



Ministry of Higher Education
and Scientific Research
University of Baghdad
College of Science
Department of Biology

Practical Comparative Anatomy 2021-2022

المرحلة الرابعة - الدراساتين الصباحية والمسائية

الفصل الدراسي الثاني

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Lab1:Classification of chordate:

Phylum Chordate includes **53000** species of animals, they all characterized by:

- 1- Dorsal hollow nerve cord.
- 2- They Contain notochord.
- 3- Pharyngeal gill pouch and gill slits.
- 4- endostyle
- 5- postanal tail

Classification of Phylum: chordate

A. Protochordata (Acraniata)

1- Subphylum: Hemichordata

Ex: *Dolichoglossus kawalveskii*

2- Subphylum: Urochordata

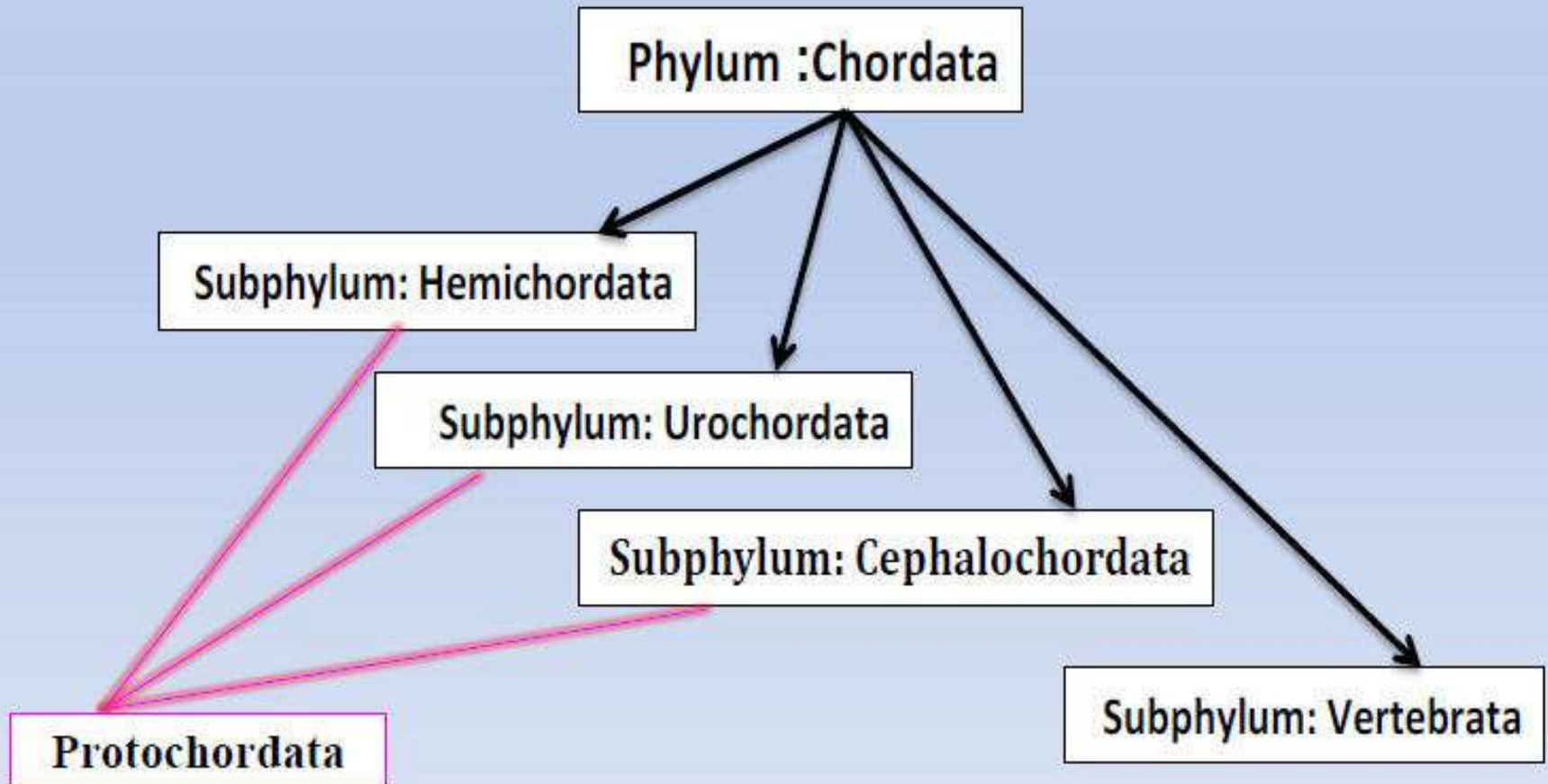
Ex: *Molgula*

3- Subphylum: Cephalochordata

Ex: *Branchiostoma lanceolatum*

B. Vertebrata (Craniata).

Classification of Chordates



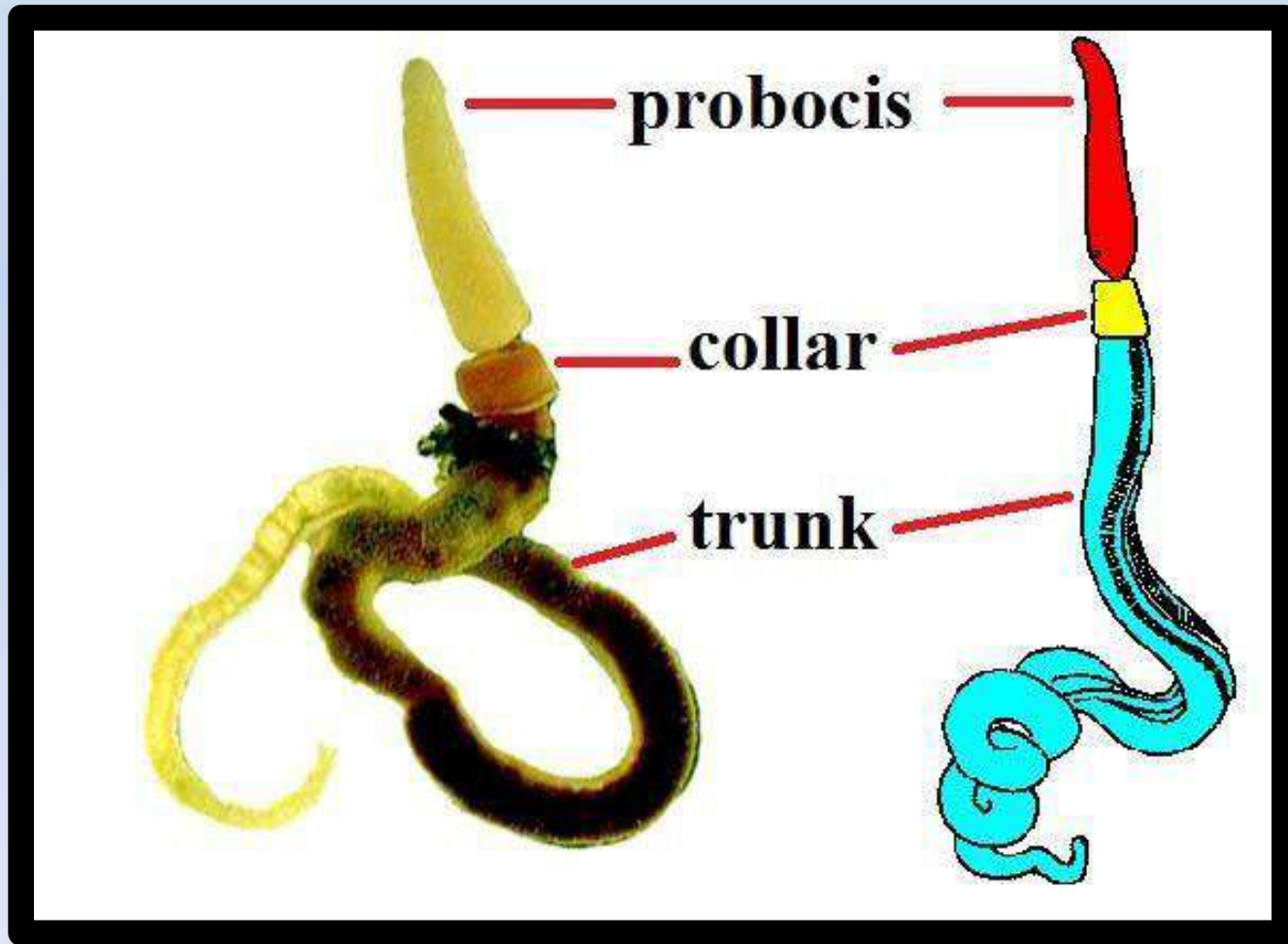
General characteristics of protochordata

- Exclusively marine.
- Relatively small sized animalsCranium or brain box, jaws, vertebral column and paired appendages are absent.
- Dorsal tubular nerve cord, gill slits and notochord are usually present.
- Sexes may be separate or united.
- Solitary, colonial, free living, pelagic, burrowing or tube like living forms

Phylum: chordate Protochordata (Acraniata)

Subphylum: Hemichordata

Ex: *Dolichoglossus kawalveskii*



General Characteristics of hemichordates

- The name Hemichordata refers to the presence of a short notochord, reduced to half the size (hemi – half; chorde – cord). This structure is present in the anterior region of the animal, the proboscis
- Exclusively marine and soft-bodied forms
- Body is divisible into proboscis, collar and trunk
- Numerous paired gill slits are present.
- Fertilization is external.

Phylum: Chordate Protochordata (Acraniata)

Subphylum: Urochordata

Ex: *Molgula manhatensis*



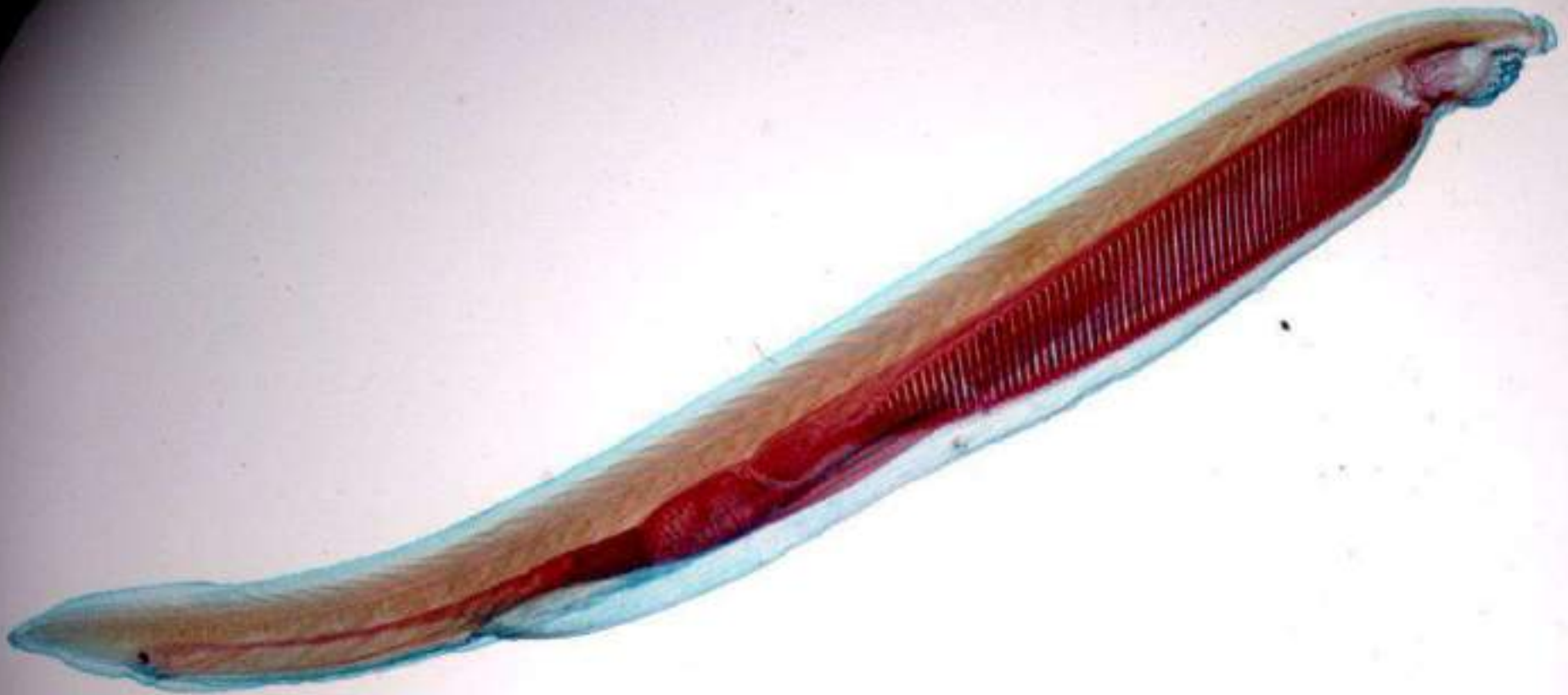
General characteristics of Urochordata

- Urochordata is the term used to refer to the presence of a notochord in the tail region.
- The notochord is restricted to the tail region of the larval forms of urochordates and is absent in the adults.
- Tunicata is the other name of this subphylum Urochordata, due to the presence of an outer leathery covering called tunic or test in the adult. Exclusively marine and commonly known as sea squirts.
- Solitary or colonial. Body is covered by a cuticular tunic or test in adult stage.
- Dorsal tubular nerve cord is present in the larval forms while degenerates in the form of small ganglion in adults. A numerous gill slits are present.
- Sexes are united that is hermaphrodite. Heart is ventral, simple and tubular.

Phylum: chordate Protochordata (Acraniata)

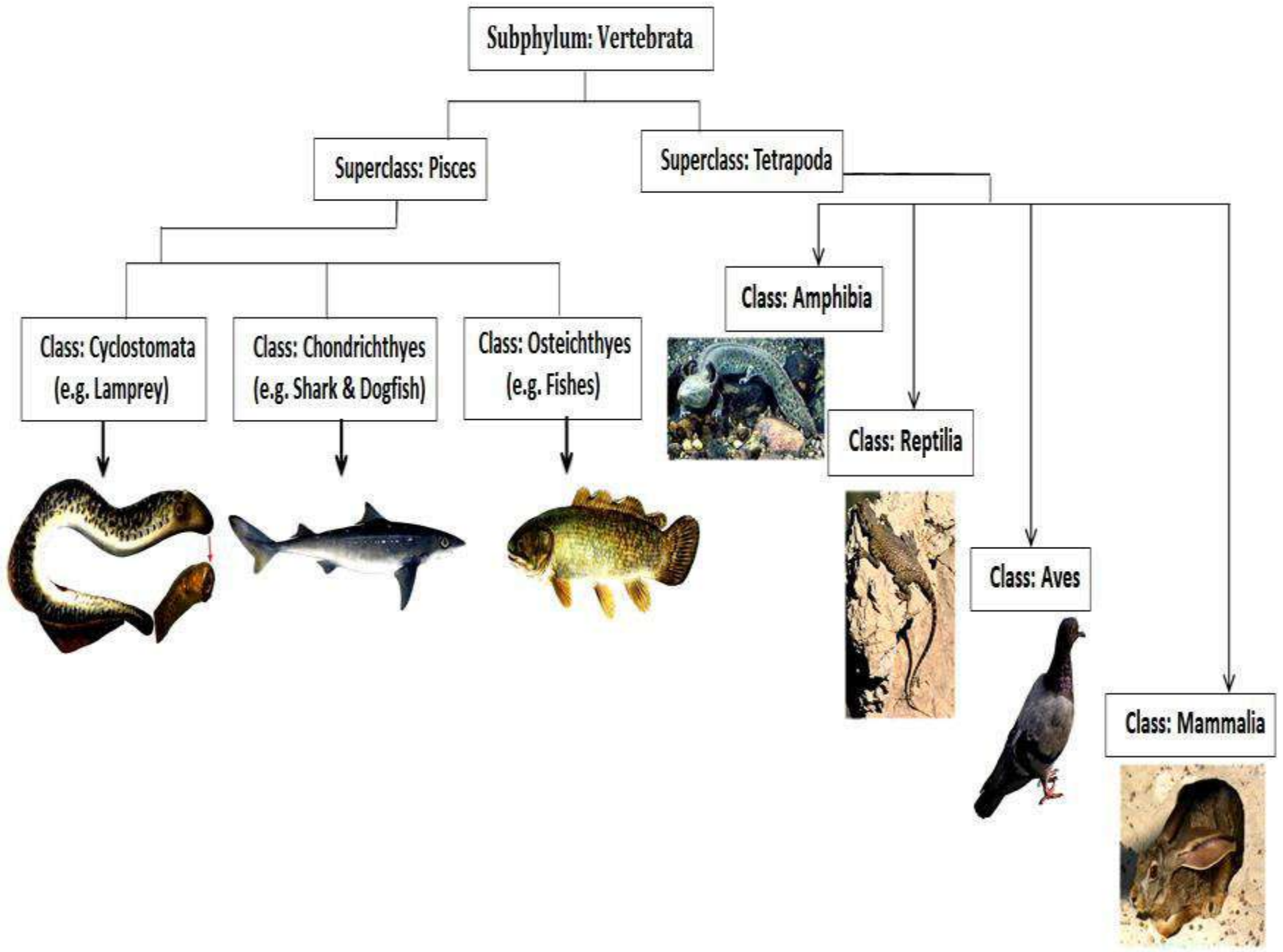
Subphylum: Cephalochordata

Ex: *Branchiostoma lanceolatum*



General characteristics

- The term Cephalochordata refers to the notochord that extends the entire length of the body up to the head region (cephalon – head; chorde – cord).
- The notochord lies on the mid dorsal region just above the alimentary canal and below the nerve cord.
- Exclusively marine and solitary forms
- Notochord and nerve cord extend the entire length of the body.
- Notochord, nerve cord and pharyngeal gill slits remain throughout life of the animal.
- Limbs or paired fins are absent.
- No distinct head but tail present; mouth surrounded by tentacles
- Exoskeleton, head, brain, auditory organs and jaws are absent.
- Sexes are separate.



4. Subphylum: Vertebrata

Superclass: pisces

1 Class: Cyclostomata

Ex: Petromyzon marinus

2 Class: Chondrichthyes

Ex : Squalus acanthias

3 Class : Osteochthyes

Super order : Holostei

Ex: Amia calva

Super order : Telostei

Ex: Hippocampus kuda

Subphylum: Vertebrata

Superclass: Pisces

Superclass: Tetrapoda

**Class: Cyclostomata
(e.g. Lamprey)**

**Class: Chondrichthyes
(e.g. Shark & Dogfish)**

**Class: Osteichthyes
(e.g. Fishes)**



Characteristics of Pisces

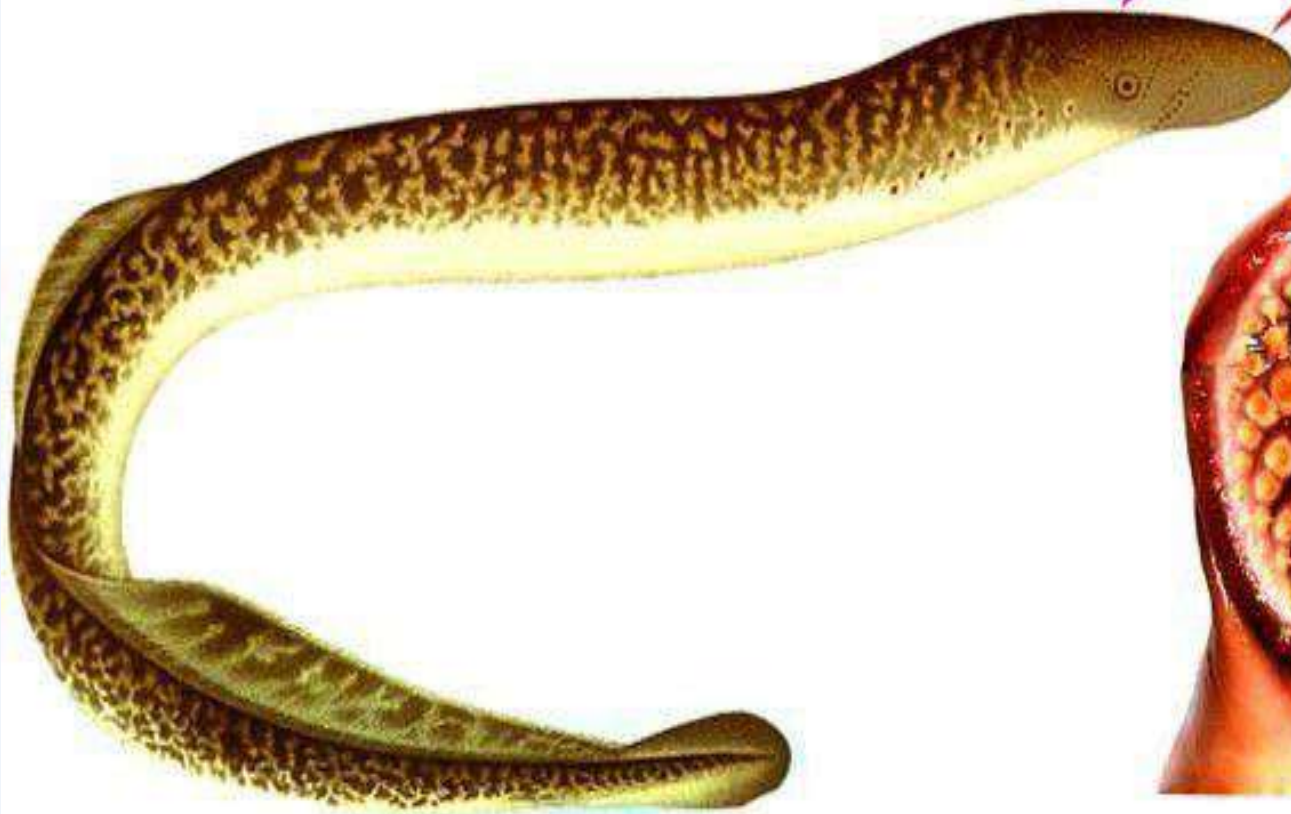
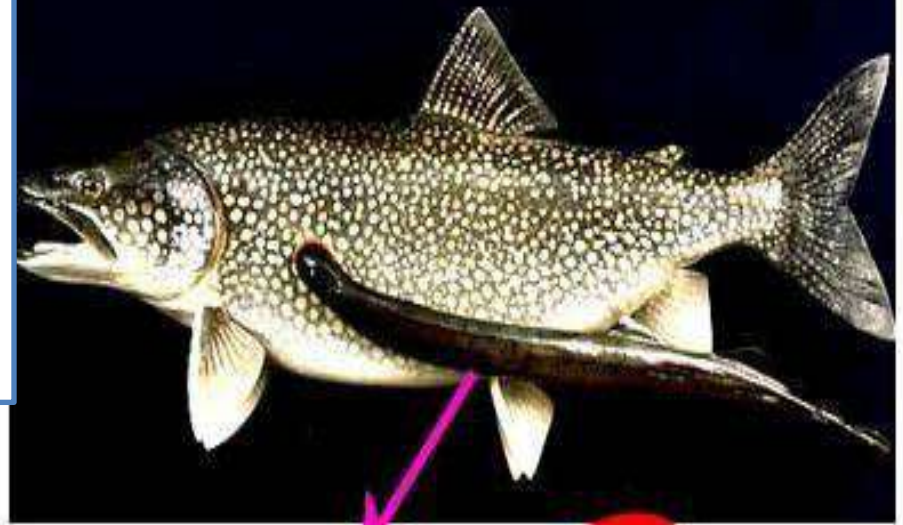
- they are found in fresh, marine, and brackish water.
- The body is usually streamlined. Some have a spindle-shaped or elongated body as well.
- They swim with the help of their tail.
- Paired and unpaired fins represent the appendages. These help the fish to balance while swimming.
- The lateral line system acts as a sensory organ to sense the disturbances in the nearby environment.
- The body is covered with dermal scales which provides protection to them.
- The gills help in respiration.
- The internal skeleton is bony or cartilaginous.
- These are cold-blooded organisms.
- They may be herbivores or carnivores, oviparous or ovoviviparous.
- The sexes are separate.
- Fertilization may be external or internal.
- Non amniotes (extra-embryonic membranes).

Subphylum: Vertebrata

Super class: Pisces

Class: Cyclostomata

Ex: Petromyzon marinus



Subphylum: Vertebrata

Superclass: pisces

Class: Chondrichthyes

Ex : Squalus acanthias



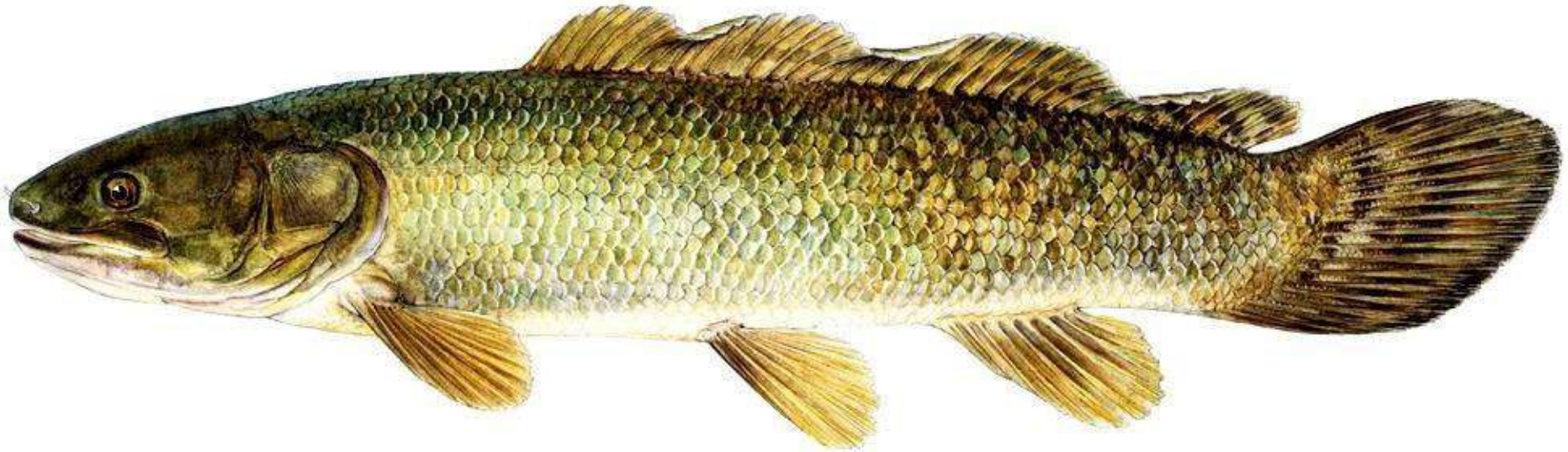
Subphylum: Vertebrata

Superclass: pisces

Class: Osteochthyes

Super order : holostei

Ex: Amia calva



Class: Mammalia.

Subclass: Prototheria: *Echidna*



Class: Mammalia .

Subclass: Metatheria: *Kangaroo*



Subclass : Eutheria

Order: Lagomorpha

capensis arabicuEx : Lepus



Lab.2

THE INTEGUMENTARY SYSTEM

Skin and its Derivatives

Edit By
Dr. Sura A. Munaf

Functions of Skin

- **Protects from injuries**
- **Acts as barrier and regulates what enters/leaves body.**
- **Regulates body temperature.**
- **Synthesizes, stores vitamins**
- **Sensory functions Excretion Absorption**
- **Respiration**

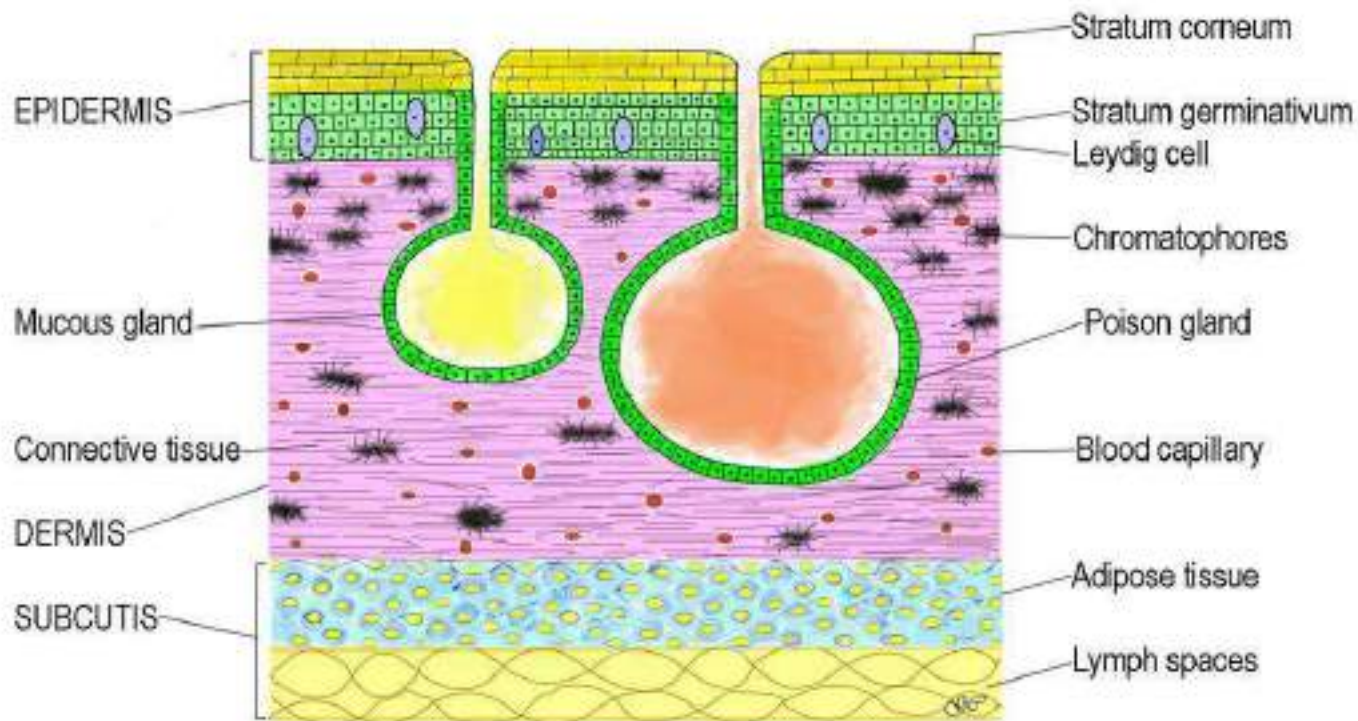
3. Chondrichthyes(Shark)

- The epidermis is composed of many layers of similar epithelial cells and goblet cell.
- Dermis is less vascularized and has no layers.
- In some deep-sea fishes photophores are present.
- Placoid scales are present.



4. Amphibia:

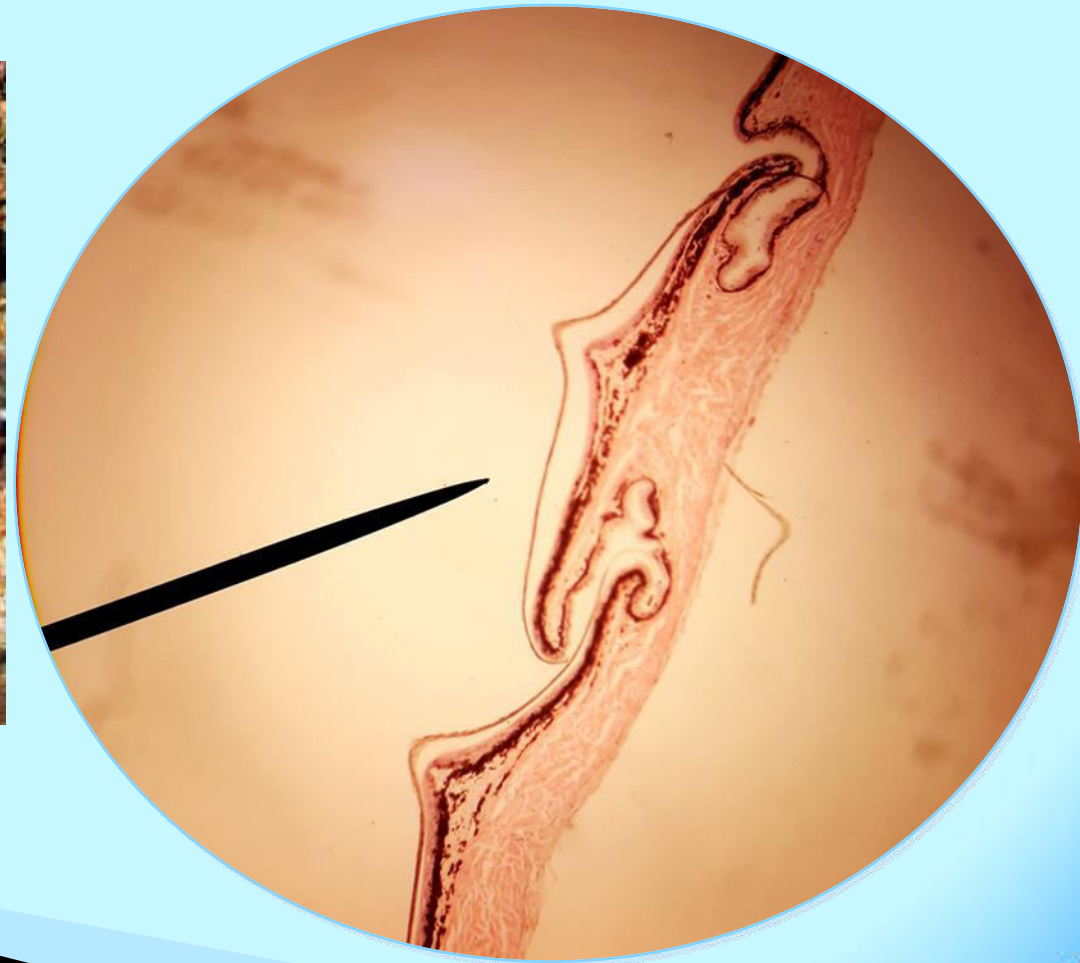
- The epidermis has 5 to 7 layers of cells.
- mucous glands which are numerous and smaller, and poison glands are less numerous and larger
- The dermis is two-layered, an outer loose and inner compact
- Dermis is richly vascularized.



VERTICAL SECTION OF SKIN OF FROG

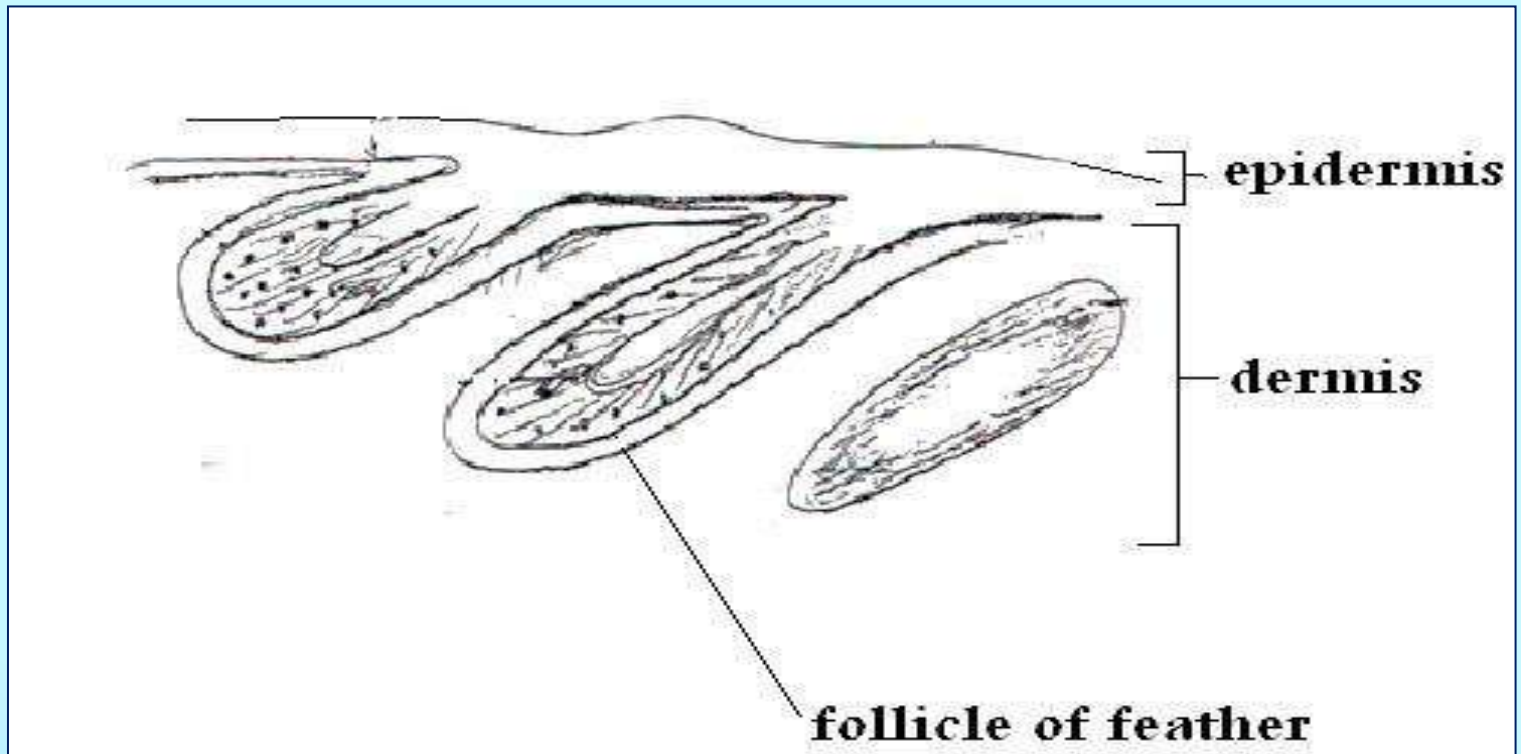
5. Reptilia:

- The epidermis covered with horny epidermal scales to adapted to the life on dry land.
- The skin is dry or contain very scarce gland.
- The dermis consists of connective tissue.



6. Aves:

- The epidermis is thin layer and posses feather:
- The dermis is thicker and contain follicle of feather.
- No glands except the uropygial gland in the tail used to preen its feathers.
- The dermis consists of connective tissue.



6. Skin of Mammalia

➤ **The epidermis is thicker than dermis and consist of five layers :-**

- **Stratum corneum**
- **Stratum lucidum.**
- **Stratum granulosum.**
- **Stratum spinosum.**
- **Stratum germinativum. (Be Smiley to Gain Love & Confidence)**

➤ **The dermis consists of two layers:-**

- **Outer layer: Loose connective tissue.**
- **Inner layer: compact connective tissue**

➤ **The skin of mammals contains some glands like sebaceous gland and sweat gland, and the color of skin refer to presence of melano cell in the epidermis.**

Lab.3

DERIVATIVE OF SKIN

➤ **1.Epidermal derivative :**

➤ Scales in Reptiles and birds.

➤ Horns: the hollow horn in cattle (ox ,goat and sheep)

➤ Claws, Nail & Hoof: it found in amniotes (reptilian ,birds &mammals) ,

➤ Feathers: there are three principal types .

➤ Hair in mammals

➤ **2-Dermal derivatives:-**

➤ Scales of fish

➤ The external skeleton of Turtle

1.MAMMALS EPIDERMAL DERIVATIVES

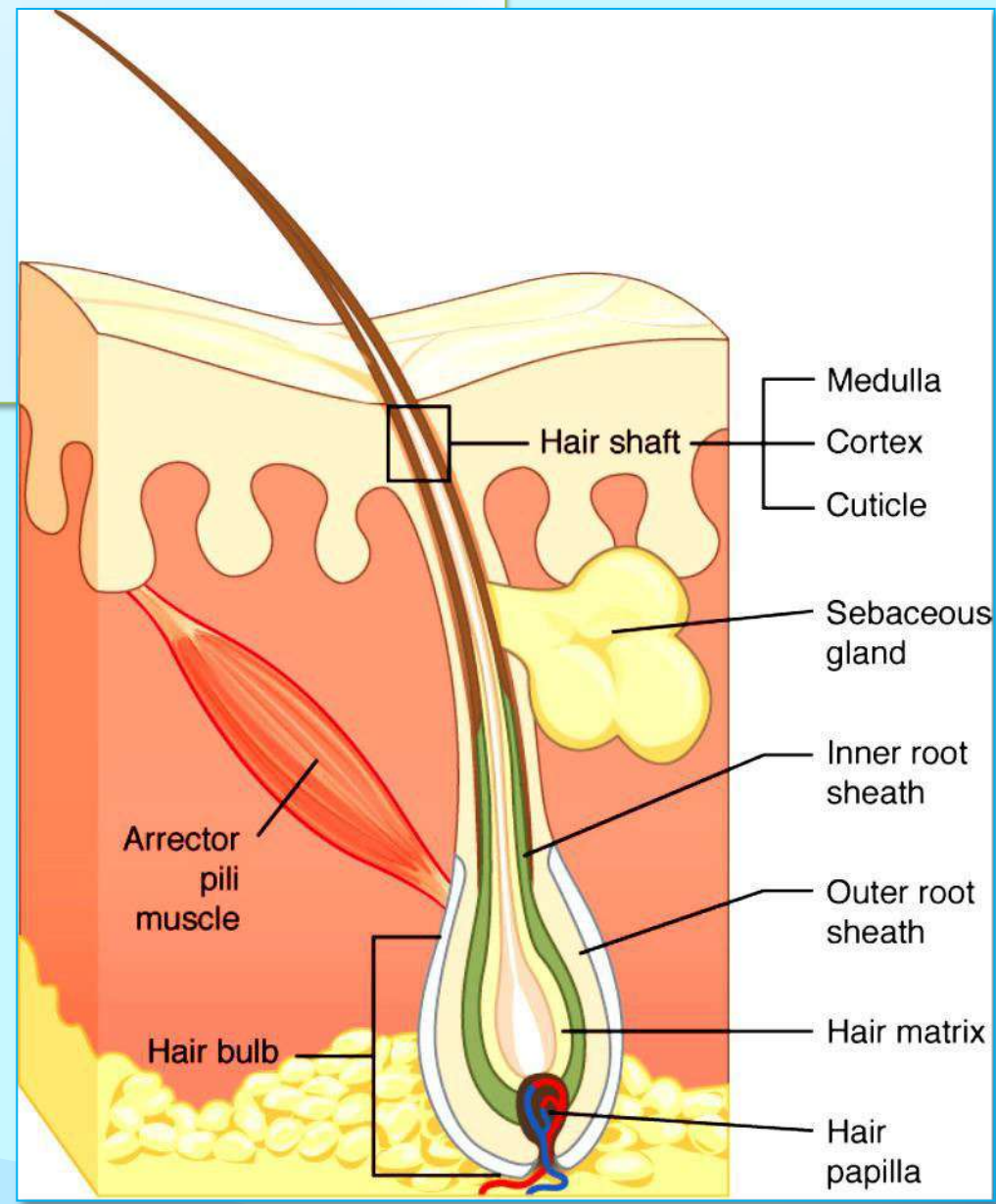
- **HAIR:** shaft, bulb, root
- **NAILS:** lunula, nail bed root
- **CLAWS:** cats, monkeys, etc.,
- **HOOVES:** ungulates ; cow, goat, etc.
- **Horns:** ungulates ; cow, goat, etc.

MAMMALS EPIDERMAL DERIVATIVES

1: HAIR

PARTS OF HAIR

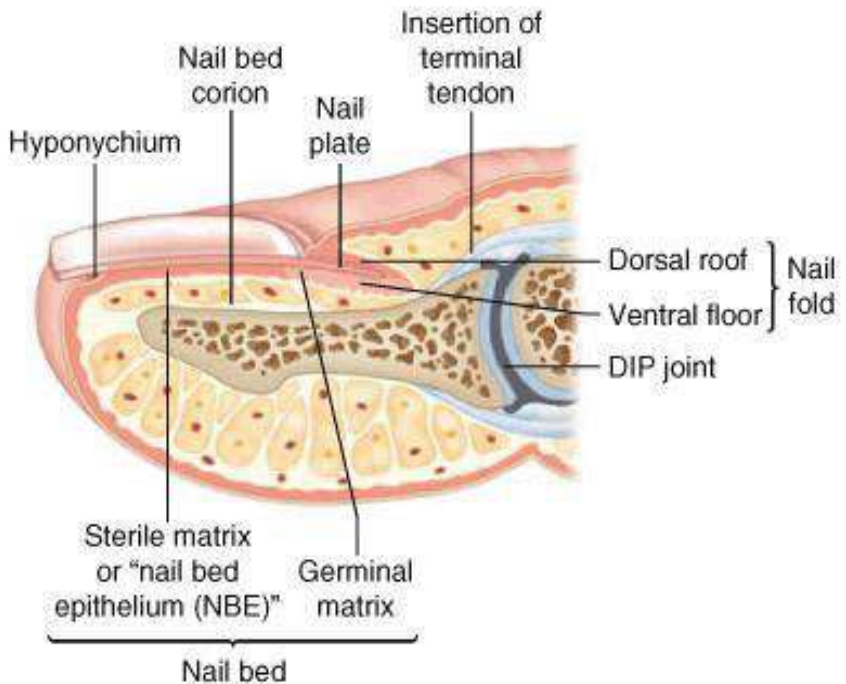
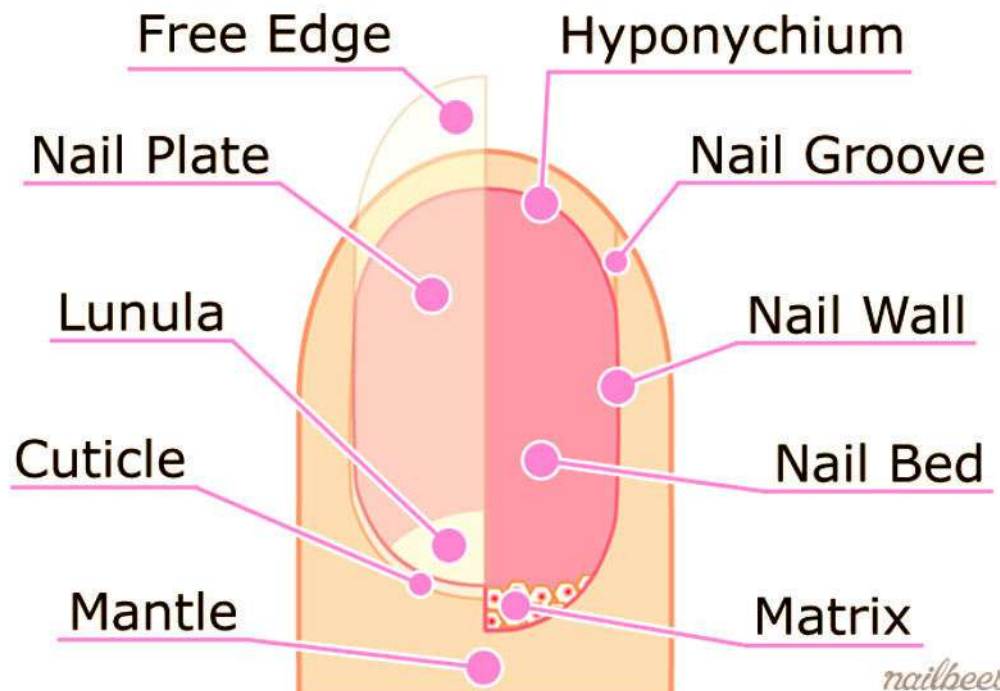
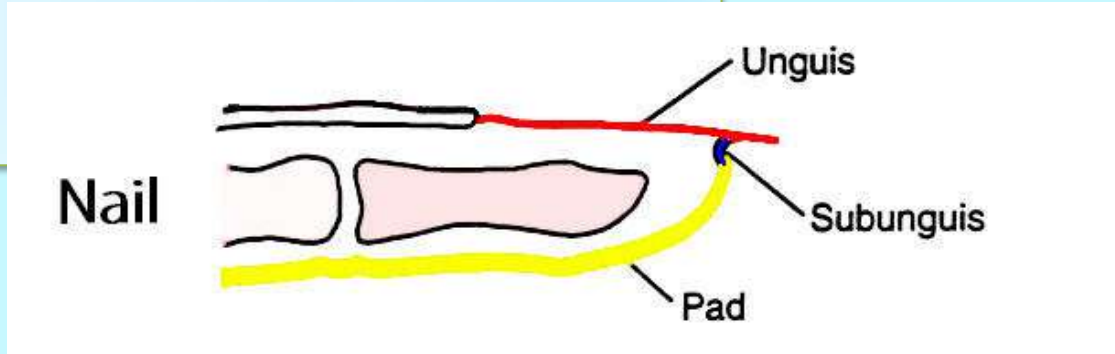
- A. HAIR ROOT FOLLICLE
- B. HAIR SHAFT
- C. HAIR BULB MEDULLA
- E. HAIR CORTEX



MAMMALS EPIDERMAL DERIVATIVES

2: NAIL

- NAIL ROOT
- NAIL BED
- LUNULA

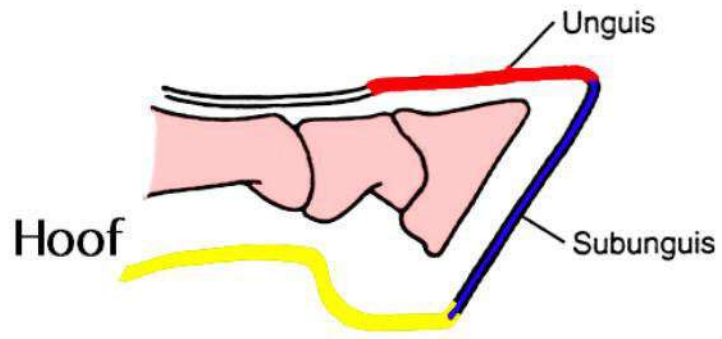


nailbeel

MAMMALS EPIDERMAL DERIVATIVES

3: Hooves

- Hooves are present in ungulates; sheep, cows, and horses etc.
- It is a cylinder, horny, surround and protect the tip of toe.



1 HOOF – 4 HOOVES



2 TOED HOOF

4 TOED HOOF

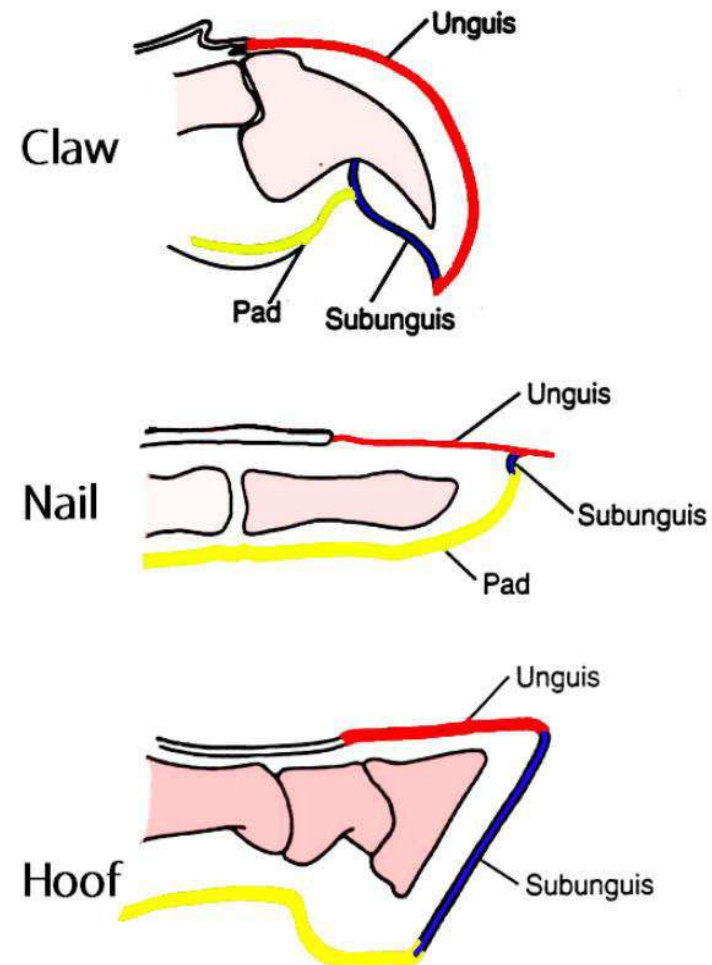


MAMMALS EPIDERMAL DERIVATIVES

4: Claws are present in amniotic classes

The claw consists of two parts:

- The dorsal **unguis** made of keratin, growth and is arranged in layers at an oblique angle
- Ventral **subunguis** is the soft and flaky



MAMMALS EPIDERMAL DERIVATIVES

5: Horn and Antler



Antlers ...

- Are shed & re-grow
- Are made of bone
- Have branches or “points”
- Antlers belong to the cervids. That includes all deer, elk, moose and caribou



Horns ...

- Are permanent
- Are made of (keratin)
- Have no branches or “points”
- Horns belong to the bovids: animals such as sheep, goats, cows, and bison



COSMOID SCALES

Cosmoid scales are found in the Lungfishes (family Ceratodidae) and some fossil fishes.



A scale from an Australian Lungfish in the fish collection.

Lab.4

Classification

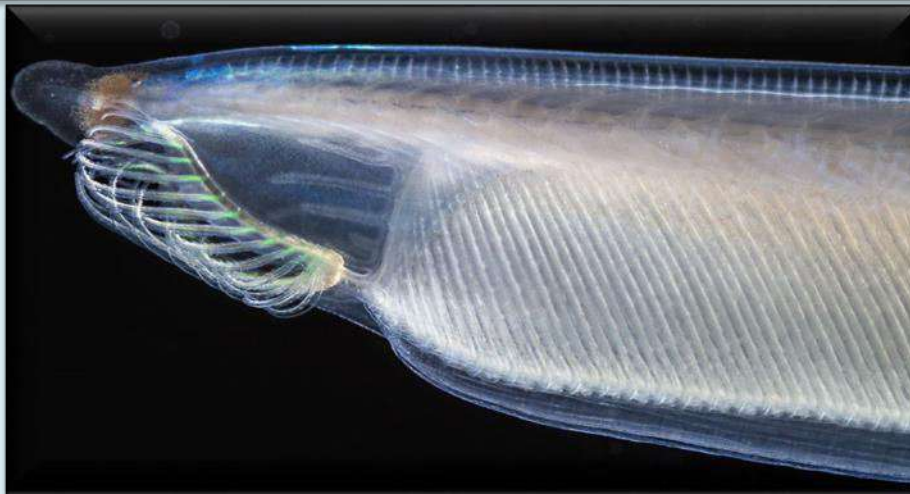
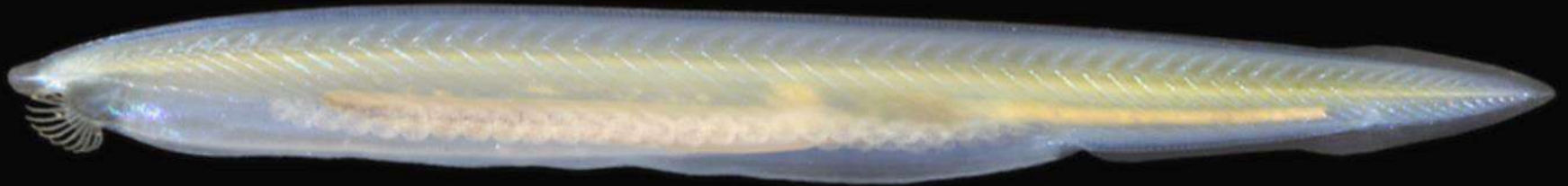
Kingdom: Animalia

Phylum: Chordata

Subphylum: Cephalochordata

Species: *Branchiostoma lanceolatum*

Common name: Amphioxus or Lancelet



Lab.5

Classification

Kingdom: Animalia

Phylum: Chordata

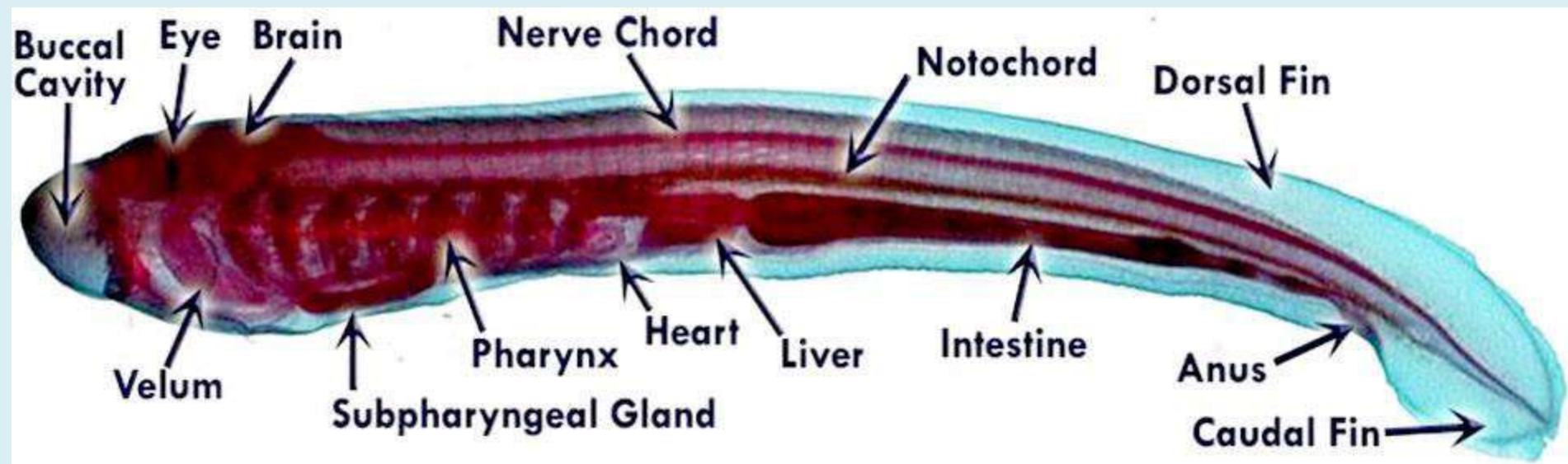
Subphylum: Vertebrata

Class: Cyclostomata

Species: *Petromyzon marinus*

Common name: Sea lamprey.

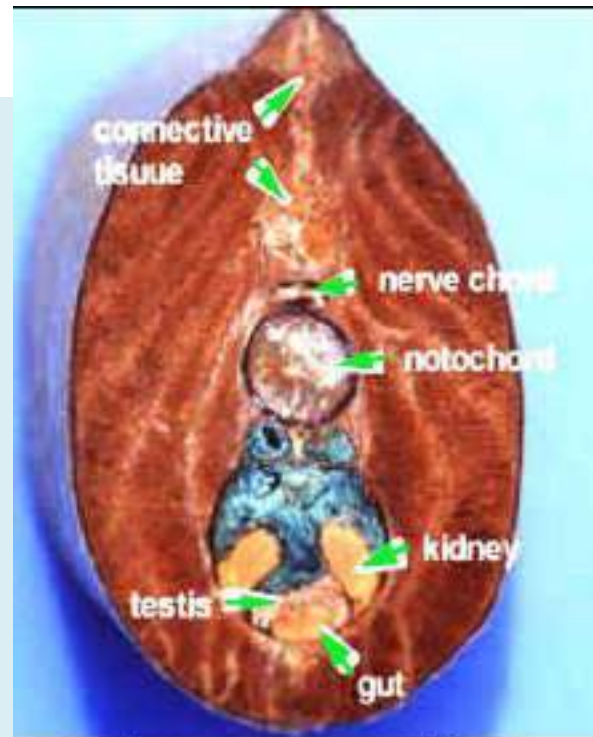




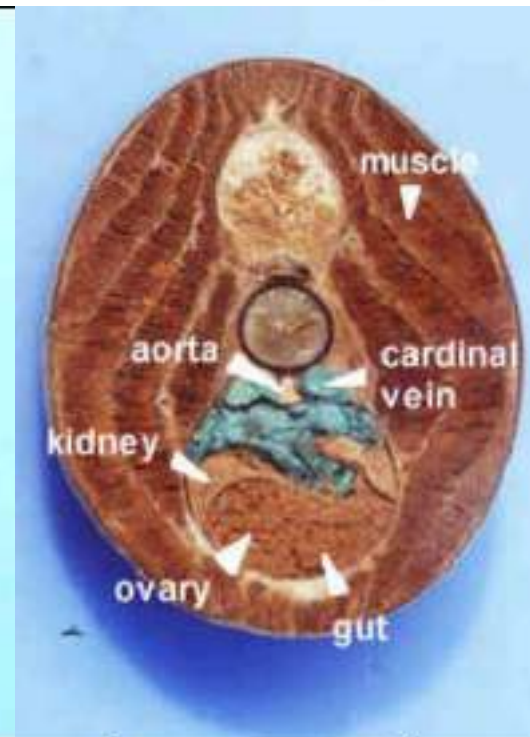
3. C.S. in Posterior Trunk Region

This section shows:

Dorsal fin, **notochord**, **nerve chord**, **myotomes**, two **posterior cardinal veins** and **dorsal aorta** in between them. **Gonad** (testes, ovary), **liver**, **kidney** and **intestine** (where as small tube ventral to gonad) may be shown.



Lamprey cross section
(male)

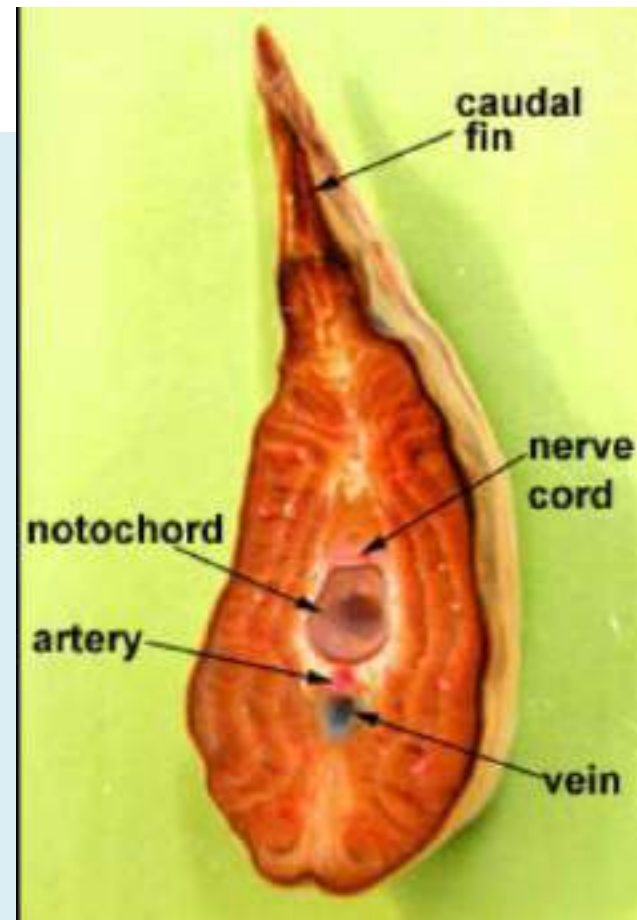


Lamprey cross section
(female)

4. C.S. in Tail Region:

This section shows:

Notochord, nerve chord, myotomes, myoseptum, caudal artery, caudal vein and caudal fin.



Lab.6

Squalus acanthias (Dogfish)

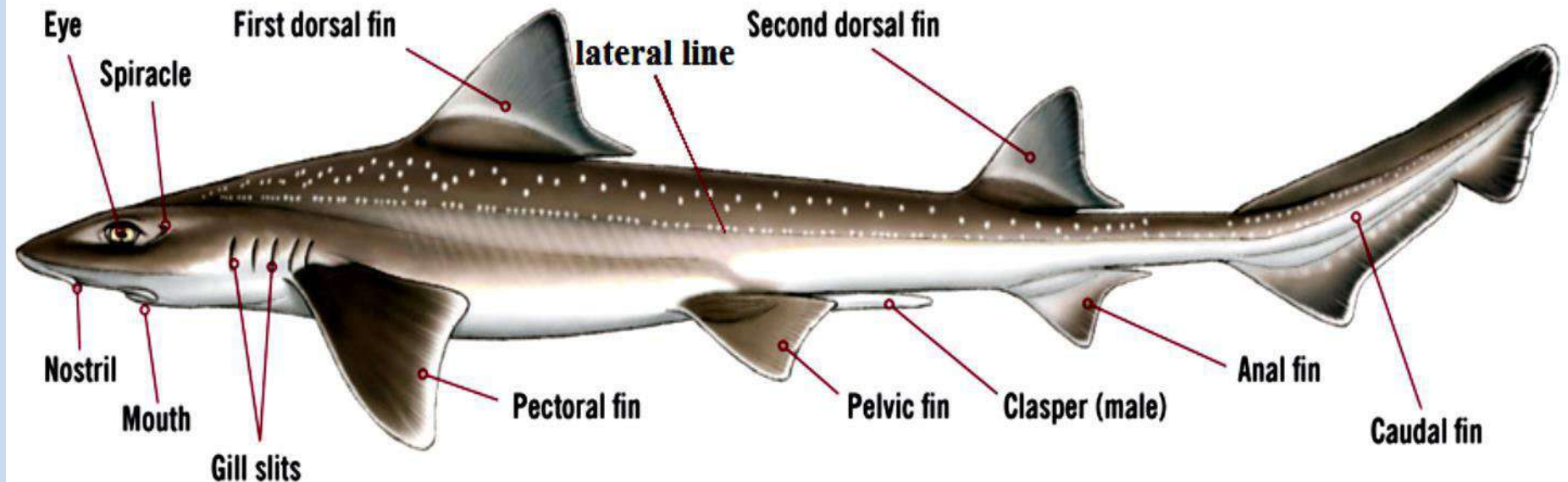
Kingdom: Animalia **Phylum:** chordate

Subphylum: Vertebrata

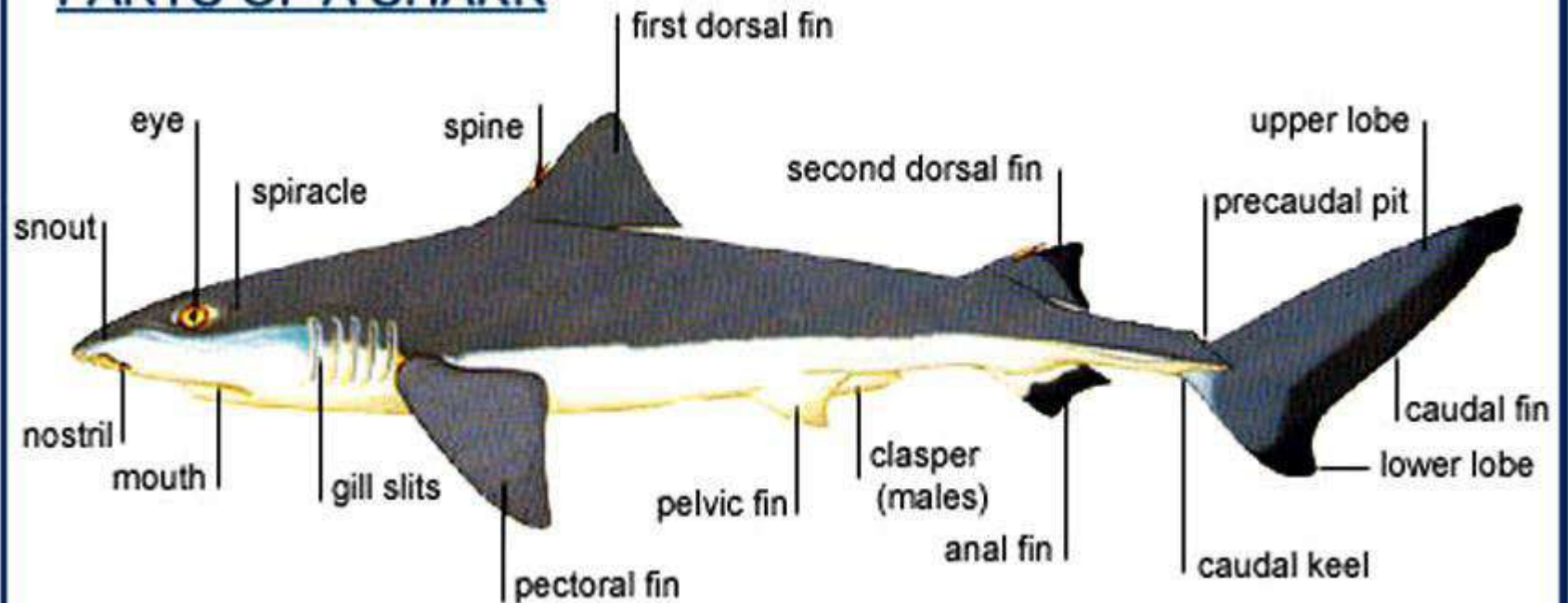
Super class: Pisces

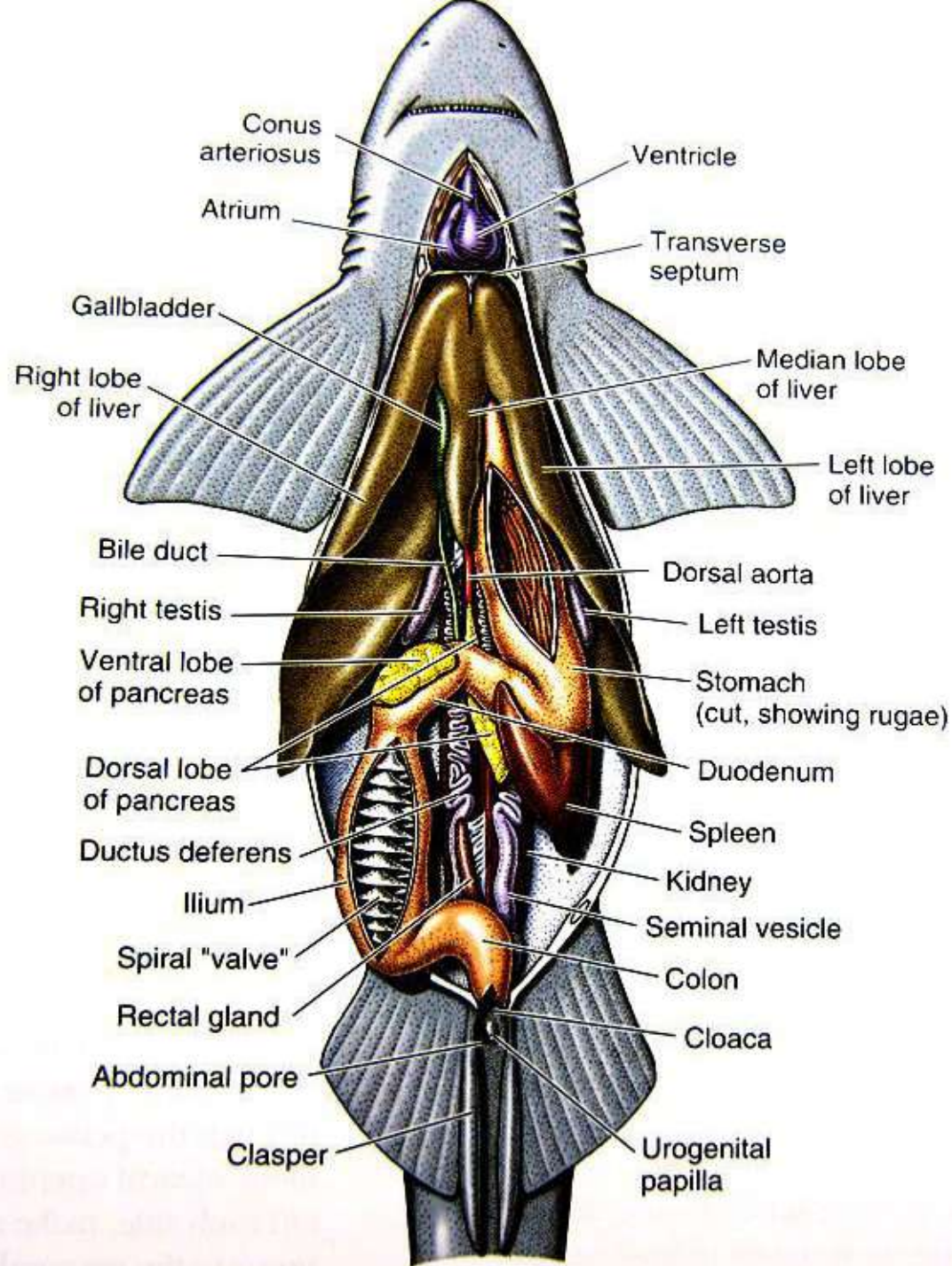
Class: Chondrichthyes

Ex: *Squalus acanthias* (Dogfish)



PARTS OF A SHARK







Lab. 7: Common Carp

Kingdom: Animalia

Phylum: Chordata

Subphylum: Vertebrata

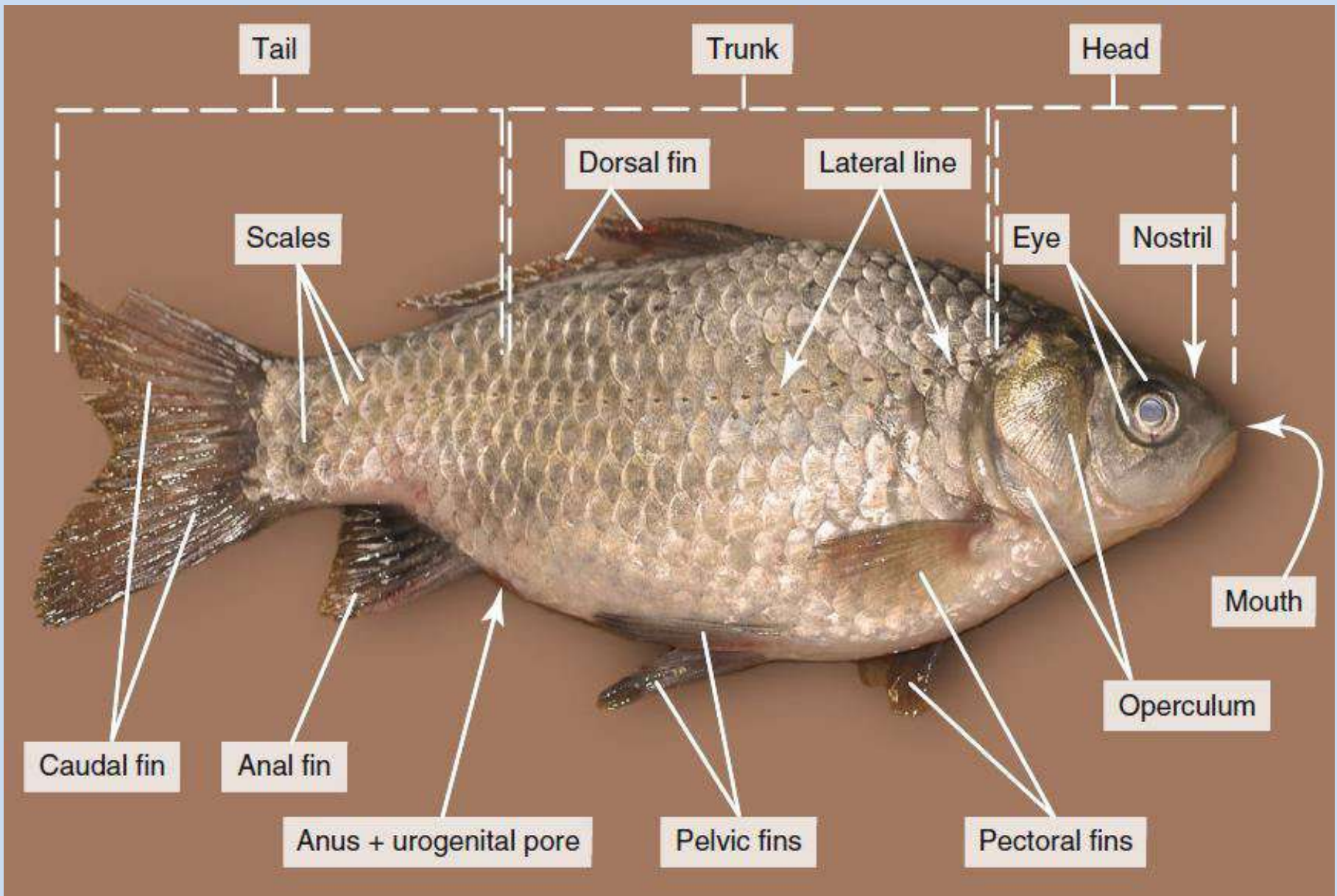
Class: Osteichthyes

Ex.: *Cyprinus carpio*



External Feature:

- The body of a fish is divided into a head, trunk and tail.
- The main skeletal element is the vertebral column, composed of articulating vertebrae which are lightweight yet strong.
- The head is relatively small. The lips are thick and can be extended.
- Males are usually distinguished from females by the larger ventral fin.
- The main external features of the fish, the fins. They are supported by the muscles which compose the main part of the trunk.
- Carp are characterized by their deep body and serrated dorsal spine.
- This species is omnivorous, feeding on aquatic crustaceans, insects, worms, aquatic plants, algae and seeds
- The tail has two, rounded but deep lobes. Males have a slightly larger fin on their bellies, but otherwise males and females look very much alike.



Digestive System

- The esophagus in bony fishes is short and expandable so that large objects can be swallowed. The esophagus walls are layered with muscle
- The stomach is a bent muscular tube in a "U" or "V" shape. Gastric glands release substances that break down food to prepare it for digestion.
- At the end of the stomach, many bony fishes have blind sacs called pyloric caeca. The pyloric caeca are an adaptation for increasing the gut area; they digest food.
- The pancreas secretes enzymes into the intestine for digestion.
- Difference between a small intestine and a large intestine is indistinguishable.
- The digestive system terminates at the anus.

Circulatory System

- **The circulatory system is quite simple. It consists of a heart, blood and blood vessels.**
- **The heart is located behind and below the gills and enclosed by pericardial membrane or pericardium.**
- **The heart consists of an atrium, a ventricle, a thin-walled structure called sinus venosus and a tube called bulbus arteriosus.**
- **Blood from the body enters the sinus venosus, moves into the atrium, then into the ventricle. From the ventricle it enters the conus arteriosus, and then goes to the gills for gas exchange.**

Respiratory System

- **Water enters the gill chamber through a fish's mouth and exits through gill openings under the operculum.**
- **Blood flowing through the gill filaments absorbs oxygen from the water.**
- **The swim bladder is located in the body cavity and is derived from an outpocketing of the digestive tube. It contains gas (usually oxygen) and functions as a hydrostatic, or ballast, organ.**

Lab: 8

Classification

Kingdom: Animalia

Phylum: Chordata

Subphylum: Vertebrata

Superclass: Tetrapoda

Class: Amphibia

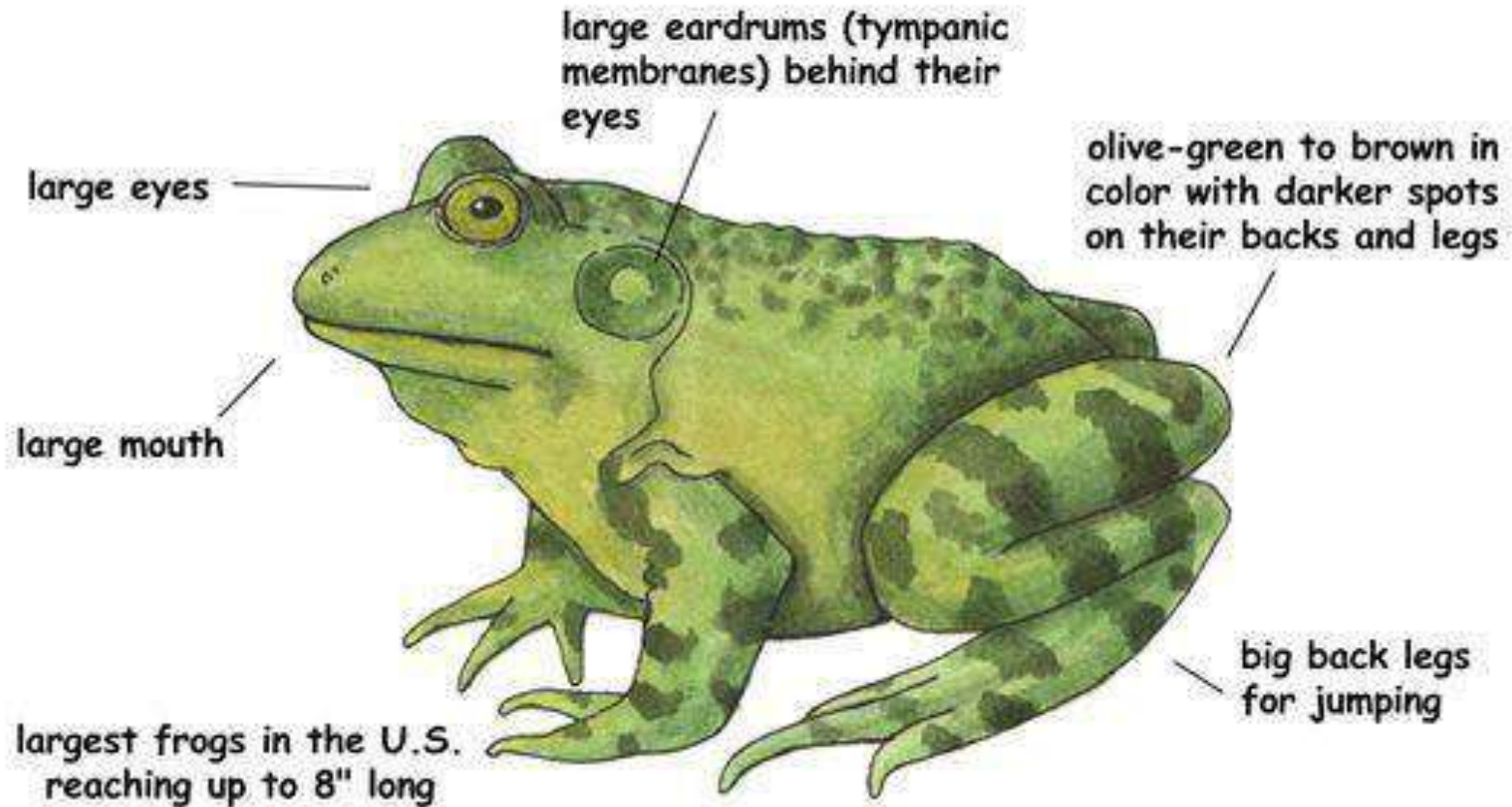
Order: Anura

Ex.: *Rana ridibunda*



American Bullfrog

Rana catesbeiana



The External Feature

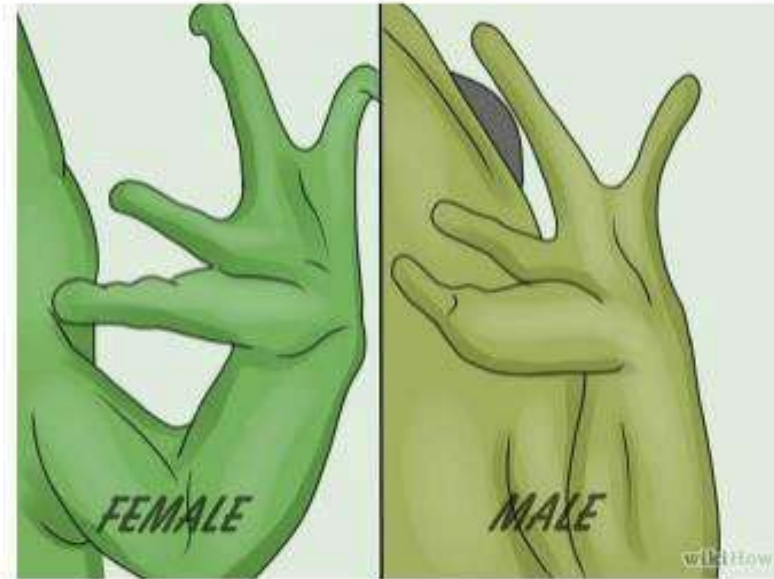
- Frog has a body which can be distinguished into **head** and **trunk**.
- Absence of neck and tail.
- The **eyes** are bulging.
- **The head** is triangular but blunt, is dorsoventrally compressed and terminates in a wide mouth. The external nares (**nostrils**) are two small opening lying near the anterior tip of the head.
- **The eyes** are guarded each by two **eye lids**, an immoveable upper, and **semi-transparent** movable lower eye lid proper below and a **nictitating membrane**.
- **The tympanic membrane** or **ear-drum** which is more or less circular area found posterior to each eye.
- **The trunk** is compact and divided into **thorax** and **abdomen**.
- **Hindlimbs** end in five digits and they are larger and muscular than **forelimbs** that end in four digits.
- Males can be distinguished by the presence of **vocal sacs** and a **copulatory pad** on the first digit of the fore limbs which are absent in females.

Determine if your frog is a Male or Female



Copulatory pad of male frog

Fore limb of frog



The sex of a frog may be determined externally by examining the **thumb pads** on the front feet. The thumb pads of males are enlarged at the base as in the drawing on the right.

The Digestive System:

- ✓ **The mouth opening is lead to buccal cavity.**
- ✓ **The esophagus is cylindrical, short (because of the absence of the neck region) and open into stomach.**
- ✓ **The stomach is a muscular curved sac, it has two ends: a cardiac and a pyloric end, which leads into the intestine.**
- ✓ **The intestine is long. Small intestine consists of the duodenum and ileum. Large intestine consists of rectum and opened to the cloacae.**
- ✓ **The following accessory glands connected with the digestive system: liver 3 lobes (with gall bladder) and pancreas,.**

Lab: 9



Classification

Kingdom: Animalia

Phylum: Chordata

Subphylum: Vertebrata

Super class: Tetrapoda

Class: Reptilia

Order: Chelonia

Species: Testudo graeca (Turtle)

External Morphology

- Turtles have a **head, tail** and **four legs** projecting from a broad **bony shell**.
- The head, legs, and tail are covered by **horny scales**, and the feet have **horny nails**.
- They have conspicuous **eyes** placed well forward on the upper sides of head.
- The eyes are provided with upper and lower **eye lids**, and additional eye lid at anterior corner.
- There is no ear on the outside of a turtle's body. But the **eardrum** is covered with head or neck scales.
- They use their **jaws** to cut and handle food. Instead of teeth, a turtle's upper and lower jaws are covered by horny ridges, similar to a bird's beak.

Lab.10

Classification

Kingdom: Animalia

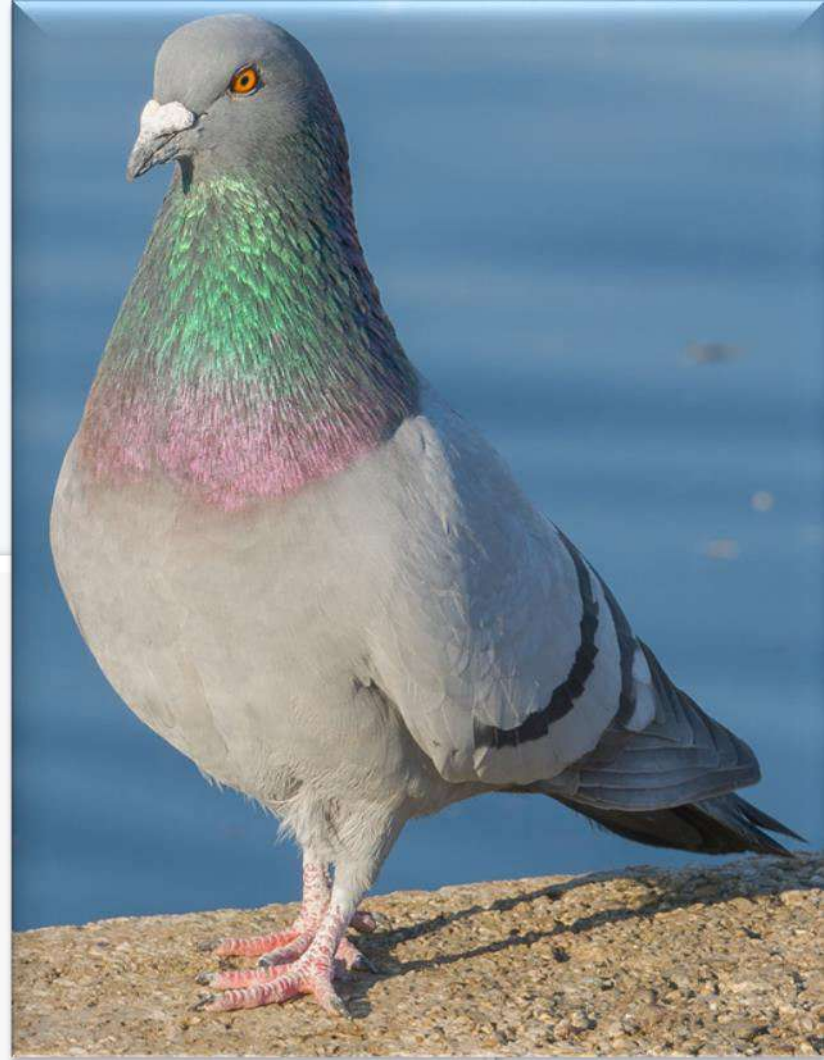
Phylum: Chordata

Subphylum: Vertebrata

Super class: Tetrapoda

Class: Aves

Scientific name: *Columba livia* (pigeon)



External feature:

- Feather cover almost the whole body except the beak and feet .the body consists of head ,neck ,trunk and tail.
- **head**, the strong, horny, straight beak, at the base of which is a naked swollen portion of sensitive skin forming the cere. the two nostrils are obliquely situated in the cere ,each eye surrounded by three eye lids an upper a lower and a nictitating membrane ,posterior of the each eye ,there is an external auditory aperture.

- **The neck** is long, flexible, and can bent to form S shape
- **The trunk** is divided into a large thorax and small abdomen. Keel projects mid-ventrally which can be felt.
- **The tail** is short on the dorsal surface of the tail there is an oil or pyjeal gland , used by the bird to preen its feathers .
- The fore limbs are modified into wings.

Respiratory System

- The **nostrils** are generally at the base of the upper mandible.
- Air passes to the **glottis** to enter the **larynx**.
- The **trachea** connects to the **syrix**, at the **tracheal bifurcation**.
- The **bronchi** connect the **syrix** to each **lung**.

Air sacs: which are membranous extension of the two bronchi , nine air sacs are found:

- 1. Cervical air sac:** two in number and lie at the base of neck.
- 2. Interclavicular air sac:** single and lies between the two clavicles.
- 3. Anterior thorax air sacs:** two in number.
- 4. Posterior thorax air sacs:** two in number.
- 5. Abdominal air sac:** are the largest air sac and two
in number