GENERAL CHARACTERS OF UROCHORDATES:

PHYLUM CHORDATA IS divided in to three subphyla namely:

1)UROCHORDATA

2)CEPHALOCHORDATA

3)VERTEBRATA(Commonly known as higher chordates or euchordates)

Urochordates and Cephalochordates are commonly known as lower chordates and often grouped together as protochordates.

General characters of urochordata:

a)urochordates are Marine mostly the sessile,filterfeeding .

b) the notochord occurs only in the tail of the larva and disappears in the adult. This character gives thesub phylum Its name.

c) the gill slits are numerous persist in the adult and open into an ectoderm lined cavity , the atrium, instead of to the exterior. There are no gills.

d) The tail mayor may not persist throughout life.

e) body is generally enclosed in a leathery test (tunic) composed largely of tunicin,allied to plant cellulose.

f)More chordate like larva called tadpole changes in to a degenerate adult.This is called retrogressive metamorphosis.

e.g HERDMANIA

Classification of urochordata

Urochordata is divided in three classes namely

1)Ascidiacea **2)**Thaliacea **3)Larvacea**

Ascidiacea

1)solitary ,colonial or bottom living.

2)Body form and size variable.

3)Test permanent, well developed and thick.

4)Atrium opens dorsally by atriopore.

5)Pharynx large with many persistent gill slits.

6)Sexes United.Larva free swimming and highly developed.

7)Adults usually sessile after retrogressive metamorphosis when larval notochord, nerve cord and tail are lost.

Ascidiacea is having two orders:

1)Enterogona. 2)Pleurogona

Enterogona:1)Body divided in to thorax and abdomen.

2) Neural gland ventral to ganglion.

E,g Ascidia

2)Pleurogona:1)Body compact and undivided.

2)Neural gland dorsal or lateral to ganglion.

e.g Herdmania

Class:Thaliacea

1)Solitary or colonial.

2)Body shape and size variable.

3)Test permanent, thin and transparent with circular muscle bands.

4)Atriopore located posteriorly.

5)Pharynx with two large or many small gill slits.

6)Sexes United. Larva formed or absent.

7)Adult without notochord, nnervechord and tail.

Class:Thaliacea is having 3 orders

1)Pyrosomida 2)Doliolida 3)Salpida

Order: pyrosomida:

A) body compact , tubular, closed at one end and phosphoresent in life.

b) muscle bands confined to body ends.

c) Gil slits tall , numerous up to 50.

d) No free swimming larval stsge.

e.g Pyrosoma(single genus)

Order:Doliolida

a) **Body barrel-shaped.**
b) **Muscle Band f o r m 8 complete rings.**
c) **Gill slits small, few to many.**

e.g Doliolum , Doliopsis

Order: salpida

a) **Body cylindrical or prism shaped**
b) **Muscle bands incomplete ventrally**
c) **Pharynx communicates freely within atrium through a large gill slit**

e.g Salpa

Class Larvacea

a) **Solitary, free swimming**
b) **Test temporary,renewed periodically**
c) **Atrium and atrial aperture absent**
d) **Gill slits 2, opening directly to the outside**
e) **Sexes united,no metamorphosis**

Class Larvacea is having two orders

1) **Endostylophora 2)Polystylophora**

Order :Endostylophora

a) **House bilaterally symmetrical, with single inhalent and exhalent apertures.**
b) **Pharynx with endostyle.**

e.g Oikopleura

Order: polystylophora

a) **House biradially symmetrical, with single aperture**
b) **Pharynx without endostyle**

e.g Kowalevskia

complete classification

GENERAL CHARACTERS OF CEPHALOCHORDATES:

a) The notochord extends to the tip of the snout and persists throughout life,hence the name (kephale:head,chorda:string)
b) The nervecord persists throughout life but no brain is formed.
c) The gill slits are numerous persist in the adult and open into an atrium instead of to the exterior .There are no gills.
d) The tail persists throughout life.

Cephalochordata includes a single class Leptocardii,which has a single family,Branchiostomidae.The family contains only two genera Branchiostoma and Asymmetron.

Leptocardii:

a)Body 4-5cm long,whitish,laterally compressed Spindle like body pointed at both ends.

b) Body is divisible into long trunk and a short tail.

c) the trunk has an interior oral hood bearing oral cirri a long dorsal fin along the entire back and short ventral fin in the posterior region.

e)Tail bears a caudal fin.

f) Paired appendages lacking .Median fins present.

g) exoskeleton absent

i) sexes separate

e.g Branchiostoma

General characteristics of Agnatha:

Agnatha is a division of jawless fish in the phylum chordata Consisting of both present cyclostomes and extinct ostracoderms species.

1) **It consists of lampreys and Hags the only surviving agnathans.**
2) **It is distinguished from all other living creatures by the possession of pouched gills and single nostril and the Primitive absence of Jaws or paired fins.**
3) **They have Long cylindrical eel like body, predatory on fish.**
4) **Skin is slimy with unicellular mucous glands. There are no scales.**
5) **Mouth round and suctoria and lhence the name cyclostomata.**
6) **Gill 5 to 16 fairs and gill slits 1 to 16 pairs.**
7) **Buccal cavity with a muscular tongue provided with epidermal teeth.Mouth being circular and suctorial helps in along adhereing to the prey.**
8) **Endoskeleton is cartilaginous and exoskeleton is lacking.**
9) **Sexes separate.Gonad single,large without gonoduct. fertilization external and development usually direct.Life history may include larva called Ammocetes.**
10) **. Agnathans are ectothermic.**

e.g Petromyzon and Myxine

CLASSIFICATION OF AGNATHANS:

Agnatha is divided into two orders.:

1) **Petromyzontiformes**
2) **Myxiniformes**

Petromyzontiformes:

a) **Mouth ventral suctorial with rasping tongue beset with many horny teeth**

b) Nostril dorsal. Naso hypophyseal Sac terminates posteriorly in a blind sac i.e it does not communicate with the pharynx.

b) **7 pairs of Gill pouches and gill slits**
c) **Dorsal fin well developed and supported by cartilaginous fin rays**
d) **Eggs numerous and small. Development indirect**

Example PETROMYZON

MYXINIFORMES:

a) **Mouth terminal and surrounded by eight small tentacles. Teeth few, no buccal funnel.**
b) **Nostril terminal nasal hypophyseal Sac open posteriorly in the pharynx**
c) **Gill pouches and Gill slits 6 to 14 pairs**
d) **Dorsal fin weak or absent .Eggs few and large**
e) **Development Direct**

Example MYXINE

General characters of Pisces:

1) **Body form: The body is literally compressed ,dorsoventrally flattened or** spindle i**n shape. It consists of head,** trunk **and Tail. Neck is lacking.**
2) **Appendages:** the Fins are supported by horny fin rays ,cartilaginous or bony fin rays. The pelvic fins bear copulatory organ organs called claspers in the male in case of chondrichthyes Pectoral and pelvic fins act as balancers and brakes during swimming. Pelvic pain lack claspers in both sexes in case of ostechithyes.paired and unpaired fins are present. Caudal fin is asymmetrical or symmetrical.
3) **Skin:** The second has epidermal unicellular mucous glands and placoid scaleswhich are partly epidermal and dermal in origin. Cycloid ,ctenoid or ganoid scales are dermal in origin The scales are impermeable to water they reduce water loss in marine environment and entry of water in freshwater environment.
4) **Endoskeleton** . The endoskeleton is cartilaginous or partly or wholly bony. Notochord often persist in a greatly reduced form
5) **Digestive system :** The mouth is ventral or anterior. The alimentary canal opens into the cloaca or open out by anus.
6) **Respiratory system: The respiratory system includes five to seven pairs of lamelliform or four pairs of filamentar gills. In the gills blood takes up oxygen from water. therefore a fish cannot survive out of water Gill slits are with or without Gill coverd(operculum)**
7) **Swim bladder:** The gas filled swim bladder is oftenl present. By altering the gas pressure in it the swim bladder act as a buoyancy regulator and enables the fish to stay at a particular depth without o setae at the particular Depth without expending energy in swimming
8) **Circulatory system**: The heart is generally two Chambered having one auricle and one ventricle. Sinus venosus and conus arteriosus our present. Renal postal system is well-developed. Red blood corpuscles are oval bi convex and nucleated.
9) **Cranial nerves**: There are 10 pairs of cranial nerves.
10) **Sense organs**: the olfactory sacs are dorsal or ventral Lateral line sense organs are well-developed. These detective waves and currents in water.
11) **Excretory system**: Kidneys are opistho nephric. Nitrogenous waste matter is urea or ammonia.
12) **Reproductive system**: The reproductive duct lead directly to the exterior or into the cloaca Fertilization is generally external , in some cases. It is internal too
13) **Temperature:** The body temperature is variable.(poikilothermic)
14) **Natural History**: fishes occur in all sorts of water; fresh, brackish ,salt, warm and cold. Many deep species have protective spines on Dorsal fins. many deep sea fishes are luminescent light flashes are used to attract prey or mate.

CLASSIFICATION OF SERIES PISCES:

Classification is adopted from L.S Berg(1947).Only important living groups have been taken.

Series Pisces is divided into four classes namely:

1)**ELASMOBRANCHI 2)HOLOCEPHALI 3)DIPNOI 4)TELEOSTOMI**

CLASS 1:ELASMOBRANCHI:

a)skin is covered withplacoid scales or naked.

b)Endoskeleton cartilaginous, often calcified .

c)Gill slits 5-7 on each side,

d)operculum or gill cover is absent.Air-bladder and lungs are absent.

e)Mouth is ventral.

f)Cloaca is present.

g)Male usually possesses claspers

h)Mostly marine.

SUB-CLASS: SELACHII

a)Paired fins without a median axis.

b)Base of pectoral fin constricted .

c)Pectoral radials constricted.

d)Male with claspers.

SUPERORDER 1: PLEUROTREMATA

a)Gill slits on lateral sides

b)Anterior margin of pectoral fin free

ORDER: **LAMNIFORMES**

a)Two dorsal fins without spines.

b)Anal fin present.

c)Five gill arches.

Examples: Scoliodon,Stegostoma,Zygaena

SUPERORDER II : HYPOTREMATA

a)Gill slits are ventral.

b)Anterior margin of pectoral fin fused with sides of the body or head.

ORDER: RAJIFORMES

a)No electric organs between head and pectoral fins.

b)Preorbital cartilages not enlarged.

Examples:Rhinobatus,Trygon,Raja

ORDER: TORPEDINIFORMES

a)Electric organs present between the head and pectoral find.

b)Preorbital cartilages greatly enlarged.

Examples: Torpedo or Astrape

CLASS II -HOLOCEPHALII

a)Four gill slits on each side covered by operculum.

b)An inter-orbital septum is present dorsal to the brain case.

c)Cloaca is absent.

d)Two halves of the pelvic girdle not fused.

e)Males with claspers.

SUBCLASS- CHIMARARE

a)Notochord persistent, usually surrounded with numerous,partly calcified rings.

b)No true centra.

c)Pectoral fins normal types.

ORDER- CHIMAERIFORMES

a)Body elongated and shark like.

b)Skin naked with characteristic open groove lodging the lateral line system.

c)Mouth and nostrils are ventral in position.

d)Pectoral and pelvic fins are large.

Example: Chimaera

CLASSIII- DIPNOI

A)Slender or eel like body

b)Single gill slit on either side is present.

c)More or less acutely lobate or filamentous paired fins.

d)Cycloid scales are present.

e)Mouth is present on the ventral surface and the cloacal aperture lies at the root of the tail.

SUPERORDER-CERATODI

a)Cranial roof bones few but large.

b)Caudal fin diphycercal,confluent with dorsal and anal fins.

ORDER I: CERATODIFORMES

a)Endocranium cartilaginous.

b)Air bladder single.(left lung suppressed)

c)Paired fins lobate

Examples:Neoceratodus,Ceratodus

ORDER II: LEPIDOSIRENIFORMES

a)Endocranium membranous.

b)Air bladder paired.

c)Paired fins filamentous.

Examples:Protopterus,Lepidosiren

CLASS IV: TELEOSTOMI

a)Endoskeleton more or less bony.

b)Single external gill slit on each side of the head.

c)Mouth is terminal.

d)Operculum is present.

e)Airbladder usually present.

f)Cloaca and claspers are absent.

SUBCLASS I: CROSSOPTRGII

a)Paired fins with a scale covered lobe(containing radials)

b)Internal nares are present.

c)Squamosal bone present.

Examples:Latimera(Extinct), Coelacanths(Extinct)

SUBCLASS II: ACTINOPTERYGII

a)Radials of paired fins not arranged biserially

b)Paired fins present supported by fin rays

c)Internal nares are present.

d)Squamosal bone absent.

ORDER 11 POLYPTERIFORMES

a)Skin covered with rhombic ganoid scales.

b)Dorsal fin with many peculair finlets.

c)Pectoral fins with a small prominent base.

d)Air bladder bilobed.

Example:Polypterus

ORDER 2 Acipenseriformes

1)Body covered with five rows of bony scutes.

2)Snout elongated.

3)Endocranium cartilaginous

4)Caudal fin heterocercal

Example: Acipencer

ORDER 3: AMIIFORMES

1)Thin,overlapping cycloid scales.

2)caudal fin heterocercal.

3)Long dorsal fin.

4)Snout normal rounded

5)Single swim bladder

Example:Amia

ORDER 4 LEPIDOSTEIFORMES

1)Skin covered with rhombic ganoid scales.

2)Nasal openings at the end of mush elongated snout.

3)Caudal fin heterocercal.

Example:Lepidosteus

ORDER 5: CLUPEIFORMES

1)Scales are well developed and cycloid.

2)Caudal fin homocercal

3)Dorsal and anal fins without spines.

Example:Salmo

ORDER 6 SCOPELIFORMES

1)Dorsal and anal fins without spines

2)An adipose fin is present.

3)mouth is large with numerous small teeth.

Example:Horpodon

ORDER 7 ANGULLIFORMES

1)Body slender,elongated eel like.

2)Skin naked or with minute scales embedded in it.

4)Dorsal,caudal and anak fins are long and nartow and usually continuous.

5)Fins devoid of spines.

Example: Anguilla

ORDER 8: BELONIFORMES

1)Body elongated covered either cycloid scales.

2)Fins without spines

3)Ventral fins abdominal

4)Some fishes of this order are capable of jumping in to the air and glide with the help of enlarged pectoral fins,located high on body.

Example:Exocoetus

ORDER 9 SYNGNATHIFORMES

1)Body covered with protective layet of scales or bony rings.

2)mouth is terminal at tubiform snout.

3)Fin rays of dorsal,anal and pectoral fins not branched

Example:Hippocampus

ORDER 10 PERCIFORMES

1)Fins usually without spines

2)Two dorsal fins.Pectoral fin placed high on body

3)Ventral fins with not more than 6 rays

Example:Anabas

ORDER 11 CYPRINIFORMES

1)A peculiar webrian apparatus connecting the ear with air bladder is present.

2)Air bladder is connected with the alimentary canal by a duct.

3(Fins either without spines or dorsal,anal or pectoral have a spine each.

4)Ventral fins are abdominal.

5)Body covered with scales or naked

Example Labeo,Cyprinus

ORDER 12 OPHIOCEPHALIFORMES

1)Body covered with cycloid scales

2)Head depressed,covered with large scaled

4)Fins without spines

5)Acessory respiratory organs are present

Example:Ophiocephalus

ORDER 13 SYMBRANCHIFORMES

1)Body eel like or snake like,devoid of scales

2)Air bladder is absent

3)Fins are without spines

4)Dorsal ,anal and caudal fins are continuous

Example:Amphipnous

ORDER 14 PLEURONECTIFORMES

1)Body flat adapted fir bottom living

2)Both the eyes are on the upper side

3)Fins usually without spines

4)Air bladder is absent in adults.

Example:Synaptura

ORDER 15 MASTACEMBELIFORMES

1)Fresh water eel shaped fishes

2)Dorsal,caudak and anal fins are continuoud

3)Some free spines present befire dorsak fin

4)Anal fin with three spines

ORDER 16 ECHENIFORMES

1)First dirsal fin is modified in to an adhesive disc for attachment

2)Scales cycloid

3)No spines in second dorsal and anal fins

4)Air bladder is absent

Example Echeneis

ORDER 17 TETRODONTIFORMES

1)Scales are modified in to spines

2)Scutes or bony plates cover the body

3)Air bladder present or absent

Example Tetrodon

ORDER 18 LOPHIFORMES

1)First ray of the spinous dorsal fin is placed on the head and transformed in to illicium(line and bait)

2)Air bladder present

Example Lophius

TOPIC :OSMOREGULATION IN FISHES:

Kidneys and gills perform the function of osmoregulation also in addition to excretion of nitrogenous waste. Fishes live in two different environments(fresh water and sea water) and are faced with entirely different situation in each medium. Water flows from a dilute to a more concentrated solution by osmosis. As the concentration of body fluids in marine teleosts varies between 350 and 450 m Osm/l (milliosmole per litre) called osmolality, water flows out of the body in to the sea . But in the chondrichthyes the osmolality of the blood is slightly higher than that of the sea water, so the water flows from sea water into blood. Marine teleosts are hyp osmotic while Chondrichthyes are hyperosmotic. freshwater fishes are hyperosmotic to the surrounding medium. Thus, fishes living in Freshwater are faced with the problem of large inflow of water and loss of salts, while those living in the sea are faced with loss of water and Gain in salt.

Osmoregulation in Freshwater fishes:

In Freshwater fishes the osmolality of the body is higher than the surrounding medium hence water diffuses into the body through gills ,oral membrane and gut.Skin has low permeability to water and salt ions, hence very little water is allowed to enter the body or salt to diffuse out through it.To counter the continuous in flow of water through gills, freshwater fishes produce a large amount of dilute urine. The kidney of these fishes has a very large number of well-developed, glomeruli, Which are well vascularised and continuously filter excess of water which is eliminated as hypotonic urine.The kidney of a freshwater fish is larger in relation to the body weight than that of a marine fish and produces copious urine which is 5 to 12 % of the body weight per day .A freshwater teleost does not drink water as large amount of water enters the body by osmosis and is more than necessary for the fish.

Freshwater fishes lose salt especially chloride by passive diffusion through membranes. Some salts are lost through faeces and also in urine.Urine also contains some nitrogenous waste as creatin, creatinine and urea and a little ammonia. The quantity of salt lost in the day varies in different species.In Salomon loss of salts may be up to 17% of the body chloride while in goldfish carassius auratus, It is only 5 %. the loss of salts is however kept at the minimum by active reabsorption in the proximal and distal tubules. loss of salts is partly compensated through food and by absorption of salt ions from the surrounding water. This is accomplished mainly by the chloride cells in the gills and oral membranes. salt ions absorbed by these special cells at the base of the gill lamellae are lithium, sodium, calcium chlorine, bromine , So4 and phosphate .The entire mechanism of salt balance is under hormonal control .

Osmoregulation imaMarine Teleosts

Marine teleosts are hypo osmotic and live in a medium having high concentration of salts .The Skin of marine fishes as in Fresh water species is impermeable, and osmotic exchanges occur through the gills and oral membrane, marine fishes are faced with the problem of continuous loss of water and gain salts. To prevent osmotic dehydration, marine fishes drink seawater but this further increases salt content of the body. Urine output is considerably reduced to conserve water the glomeruli are reduced or become non-functionfish.The distal segment of the tubule is absent. Thus only a small amount of concentrated urine is produced and most of the water is reabsorbed in the tubule.

As marine fish drinks sea water and sodium and chloride ions are actively absorbed through the gut many species are reported to drink water more than 25% of their body weight per day of which 80% is absorbed . This excess of salt ions is excreted out into the water by the special chloride cells in the

gills oral membrane and inner surface of operculum. urine flow is reduced in some species by having a glomerular kidney as in OPsanus tau.

Osmoregulation in chondrichthyes

The chondrichthyes maintain osmotic concentration of blood nearly at the same levels as that of seawater and are and are not in danger of dehydration and do not drink seawater. this is achieved by retaining nitrogen-containing compounds mainly urea and tri methyl amine oxide in the blood which is slightly hyperosmotic to sea water. Consequently these fishes gain water through osmotic diffusion diffusion across the Gills and do not drink seawater .the kidney has a large glomeruli kidney as in Freshwater fishes and urine is formed by filtration, but most of the urea contained in the filtrate is reabsorbed by special segments of the urinary tubules. the gills of chondrichthyes are impermeable to urea so that it is retained in the blood in large quantity to raise the osmotic concentration. Of blood to slightly higher level than seawater. It is reported that the average urea content in the blood of chondrichthyechond1000/2000 mg % and that of urine to 230 mg % . the osmotic balance in these fishes is maintained by urea cycle . Salts are excreted in the feces and in the urine some salt are reabsorbed in the kidney tubules also but gills do not excrete salts . Gills of chondrichthyes do not have special salt excreting cells. They achieve Salt balance by secreting a fluid containing higher concentration of sodium and chloride ions from the rectal gland.

Diadromous and migratory fishes Salmon and hilsa are anadromous fishes and live in seawater but migrate to rivers to spawn. the eggs develop into fry or fingerlings in the rivers and later returned to the sea. These species are able to adjust water of different salinities due to hormonal activity. Thus young Salomon do not enter the sea until salt secreting cells have developed in the gill and other physiological changes have been completed. The Adjustment in osmotic regulation is brought about by hormones.

Role of hormones

Hormones influence the amount of urine flow by altering the filtration rate in the renal corpuscle through changes in blood pressure . Thus, amount of urine output is altered as required. Salt balance is maintained by hormones controlling diffusion and adsorption of ions by the chloride cells in the gills. adrenocortical hormones, thyroid hormones and those produced by suprarenal, are also known to influence excretion and osmoregulation in fishes . Prolactin also has a role in osmoregulation.