beetle, has significant economic importance due to its impact on stored pulse and legume crops.

a. **Damage to Stored Pulses:** *Callosobruchus chinensis* larvae infest and feed on stored pulses, such as beans, lentils, peas and chickpeas. Female beetles lay eggs on the surface of pulses and the hatched larvae tunnel into the seeds, consuming the nutritious contents. This feeding activity results in damaged and hollowed-out seeds, rendering them unsuitable for consumption and reducing their market value.
b. **Losses in Quality and Quantity:** Infestations of *Callosobruchus chinensis* can lead to significant losses in the quality and quantity of stored pulses. The presence

of damaged seeds affects the taste, texture and appearance of the pulses, making them less appealing to consumers. Additionally, the loss of viable seeds due to larval feeding reduces the overall yield and economic returns for farmers and traders.

c. **Rapid Reproduction and Spread:** *Callosobruchus chinensis* has a rapid reproductive cycle, with females capable of laying multiple eggs on different pulses. The beetles are also capable of flight, facilitating their dispersal and spread to new storage areas. These factors contribute to the quick buildup of infestations and the potential for widespread damage in pulse storage facilities.

d. **Control Measures**: Effective control of *Callosobruchus chinensis* infestations involves a combination of preventive and curative measures. Preemptive actions include proper storage practices, such as cleaning and drying pulses before storage, maintaining proper moisture levels and using airtight containers or insect-proof storage facilities. Curative measures may involve the use of fumigants, insecticides or physical methods like heat treatment to control existing infestations.

Proper storage hygiene, monitoring for early signs of infestation, and timely implementation of control measures are vital for minimizing the economic losses caused by *Callosobruchus chinensis* infestations. By protecting stored pulse crops from infestation, farmers and traders can preserve the quality, quantity and market value of their produce.

e. *Sitophilus oryzae* (Rice Weevil):

Identifying Features:

Sitophilus oryzae, commonly known as the Rice Weevil, is a common pest that infests stored grains, including rice, wheat, barley, oats and other cereal crops. Here are some identifying features of *Sitophilus oryzae*


a. **Size:** Adult Rice Weevils are relatively small beetles, measuring approximately 2 to 3.5 millimeters in length. The body is elongated, cylindrical and usually reddish-brown or black in color.
b. **Head and Snout:** *Sitophilus oryzae* has a distinct elongated snout or proboscis projecting from the front of its head. The snout is used for piercing grains and laying eggs.
c. **Antennae:** The Rice Weevil has bent or elbowed antennae that arise from the base of its snout. The antennae have a segmented structure and are used for sensory perception.
d. **Elytra:** The wing covers, known as elytra are hardened and protective in nature. They extend the full length of the abdomen and typically have distinct longitudinal ridges or grooves.

Economic Importance:

Sitophilus oryzae, the Rice Weevil, has significant economic importance due to its impact on stored grain crops. Here are some key points regarding its economic importance:

a. **Damage to Stored Grains:** Rice Weevils infest and feed on a wide range of stored grains. The adult weevils pierce the grains using their snout and lay eggs inside. The hatched larvae then feed on the grains, consuming their starchy contents. This feeding activity can result in damaged and hollowed grains, rendering them unfit for consumption and reducing their market value.
b. **Quantity and Quality Losses:** Infestations of *Sitophilus oryzae* can lead to significant losses in the quantity and quality of stored grains. The presence of damaged grains affects their weight, volume, and nutritional value. Additionally, the reduced germination capacity of infested grains can impact seed quality and agricultural productivity.
c. **Rapid Reproduction and Spread:** Rice Weevils have a relatively short life cycle, allowing for multiple generations within a single year. Female weevils can lay hundreds

of eggs in their lifetime. This rapid reproduction, coupled with the ability to fly and disperse, enables the weevils to quickly spread within storage facilities and infest large quantities of grains.

d. Control Measures: Effective control of *Sitophilus oryzae* infestations involves a combination of preventive and curative measures. Preventive actions include proper storage practices, such as cleaning and drying grains before storage, maintaining proper moisture levels, and using airtight containers or insect-proof storage facilities. Curative measures may involve the use of fumigants, insecticides, or physical methods like heat treatment to control existing infestations.

Proper grain storage management, regular monitoring for signs of infestation and prompt implementation of control measures are crucial for minimizing the economic losses caused by *Sitophilus oryzae* infestations. By protecting stored grain crops from infestation, farmers, grain handlers, and consumers can maintain the quality, quantity and market value of their products.

f. *Tribolium castaneum* (Red Flour Beetle):

Identifying Features:

Tribolium castaneum, commonly known as the Red Flour Beetle, is a common pest that infests stored grain products, including flour, cereal, grains and various processed food products. Here are some identifying features of *Tribolium castaneum*:

a. **Size:** Adult Red Flour Beetles are small insects, measuring approximately 3 to 4 millimeters in length. The body is elongated and flattened, with a reddish-brown or dark brown coloration.
b. **Body Shape:** *Tribolium castaneum* has an oval-shaped body with distinct ridges along the wing covers (elytra). The elytra cover the abdomen and meet in a straight line down the middle of the back.
c. **Antennae:** The Red Flour Beetle has segmented antennae that arise from the front of its head. The antennae are slender and clubbed at the tips, giving them a distinct shape.
d. **Wings:** Although they possess wings, Red Flour Beetles are poor fliers. The wings are membranous and located underneath the elytra. However, the beetles primarily rely on crawling for movement.

Economic Importance:

Tribolium castaneum, the Red Flour Beetle, has significant economic importance due to its impact on stored grain products and processed food. Here are some key points regarding its economic importance:

a. **Damage to Stored Food Products:** Red Flour Beetles infest and feed on a wide range of stored grain products, including flour, meal, cereal and other processed food items. They can penetrate packaging materials and contaminate the products, resulting in quality degradation, off-flavors, and off-odors. Infested products may also become unappetizing and unsuitable for human consumption, leading to economic losses for food manufacturers and retailers.

b. **Product Contamination:** *Tribolium castaneum* beetles and their larvae can contaminate stored food products with their feces, body parts, and cast skins. This contamination poses a health risk, as it can introduce pathogens, bacteria and allergens into the food, potentially leading to food borne illnesses and product recalls.
c. **Rapid Reproduction:** Red Flour Beetles have a rapid reproductive cycle, with females capable of laying hundreds of eggs in their lifetime. The eggs are laid in food products, and the hatched larvae feed on the products, further increasing the damage and potential for infestation spread. This reproductive capability allows for quick population growth and infestation development in storage facilities.
d. **Resistance to Control Measures:** *Tribolium castaneum* has demonstrated the ability to develop resistance to various insecticides used for control. This resistance poses challenges for effective pest management and necessitates Integrated Pest Management (IPM) strategies, including the use of multiple control methods and regular monitoring for resistance.

Effective management of *Tribolium castaneum* infestations involves a combination of preventive measures and control techniques. This includes maintaining proper sanitation, implementing good storage practices, employing physical controls (such as heat treatment and freezing), and utilizing insecticidal treatments when necessary. By implementing robust pest management practices, food producers can minimize the economic losses caused by Red Flour Beetle infestations and ensure the quality and safety of their products.

PRACTICAL II

UNIT III: APPLIED ZOOLOGY

POULTRY: TO STUDY THE BREEDS OF POULTRY BIRDS WITH THE HELP OF PHOTOGRAPHS

(2 INDIGENOUS AND 2 EXOTIC POULTRY BIRDS)

Poultry farming refers to the practice of raising domesticated birds, primarily chickens, ducks, turkeys and geese for the purpose of producing eggs and meat for human consumption. Poultry farming is a common and essential agricultural activity worldwide due to the high demand for poultry products, which are a significant source of animal protein in many diets.

Here are some key aspects of poultry farming:

1. **Types of Poultry:** The most common types of poultry raised for commercial farming are Chickens (broilers and layers), Ducks, Turkeys and Geese. Each type of poultry serves different purposes and has specific management requirements.
2. **Broilers:** Broilers are chickens raised for meat production. They are reared in controlled environments, such as broiler houses and are typically ready for slaughter within a short period (around 6 to 8 weeks) due to their fast growth rate.
3. **Layers:** Layer chickens are raised for egg production. They are kept in layer houses, and with proper management, they can produce eggs consistently for several months to a couple of years, depending on the breed and quality of care.
4. **Free-range vs. Intensive Systems**: Poultry farming can be done using different systems, including free-range and intensive systems. In free-range systems, birds have access to outdoor areas to roam and forage, while in intensive systems, they are confined to indoor facilities with controlled environments.
5. **Feed and Nutrition:** Proper nutrition is crucial for poultry health and productivity. Poultry feed usually consists of a balanced mix of grains, protein sources, vitamins, and minerals. Commercially prepared feed is commonly used to meet the birds' specific nutritional requirements at different stages of growth.
6. **Health and Disease Management**: Poultry farmers need to pay close attention to the health of their birds. Preventive measures, such as vaccination, Biosecurity protocols, and regular health checks, help minimize the risk of diseases and ensure the overall well-being of the flock.
7. **Housing and Management:** Poultry houses should provide a safe and comfortable environment for the birds. Factors like Temperature Control, Proper Ventilation, Lighting and Litter Management are critical for successful poultry farming.

8. **Egg Production:** For egg production, farmers often use nesting boxes or slanted platforms for hens to lay their eggs comfortably. Eggs are collected daily to maintain cleanliness and reduce the risk of egg breakage.
9. **Slaughter and Processing:** When poultry reaches the desired market weight (in the case of broilers) or the end of their productive egg-laying phase (in the case of layers), they are slaughtered and processed for meat or egg distribution to consumers.

Poultry farming is an economically viable venture that plays a significant role in global food production. However, like any agricultural practice, it requires careful management and attention to ensure animal welfare, product quality, and sustainable production practices.

BREEDS OF POULTRY BIRDS

India is home to a variety of indigenous and exotic poultry bird breeds. These breeds differ in their characteristics, adaptability and purposes, reflecting the rich diversity of poultry farming practices in the country.

INDIGENOUS POULTRY BIRDS:

1. **Kadaknath:** Kadaknath is an indigenous breed from Madhya Pradesh, known for its distinctive black plumage and flesh. The meat is considered to have high nutritional value and is sought after for its taste and medicinal properties.

2. **Aseel:** Aseel, also known as the fighting cock, is a robust indigenous breed from Punjab and Andhra Pradesh. These birds are primarily used for cockfighting but are also valued for their meat.

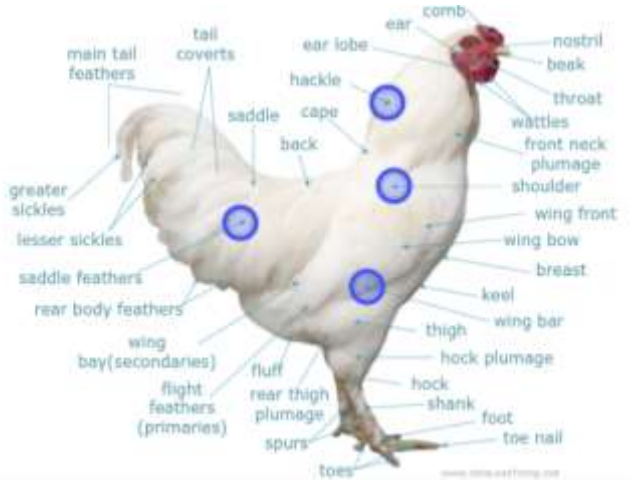
3. **Giriraja:** Giriraja is an indigenous dual-purpose breed known for its high egg production and decent meat quality. They are hardy birds, well-suited to Indian climatic conditions.

4. **Gramapriya:** Gramapriya is a crossbred indigenous bird developed by the Project Directorate on Poultry (ICAR). It is known for its excellent egg-laying capabilities, making it popular among small-scale farmers.

5. **Nicobari:** Nicobari is a native breed from the Andaman and Nicobar Islands, known for its adaptability to the tropical island climate and good egg-laying performance.

EXOTIC POULTRY BIRDS:

1. **White Leghorn:** White Leghorn is an exotic breed known for its exceptional egg-laying ability. It is popular in commercial egg production due to its high egg yield and feed efficiency.



2. Rhode Island Red (RIR): RIR is an American breed widely raised in India for its dual-purpose characteristics—good egg production and quality meat.

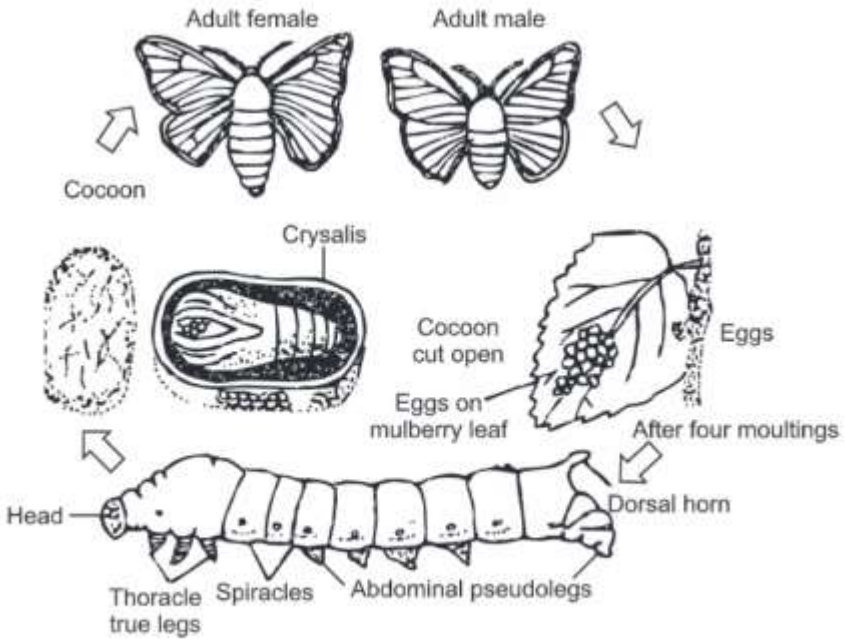
3. Cornish Cross: Cornish Cross is a fast-growing broiler breed known for its efficient feed conversion and quick attainment of market weight. It is commonly used in commercial broiler production.

4. Plymouth Rock: Plymouth Rock is an American dual-purpose breed, known for its good egg-laying capacity and meat quality.

5. Sussex: Sussex is an English breed well-adapted to Indian conditions. It is raised for both eggs and meat.

It's important to note that some breeds may have regional variations and might be known by different names in different parts of the country. Indigenous poultry breeds are valued for their hardiness, disease resistance, and adaptation to local conditions, making them suitable for backyard and small-scale farming. Exotic breeds, on the other hand, are chosen for specific traits like high egg production or fast growth, making them suitable for large-scale commercial farming operations. Both indigenous and exotic poultry birds contribute to India's poultry industry and provide a range of options for farmers with different objectives and resources.

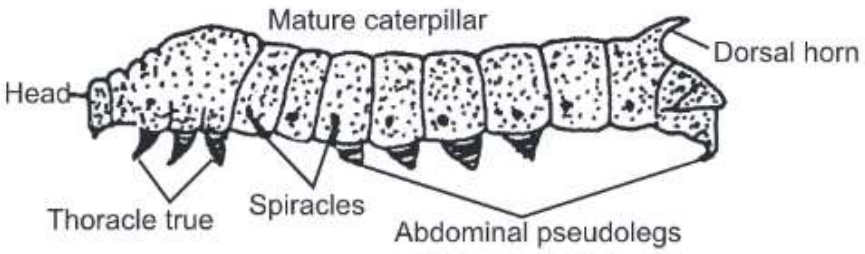
LIFE CYCLE OF MULBERRY SILK MOTH (*BOMBYX MORI*)



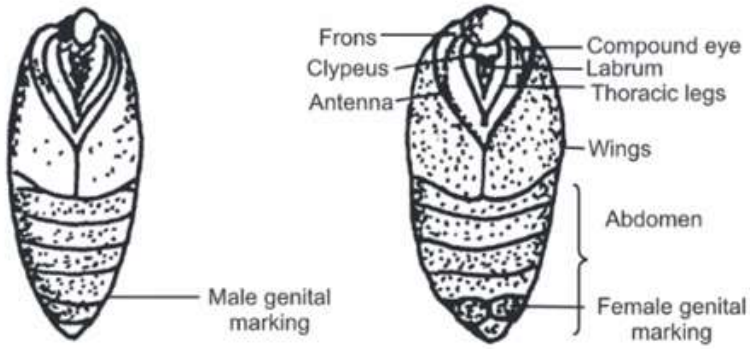
LIFE CYCLE OF SILK MOTH - BOMBAX MORI

The life cycle of a mulberry silk moth, also known as Bombyx mori, consists of four stages: egg, larva (caterpillar), pupa and adult.

1. **Egg:** The life cycle begins with the female silk moth laying eggs. Female silk moths have a short lifespan of about 4-6 days, during which they can lay around 300-500 eggs. The eggs are tiny, cylindrical in shape and usually laid in clusters on the leaves of the mulberry tree, which is the primary food source for silk moth larvae.
2. **Larva (Caterpillar):** After about 9-12 days, the eggs hatch, and the larval stage begins. The newly hatched larvae, known as silkworms, are tiny and black in color. They start feeding voraciously on the leaves of the mulberry tree. Silkworms undergo several molting stages, shedding their skin to grow larger. With each molt, they change color and become lighter. The larval stage lasts for approximately 4-6 weeks, during which silkworms increase in size significantly.

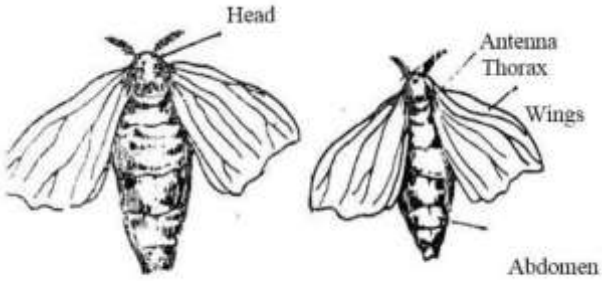


3. **Pupa:** When silkworms reach their full size, they stop eating and seek a suitable place to spin their cocoon. They secrete a sticky fluid from their salivary glands, which hardens upon contact with air and forms silk threads. The silkworm spins the silk threads in a continuous figure-eight pattern and forms a cocoon around itself. Inside the cocoon, the silkworm undergoes metamorphosis and transforms into a pupa. The pupal stage lasts for around 10-14 days.



A-MALE PUPA **B- FEMALE PUPA**

4. **Adult:** Once the pupa has completed its metamorphosis, an adult silk moth emerges from the cocoon. The adult silk moth has a plump body, large wings and is usually white or creamy-white in color. However, the adult moths are incapable of flight and have reduced mouthparts, which mean they do not eat in their adult stage. Their sole purpose is to mate and reproduce. Adult silk moths have a very short lifespan of only 3-5 days, during which they find a mate, mate, and lay eggs to start the cycle again.



Female moth Male moth

It is worth noting that in silk production, the pupae are typically killed before they can emerge as adult moths to preserve the thread of the cocoon. This ensures the thread remains intact and can be harvested as silk.

TYPES OF SILK MOTHS – MUGA, TASAR AND ERI BY PHOTOGRAPHS OR SPECIMEN

SILK MOTHS – MUGA

Muga silkworm (*Antheraea assamensis*) is a variety of silk-producing silkworm found mainly in the northeastern region of India, particularly in the state of Assam. Here are some of the characteristics of muga silkworms**:**

1. **Size:** The adult Muga silkworm is relatively large compared to other common silkworm species. The female moths are generally larger than the male moths.
2. **Body Color:** The adult Muga silkworm has a characteristic golden-yellow or coppery-brown coloration, which distinguishes it from other silkworms.
3. **Wingspan:** The wingspan of the adult Muga silkworm can vary but is generally around 10-12 centimeters for females and slightly smaller for males.
4. **Antennae:** The Muga silkworm's antennae are prominent and typically have a feathery appearance in male moths, while they are less feathery in females.
5. **Body Structure:** The adult Muga silkworm has a robust and sturdy body structure, adapted to support its relatively larger size and to endure the challenges of its natural environment.
6. **Larvae:** The larvae or caterpillars of the Muga silkworm have distinct color patterns and markings. They exhibit various stages of growth called instars and their coloration changes as they progress through these stages.
7. **Cocoons:** The Muga silkworm constructs its cocoon with silk threads, which is unique for its golden-yellow color and fine texture.
8. **Cocoon Shape:** The shape of the Muga silkworm cocoon is typically oval and elongated.
9. **Host Plant Selection:** Muga silkworms are highly selective in choosing their host plants. They primarily feed on Som (*Persea bombycina*) and Soalu (*Litsea monopetala*) leaves, which contribute to the quality and characteristics of the Muga silk.

SILK MOTHS – TASAR

The Tasar silk moth (*Antheraea mylitta*): Also known as the Tussah silk moth; exhibits several distinct morphological features. These characteristics are essential for identifying the species and understanding its life cycle. Below are some key morphological features of the Tasar silk moth:

1. **Size:** The adult Tasar silk moth is relatively large, with a wingspan of around 10 to 12 centimeters in females and slightly smaller in males.
2. **Body Color:** The adult Tasar silk moth typically has a golden-yellow or coppery-brown coloration. This characteristic color sets it apart from other silk moth species.
3. **Wings:** The wings of the Tasar silk moth are relatively broad and triangular in shape. The forewings and hind wings are usually marked with darker bands and patterns.
4. **Antennae:** The Tasar silk moth has prominent, feathery antennae that are more pronounced in males than in females.
5. **Abdomen:** The abdomen of the Tasar silk moth is relatively large and robust, particularly in females.
6. **Legs**: Like all insects, the Tasar silk moth has six legs that are used for walking and other locomotive activities.
7. **Cocoon:** The silk spun by the Tasar silk caterpillar to form its cocoon is usually coarse and darker in color compared to the silk produced by mulberry silkworms. The cocoon is oval-shaped and can be harvested for silk extraction.
8. **Caterpillar:** The larval stage of the Tasar silk moth, known as the caterpillar, has a cylindrical body with segments. The caterpillar has a characteristic appearance with distinct color patterns and markings.
9. **Host Plants:** The caterpillars of Tasar silk moths feed on various wild trees, such as Sal (Shorea robusta), Arjun (Terminalia arjuna) and Asan (Terminalia tomentosa), among others. These host plants play a crucial role in the quality and characteristics of the silk produced.

The Tasar silk moth is an economically significant species and its silk production is an essential cottage industry in some parts of India and other Southeast Asian countries. Tasar silk is valued for its unique golden-brown color, strength and durability, making it suitable for a variety of textile applications. The moth's ecological adaptability and its utilization of a wide range of host plants contribute to its survival and the sustainability of Tasar silk production.

SILK MOTHS – ERI

The morphology of the Eri silk moth (*Samia ricini*) includes various physical characteristics that are specific to this species of silk-producing moth. Below are some of the key morphological features of the Eri silk moth:

1. **Size:** The adult Eri silk moth is relatively large compared to some other silk moth species. The wingspan of the female moth can be around 10-12 centimeters, while the male moth is slightly smaller.
2. **Body Color:** The adult Eri silk moth has a creamy white to pale yellowish body color with some black spots and markings on its wings.
3. **Wings:** The wings of the Eri silk moth are quite large and broad, covering the entire body when folded. The forewings have distinctive dark brown or black spots and bands, while the hind wings are mostly pale and semi-transparent.
4. **Antennae:** The Eri silk moth has prominent feathery or plumose antennae, which are more developed in males compared to females.
5. **Legs:** Like all insects, the Eri silk moth has six legs that are used for walking and gripping surfaces.

6. **Abdomen:** The abdomen of the Eri silk moth is relatively large and round, especially in the female moths.
7. **Ovipositor:** Female Eri silk moths have a long and slender ovipositor at the end of their abdomen. The ovipositor is used for laying eggs in suitable locations, such as on host plant leaves.
8. **Cocoon:** The silk spun by the Eri silk caterpillars to form their cocoons is usually yellowish or light brown. The cocoons are open-mouthed, allowing the adult moth to emerge naturally after completing its metamorphosis.
9. **Caterpillar**: The larval stage of the Eri silk moth, known as the caterpillar, has a characteristic cylindrical body covered in soft hairs. The caterpillars may have color variations ranging from green to brown, depending on their developmental stage and food source.
10. **Feeding Habits**: The caterpillars of Eri silk moths are voracious eaters and primarily feed on various plants, including castor leaves, Kesseru, and Som, among others.

Eri silk moths are known for their peaceful and non-destructive silk production process. The open-mouthed cocoons allow the pupae to escape and complete their life cycle without being harmed during silk extraction. This ethical and eco-friendly silk production method has made Eri silk popular among environmentally conscious consumers and has contributed to the rise in demand for Eri silk products in the market.

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