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PG DEPARTMENT OF ZOOLOGY

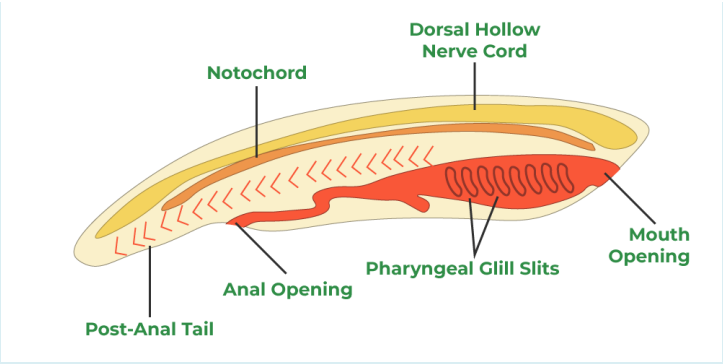
LEARNING RESOURCES

CHORDATA

Phylum Chordata

Animals belong to the largest kingdom Animalia or **Animal kingdom**. Animals can not make their own food. So, they are dependent on other organisms for nutrition and hence known as heterotrophs. They are multicellular performing different functions. They perform displacement i.e, they can move from one place to another, unlike plants. Animals transfer signals with the help of nerve cells. In sponges nerves cells are absent. The central vacuole is totally absent but a small vacuole maybe occur. Animalia possess different Phylum(Porifera, Coelenterata, Ctenophora, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, Echinodermata, Hemichordata and Chordata). The term Phylum was coined by Georges Leopold Cuvier in 1869. Let us have a glance at Phylum – Chordata.

Chordata



Diagnostic Characters of Chordates

1. **Notochord:** It is a solid unjointed, stiff but flexible rod-like structure situated on the mid-dorsal side between the central nervous system and the alimentary canal. The notochord remains throughout like in certain chordates e.g., some protochordate. In vertebrates it is only found in the embryo, however, in adults, it is replaced by a vertebral column (backbone).
2. **Dorsal Hollow Nerve Cord:** It is always hollow and lies dorsal to the notochord.
3. **Paired Pharyngeal Gill Slits**: All the chordates have at some stage of life, a series of paired narrow openings and the gill slits on the lateral sides of the pharynx.
4. **Tail:** It is a postanal part of the body. The tail is absent in many adult chordates.

Classification of Phylum Chordata

Phylum Chordata is divisible into three sub-phyla- Urochordata, Cephalochordata, and Vertebrata.

Subphylum Urochordata (Tunicata)

- This sub-phylum is also known as Tunicata because the adult body is surrounded by a leathery test or **tunic** formed of a cellulose-like organic substance entitle **tunicin**.
- Only the tail of the larva comprises the notochord. It is displaced by a dorsal ganglion in the adult.
- The dorsal tubular nerve cord is present in the larval form and it degenerates in the form of a small ganglion in the adult.
- They are Hermaphrodites.

- The larva (tadpole) undergoes retrogressive metamorphosis, i.e., change from a better-developed larva to a less-developed adult, e.g., Herdmania (sea squirt) Ascidia, Botryllus (colonial urochordate), Molgula, Doliolum, Salpa, Pyrosoma (colonial urochordate), Oikopleura.
- Exclusively marine, solitary, and colonial.
- **Examples**: Oikopleura, Herdmania, Pyrosoma, Doliolum, Salpa.

Subphylum Cephalochordata

- The notochord extends up to the anterior end of the body hence this subphylum is named.
- The notochord persists throughout life.
- Pharyngeal gill slits are more several and are better developed.
- The atrium is also present.
- The wheel organ of **Amphioxus** is also called the ciliated organ of the Muller or rotatory organ. Posterior to the wheel organ there is a circular ring-like structure called velum. The velum leads into the pharynx.
- The tail is present throughout life, e.g., Branchiostoma (= Amphioxus) or Lancelet. Subphyla Urochordata and Cephalochordata are collectively called **acrania** (without cranium brain box) or **protochordate** (primitive chordates).
- Sexes separate.
- **Examples:** Amphioxus or Branchiostoma(lancelet).

Subphylum Vertebrata or Craniata

- In the embryonic stage, the notochord is present. It is displaced by the backbone (**vertebral column**) in adult forms.
- Coupled appendages are certainly not more than two pairs.
- **Cephalization** (formation of head) can be seen.
- The epidermis consists of various layers of cells. The epidermis may put up with an exoskeleton of scales, feathers, or hair.
- The coelom is well developed.
- Complete digestive tract and is ventral to the central nervous system.
- The endoskeleton is made up of cartilage or of cartilage and bone.
- Ventrally situated hearts and their hepatic portal system are present.
- There is a closed circulatory system containing blood vascular and lymphatic systems. Lymph is like blood but is colorless. Blood is with red and white blood corpuscles. Red blood corpuscles contain hemoglobin.
- Gills, skin, buccopharyngeal cavity, and lungs are considered respiratory organs.
- Excretion takes place with the help of a pair of kidneys.
- The central nervous system (brain and spinal cord), peripheral nervous system (cranial and spinal nerves), and autonomic nervous system (sympathetic and parasympathetic nervous systems) make up the nervous system.
- Cranial nerves are 8, 10, or 12 pairs.
- All vertebrates contain endocrine glands.
- They are unisexual, except Hagfish who is bisexual. They lack asexual reproduction.

Classification of Sub-Phylum Vertebrata

Subphylum Vertebrata is divisible into two sections: Agnatha and Gnathostomata.

Agnatha (Gr., a-without; gnathos -jaws)

- Animals have vertebral columns and cranium. They are the earliest vertebrates known to humans.

- They are without true jaws but have a suctorial mouth.
- Without paired appendages or fins.

Agnatha includes the following single class:

Class Cyclostomata (Gr., kyklos- circle, stoma- mouth)

- The body is long, elongated, and eel-like.
- Skin is soft, slimy, smooth, and scaleless.
- The mouth is round, suctorial, and without jaws. They are ectoparasites and use their mouth to stick to the back of other fishes.
- The single and median nostril is present.
- Respiration is through gills contained in pouches (which are 5 to 15 pairs in hagfishes and 7 pairs of lampreys).
- The cartilaginous endoskeleton is present and the notochord is in the form of a cylindrical rod and continues throughout life.
- The heart is two-chambered.
- Gonad is single and fertilization is external. Development is direct or indirect.
- Aquatic, marine, and freshwater.
- Free-living and ectoparasites of fishes.
- Examples: Petromyzon (lamprey), Myxine (hagfish), and Bdellostoma (hagfish).

Gnathostomata(Gr., gnathos jaws; stoma- mouth)

- Vertebrates with jaws and paired appendages.
- This subphylum is divisible into the following six classes: class Chondrichthyes and class Osteichthyes, (a combination of these both classes form **Pisces.**)

Class 1. Chondrichthyes (Gr. chondros = cartilage+ ichthys a fish; cartilaginous fishes). Marine fishes with a completely cartilaginous endoskeleton. The mouth is ventral in position. Skin is tough and coated with minute placoid scales. Respiration through gills. 5 or 7 pairs of gills open outside with the help of gill slits. They have fins for locomotion (swimming) and balance. Fins may be paired (pectoral fins, pelvic fins) median (dorsal fin, caudal fin, and anal fin). Tail or caudal fin is heterocercal. The muscular tail is used for movement.

Examples*: Scoliodon, Sphyrna, Torpedo, etc.*

Class 2. Osteichthyes (Gr. Osteon = bone + ichthys a fish ; Bony fishes).
Marine and fresh-water fish with partly or whole bony endoskeleton include in class Osteichthyes. The body is generally spindle-shaped. Skin is naked or covered with cycloid or ctenoid scales. The mouth is usually terminal (anterior) in position. Four pairs of gills are present and they are coated by the operculum. Gills are filamentous. Fish take in oxygen dissolved in water with the help of gills. They lay eggs and fertilization is external.

Examples: *Labeo, Hippocampus, Anabas, etc.*
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Class 3. Amphibia (Gr., amphi-double; bios-life).
It includes frogs, toads, newts, and salamanders. These animals live both in fresh water and on land (moist places). Skin is smooth or rough, moist, slimy, glandular, and mostly without scales. Mucus glands are present in the skin. Limbs may be absent in some cases.The heart is three-chambered and has two auricles and one ventricle. Double circulation through the heart. Ectothermic (= cold-blooded animals).

***Examples**:*

- ***Apoda**: Ichthyophis;*
- ***Urodela**: Amphiuma, Salamandra, Ambystoma, Necturus;*
- ***Anura**: Rana, Bufo, Hyla, Xenopus laevis.*

Class 4. Reptilia (L., repre- to crawl; creeping vertebrates). (Includes lizards, snakes, crocodiles, and tortoises).
Cold-blooded, terrestrial or aquatic vertebrates with a body coated with dry water-proof skin having horny epidermal scales or dermal scute plates. The body ranges in form and is usually divisible into the head, neck, trunk, and tail. The tympanum is small and depressed. Teeth are present in all reptiles, exception (of tortoises and turtles). Respiration is through the lungs only. No gills are present. Fertilization is internal.

Most reptiles are oviparous and lay their eggs with tough covering and need not to lay their eggs in water. A few reptiles are viviparous for example lizards and snakes. No aquatic larval stage.

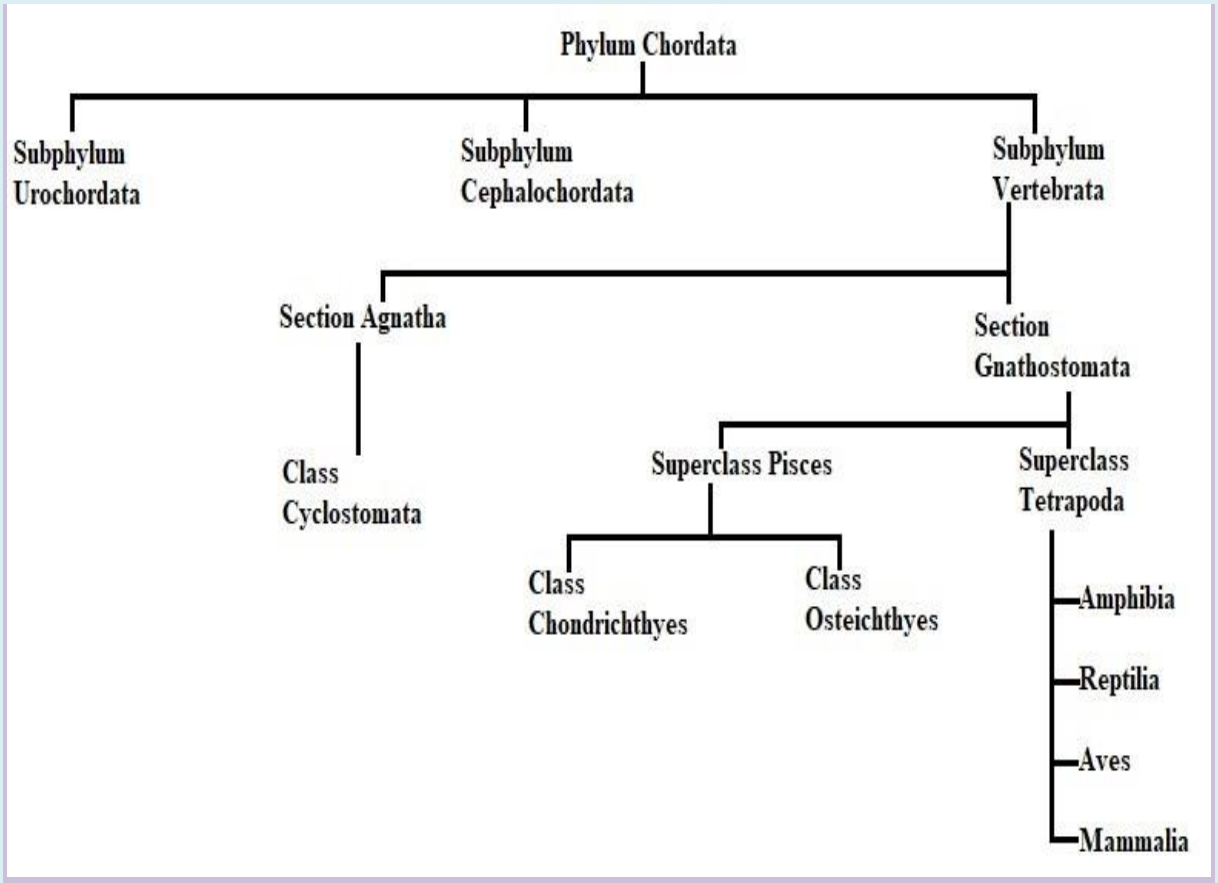
***Examples**: Kachuga, Chelone, Uromastix, Draco, etc.*

Class 5. Aves (L., avis-bird).
Warm-blooded, tetrapods vertebrates (birds). Basically, the size extended from the smallest hummingbird to the largest ostrich. Horny scales persist on the feet but the maximum part of the body is covered by feathers. Cutaneous glands are absent. Spindle-or boat-shaped body is divided into a head, neck, trunk, and tail. Fore-limbs are modified into wings for flight. Kiwis have vestigial wings. Hind limbs have four clawed digits and are adapted for walking, perching, or swimming. They show parental care. Fertilization is internal. They are oviparous.

***Examples**: Gallus, Passer, Corvus, Columba, Psittacula, Pavo, etc.*

Class 6. Mammalia (L., mamma-breast).
Mammals are warm-blooded. The body is split into the head, neck, trunk, and tail. Movable eyelids are present. Milk-producing mammary glands are present in females which secrete milk for the feeding of the young ones. Fleshy external ear (pinnae) present. Two pairs of pentadactyl limbs are present. Limbs are variously modified for walking, running, climbing burrowing, swimming, or flying. Respiration is through the lungs only.

***Examples**: Macropus, Erinaceus, Talpa, Sorex, Pteropus, Bat, Manis, Hystrix, Funambulus, Homo (human being), etc.*


Phylum Chordata
Subphylum Urochordata
Subphylum Cephalochordata
Subphylum Vertebrata
Section Agnatha
Section Gnathostomata
Class Cyclostomata
Superclass Pisces
Superclass Tetrapoda
Class Chondrichthyes
Class Osteichthyes
Amphibia
Reptilia
Aves
Mammalia

DENTITION IN MAMMALS

- **Teeth In Herbivores, Carnivores and Omnivores**

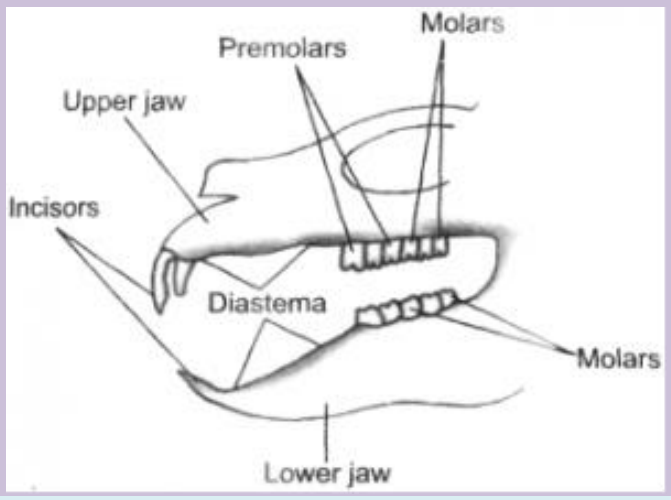
  Dentition: The arrangement of teeth in the jaws is called dentition.

  Teeth in herbivores (like rabbit), carnivores (like dog) and omnivores (like human beings) are related to the diet the animals take.

  As mentioned earlier, there are four different kinds of teeth

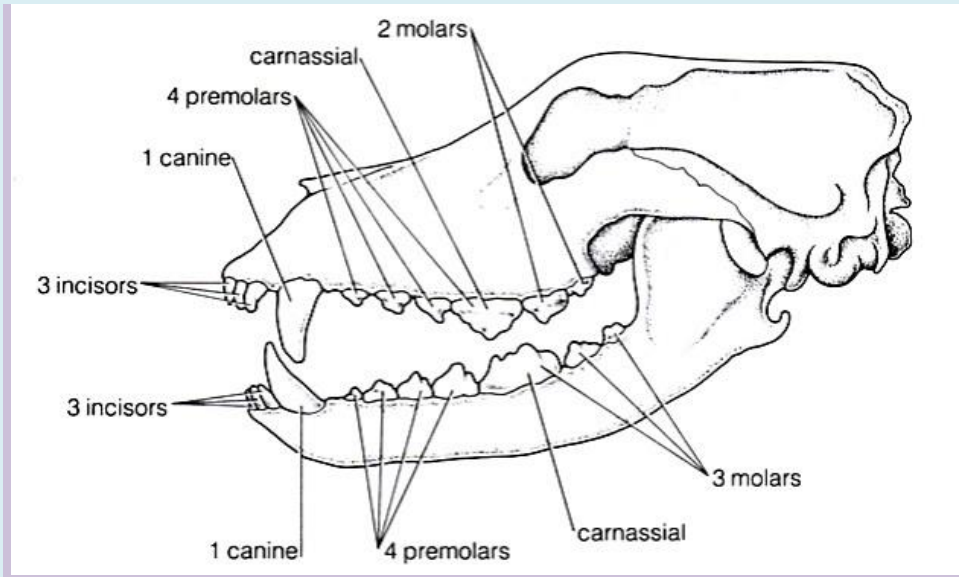
  (i) incisors (for cutting) (ii) canines (for tearing)

  (iii) premolars, (iv) molars (for grinding)

- **Dentition In Herbivores (Example Rabbit)**
- They have incisors which are sharp and used for cutting. Canines are absent and a gap occurs between the incisors and premolars. This gap is called **diastema.** The premolars and molars are used for chewing.
- 

Dentition in a rabbit

- The premolars and molars are almost similar in shape and size, as they have the same function. The gap between the incisors and the premolars (diasteina) allows the tongue to manipulate the food.



Dentition in a dog

- Dentition In Carnivores(Example Dog)

  In carnivores the teeth in different regions of the mouth are specialised to perform a particular function. They have all four kinds of teeth. The incisors in the front of the mouth grip the food and strip off small pieces of flesh. The canines are long, sharp and pointed and adapted for flesh eating. The molars have somewhat flat surface for grinding and crushing the bones.

- **Dentition in omnivores (example human beings)**

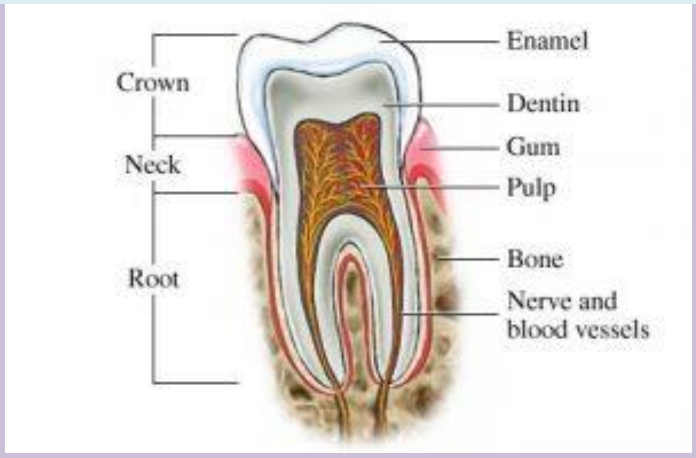
  In omnivores, all the four kinds of teeth are well-adapted to cope up with a wide range of foods the vegetables and variety of meat. The teeth are not as specialised as in carnivores and herbivores.

  The four kinds of teeth in human beings have been already described.

- **Structure of a Tooth**

- You have learnt that teeth, present in the mouth cavity, play an important role in biting and chewing the food. In an adult human being, there are four types of teeth – – incisors, canines, premolars and molars.

  Fixed to the gums, each tooth has following three parts (Figure):



- A tooth in section
- (i) **Root,** the part embedded in the jaw,
  (ii) **Crown,** the top part projecting above the gums, and
  (iii) **Neck,** the part between the root and the crown.
- Internally, there are three parts of a tooth – **enamel, dentine** and the **pulp cavity.** Enamel is the white part of the tooth, and is the hardest substance in our body. Below the enamel, dentine is present. Inner to dentine is the soft pulp cavity which contains blood vessels and nerves

FISH MIGRATION

Migration is the of mass movement of animals from one place to another for food,shelter,mates and escaping from extreme environmental condition. The reason for migration vary accordingly with the types of animals. In fishes migratory behaviour is a regular phenomenon.

Types fish migration on the basis of needs:

1. Feeding or Alimental migration: migration in search of food and feeding ground. It occur when food resources get diminished.
2. Spwaning or gametic migration: it occur during breeding period in search of the suitable breeding ground.
3. Seasonal or climatic migration: migration in search for suitable climatic condition.
4. Osmo-regulatory migration: migration for maintaining water and ionic balance.It occurs from sea to fresh water and vice-versa.
5. Juvenile migration: it is migration of larvae from breeding ground to the feeding grounds of their parent.

Examples for migratory Fishes

The following are the examples for migratory fishes:
1. Eels- *Anguilla Anguilla,A. vulgaris, A. rostra,* etc.
2. Salmon - *Salmo solar,Oncorhynchus nerka*
3. Indian shad - *Hilsa hilisa*

Causes for Fish Migration

The migration of fish is caused by the following factors:
1. Sexual maturity is a stimulus for migration
2. Hormones play significant role in migration.
3. Instinct is an important causes of fish migration.
4. To avoid predators and competition
5. Scarcity of food resources
6.Environmental factors like light, temperature, salinity, pH, water currents, turbidity, etc.

Speed of Migration

The average speed of migration is 3 times the length of the fish per second. If the length of the fish is 12 inches, the speed of migration is 12x3=36 inches per second.

Types of Migration

Fish migration is classified into four main types. They are as follows:

1. Oceanodromous,
2. Potamodromous,
3. Catadromous,
4.Anadromous.
5.Latitudinal migration:
6. Vertical migration:
7. Shore ward migration:

1. Oceanodromous migration

Long journeys within the sea for breed- ing is called oceanodromous migration. Eg.

Herrings (Clupea), Mackerels, Tunas, etc.

2. Potamodromous migration: Long travels within freshwater is called potamodromous migration. Eg. Carps and trouts and catfish

3. Catadromous migration:The journey of freshwater fishes to the for spawning is called catadromous migration. Eg. Eels.

4.Anadromous migration: The journey of marine fishes to fresh- water is called anadromous migration. Eg.Salmon, Indian shad, etc.

5.Latitudinal migration: In this type fishes migrate to north in spring and to south in autumn.This is performed by fishes like Sphyraena and swordfish of the warm tropical seas.

6. Vertical migration: Vertical migration is performed by many marine and freshwater fishes and is related to light, search of food, protection and also to spawning. Example:Mackeral rises into the surface waters when there is a rich development of plankton.After eating plankton they go to deep layers after feeding.

7.**Shore ward migration:**In this type of migration there is a temporary movement of fishes from water to land. The common eel travel from one pond to another through moist meadow grass.

Migration in Eel
(Catadromous Migration)

Eels are freshwater fishes. They travel long distance into the sea for breeding. Hence they are said to be catadromous fishes and the migration is called catadromous migration.Sexually mature female eels, migrate to- wards the sea.Males follow the females. During the travel the reproductive organs ripen and the alimentary canal shrinks. They stop feed-They travel 5000-6000 kms in the sea and reach a depth of about 500 metres. Here they spawn and die after spawning. The eggs hatch into a larva called Leptocephalus. It looks like a nerium leafand is transparent. It leads a pelagic life.Certain leptocephalus larva grows to alength of 62.5 inches. After 2 or 3 years it becomes a cylindrical larva, called Elver's larva

Elver's larva, after some time, migrates to fresh-water, reaches the place where their parents lived and grows into adults. It is a mystery how he young eels in the absence of their parents find their way and reach the same place wheretheir parents lived.

Migration of salmon
(Anadromous Migration)

Salmon is a marine fish. It migrates to reshwater for breeding. Hence it is an anadroaous fish and the migration is called anadromous migration. They migrate in pairs.Theytravel thousands of kilometres to reach the breeding ground. The males develop red spots and the females develop black spots.On entering freshwater, they stop feeding anddepend on the body fat for energy. On reaching the breeding ground, the female makes a saucer-like depression in the river bed and lays the eggs. Then the male releases the sperms and the eggs are fertilized. After spawning the parents return to their feeding ground. The fertilized eggs hatch into young salmons which after a few days migrate to the sea. These offspring, after attaining sexual maturity, take the same route and reach the same breeding ground for spawning.

Significance of fish migration

1. Migration helps to find suitable feeding and spawning ground

2. Migration gives protection from predators
3. Migration helps in survival from extreme climatic conditions
4. Migration increases genetic diversity
5. it is an adaptation for the survival of species.

LARVAL FORMS IN PHYLUM ECHINODERMATA

 In echinoderms eggs and sperms are released in water and fertilization takes place in water forming zygote.

 Echinoderms are deuterostomes and hence cleavage is radial, holoblastic and indeterminate.

 The larvae hatch in water and feed and grow through successive larval stages to become adults.

 The larvae of echinoderms are bilaterally symmetrical but lose symmetry during metamorphosis.

 Different classes of echinoderms show structurally different larval stages and their comparisons can reveal their evolutionary ancestry

LARVAE OF ASTEROIDEA

There are three larval stages in Asteroidea in the course of their development to adult stage.

EARLY BIPINNARIA LARVA

 Early bipinnaria appears like hypothetical dipleurula.

 It has oval body without arms and ciliary bands for locomotion.

 It has well developed alimentary canal for feeding and grows to become bipinnaria.

BIPINNARIA LARVA

 Bipinnaria larva possesses 5 pairs of ciliated arms which do not have any skeletal support inside.

 These arms are used for swimming in water while feeding on planktons.

BRACHIOLARIA LARVA

 Brachiolaria larva is formed after 6-7 weeks of life and growth of bipinnaria.

 This larva is sedentary and remains attached to a hard substratum for which it possesses three brachiolarian arms having adhesive discs at the tip.

 Ciliated arms get reduced and become thin and functionless, while mouth, anus and gut are well developed.

 It has axocoel, hydocoel and somatocoel that later on give rise to water vascular system.

 Development of starfish takes place inside the sedentary brachiolaria which ruptures and releases tiny starfish into water

 Pre-oral and post-oral ciliary bands are also present.

 This larva resembles Auricularia larva of Holothuroidea in general appearance

LARVAE OF HOLOTHUROIDEA

Class Holothuroidea demonstrate two larval stages, namely, auricularia and doliolaria larvae.

AURICULARIA LARVA

 Auricularia larva has striking resemblance with bipinnaria of Asteroidea as it also possesses 4 or 5 pairs of ciliated arms for swimming and has a well-developed mouth, gut and anus.

DOLIOLARIA LARVA

 Doliolaria larva is the next stage after auricularia.

 It has barrel like body with 5 ciliated bands surrounding it.

 Mouth or vestibule in on the ventral side for feeding.

 There is neural sensory plate on the anterior side for feeding.

 There is neural sensory plate on the anterior side and an apical tuft of cilia for balancing while swimming.

 Doliolaria transforms into adult but in some holothurians doliolaria stage may be absent.

LARVAE OF ECHINOIDEA

ECHINOPLUTEUS LARVA

 There is a single larval stage in echinoidea called Echinopluteus which is bilaterally symmetrical.

 The larva has oval body and long paired ciliated arms that are supported by calcareous skeletal rods.

 Pre-oral arm is present but posterolateral arm is absent.

 The other three arms are anterolateral, post-oral and posterodorsal arms.

 Mouth, anus and gut are well developed.

LARVAE OF CRINOIDEA

PENTACTULA LARVA

 Pentactula is the basic larval stage of Crinoidea but it passes inside the egg.

 There is one or two larval stages in sea lilies

DOLIOLARIA LARVA

 Doliolaria larva, which is also called Vitellaria larva, is found in some sea lilies.

 It resembles doliolaria of holothuroids but has an adhesive pit on the ventral side with which it attaches to substratum and becomes sedentary.

PENTACRINOID LARVA

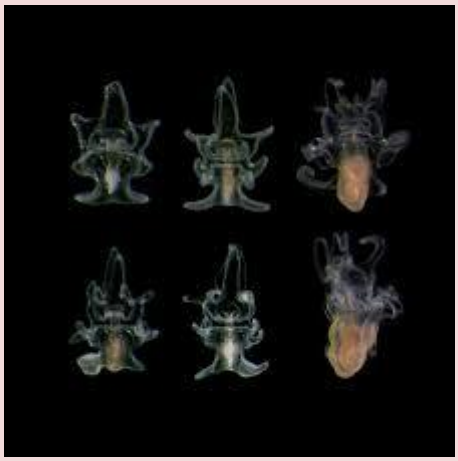
 Pentacrinoid larva is sedentary and attaches to substratum with an attachment plate.

 Body is supported by a stalk.

 There are 10 cilia bearing tentacles which are used for capturing food.

 Both mouth and anus are on the same side of the disc.

The affinities among larval stages of echinoderms demonstrate evolutionary relationships among different classes. However, the same relationship cannot be shown in the cladistics classification of echinoderms, which is based on adult characteristics. Adults are highly modified organisms in echinoderms.



PARENTAL CARE IN AMPHIBIANS

INTRODUCTION

Parental care can be defined as any non-genetic contribution by a parent that increases the fitness of offspring and can occur before or after laying or birth. (Stahlschmidt & DeNardo,2011)

Parental care in Amphibia may be defined as any behaviour exhibited by a parent towards its offspring's chances of survival(Trivers,(1972)

Looking after the eggs or young until they are independent to defend themselves from predators is known as parental care. Parental care is very important factor for survival. Parental care behaviour is any behaviour performed after breeding by one or both parents, that contributes to the survival of their offspring. Parental care is a form of altruism (unselfish concern for other) in spending time and energy to aid its offspring. The degree of parental care varies considerably, from species to species and depends upon the number of offspring produced.

The continuation of race is made possible by rearing of the offspring. Male and female giving food, shelter and protection to their off springs is parental behaviour. The amphibians were the first among vertebrates to invade land. They faced the most hardship and were anxious about the continuation of their race. Hence they developed various ways and means to protect their progenies.

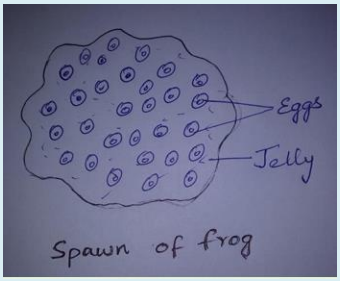
The methods of caring by amphibians is mainly divided into two categories

A) Protection by nests and nurseries

B) Direct carringby parents

A.Protection by means of nest and nurseries.

Deposition of eggs in suitable places: In Triton the eggs may be fixed with the aquatic weeds by glues. A number of different species of frogs lay their eggs in suitable place either in water or outside the water. In water-Rana tigrina (Indian Frog) lay eggs in pond water in a jelly like bunch.



On tree or away from water

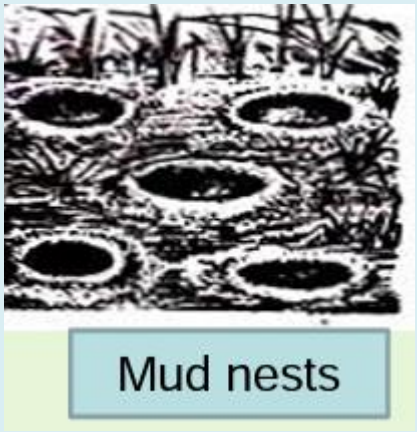
American frog Hylodes keep their eggs below the rocks, mosses and on leaves of trees. The eggs of these species are larger and development takes place fast as yolk is in sufficient quantity.

Construction of Nest

A number of different species of frogs construct nests or shelters in which the eggs are laid. They construct following different types of nests.

MUD NEST-Female tree **frog Hyla faber**

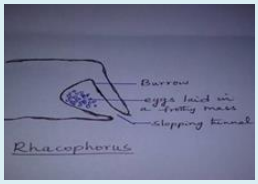
Form nurseries at the bottom of the shallow pond for care of eggs. They construct 7-10cm deep hole in the mud in shallow water.



Females lays eggs in nests and male discharge sperms to fertilize eggs.

Tunnel nest

Female Japanese tree frog (*Rhacophorus ocellatus*) makes a spherical hole in mud at pond banks and lays eggs and males discharge sperm and fertilize the eggs



Construction of Nest

Leaf Nest

Tree frog of South America (*Phyllomedusa malabariens*) ,Africa (Chiromatis) lts eggs on rolled up leaves hanging above water.The nest is covered by many leaves.Eggs develop into tadpoles.The tadpoles directly fall into the water.Further metamorphosis of larva take place in water.After two to three weeks tadpoles fall into water.

Female grass frog of rain forest *Costa rica* lay her eggs on leaves of tree and males take care of eggs.

Foam nests Many amphibians convert copious mucous secretion into nests for their young.

The female of South American tree frog, *Leptodactylus mystacinus*,stirs up a frothy mass of mucus, fills it in holes near water and lays eggs in them.

Male frog *Adelotus brevis* lays eggs in foam nests.

Gelatinous bags:

Female *Phyrynixallus biroisecrets* a transparent bag and keep their fertilized eggs in it.The transparent membranous bag is left in water current of hill stream. Entire metamorphosis occurs in it, small frog come out of this bag after maturation.

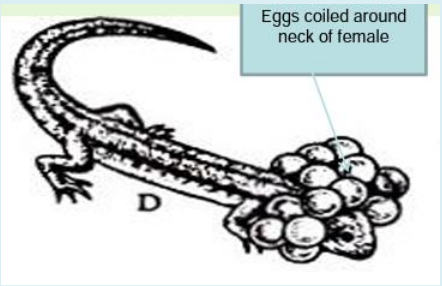
Communal nests:

The toad *Nectophyrynoides malcolmi* prepare communal nests in which eggs are deposited by several females. This nest is guarded by a single male.

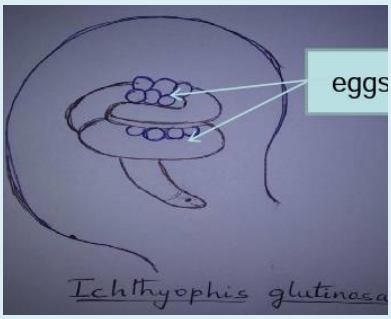
B-Direct caring by parents

Carrying of eggs over the body Eggs are protected by covering them with their body-Male *Mantophryne robusta* species covers the eggs by elastic gelatanious covering in row.Male sits on the eggs and hold them with forelimbs.

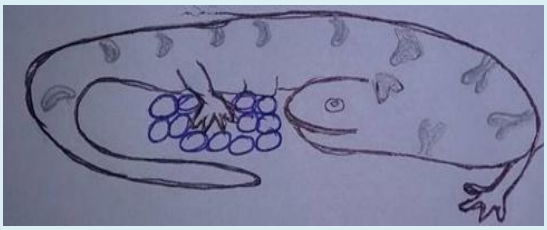
Around the head and neck *Desmognathus fucus* carry their eggs around neck and its head.



Coiling around eggs: The apodans such as *Ichthyophis glutinosa* lays eggs in a shallow hole near the water and the female coils herself around the gelatinous egg mass.



In the Salamander congo eel *Amphinuma* the female lays large eggs in burrows in damp soil and guards them by coiling her body round them until they hatch.



The female Plethodon also coils round the eggs.

Transfering tadpoles to water :

Some species of small frogs such as *Phylobates, Arthroleptis, Pelobatesin* both Tropical Africa and South Americans deposits their eggs on ground.

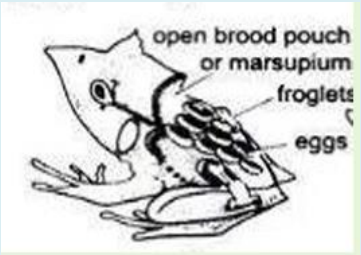
The tadpoles hatching out from parents Eg-female in Sooglossuswith their sticky ventral tropical Africa and South America deposits their eggs on ground.Thetadpoles hatching out fasten themselves to the back of one of the parents Eg:femalein Sooglosuswith their sucker like mouth or their sticky ventral side.

Eggs around the legs

Male *Alytes obstitricans* rap the rows of eggs around their legs and pelvic region and carries them till hatching.

Eggs on the back of the female

Female Brazalian tree frog (*Hyla goeldii)* Carry eggs on their back.



Pipa americana eggs are carried on the back of the mother.But the skin thickens and grows round the eggs.Until each is enclosed in a dermal cell which is finally covered by a lid formed from the secretion of glands of the skin.

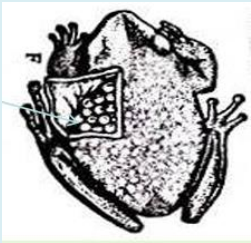
Pipa pipa (Surinam toad) the eggs are carried by female during breeding season. The fertilized eggs are attached to the soft and spongy back of the female

Eggs glued to the body

Eggs on exposed belly of female Female *Rhacophorus reticulates*, of Ceylon carry their eggs on their belly

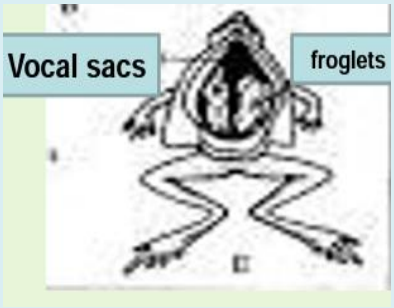
Eggs in back pouches:

Gastrotheca marsupial eggs are placed in a common pouch present below dorsal surface of body wall.



In mouth or gull pouch

South American male frog *Rhinoderma darwinii* take eggs in gull pouch. The gull pouch is modified vocal sac. (These eggs emerge into young frog. *Rhinoderma* pushes at least two fertilized eggs in vocal sacs. Tadpoles complete their development and are metamorphosis in vocal sacs.

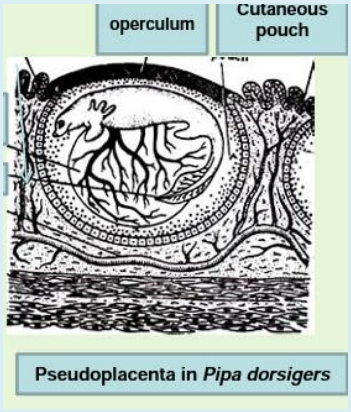


West African tree frog (*Hylambates breviceps*) female carries eggs in her buckle cavity.

Viviparity

Pipa dorsigera,Pseudophryne vivipara and *Nectopharycnoides trotnieri* are viviparous.They give birth to young ones.Their embryos develops in their uterus**.**

Embryo of *pipa dorsigera* get nutrition by pseudoplacenta. The European Salamandra salamandra produce 20 or more small young while alpine salamander *S. atra*. The eggs are placed inside the uterine cavity where the entire development takes place.The uterine wall functions physiologically as primitive placenta.



Conclusion

Parental care occurs 10-15% in Anurans exhibiting the greatest diversity

It enhances the survival rate of eggs and larvae.

Protects from predators and desiccation.

Contributes to reproduction fitness.

AQUATIC MAMMALS

Mammals are primarily terrestrial animals, but some of them have wonderfully adapted their secondary aquatic life.

So based on the relation to water and the aquatic adaptations, mammals are classified in to two group:

1. Entirely/Completely aquatic mammals

2. Semi-aquatic or amphibious mammals

They either live in fresh water or salt water.

1.Entirely/Completely aquatic mammals:

Aquatic mammals include species that live their entire live in the water and depend on it for survival, such as whales, dolphins or manatees etc. They never come to land and are completely reside in water.

2. Semi-aquatic or amphibious mammals:

•There are some mammals reside their live in both terrestrial and aquatic environments called semiaquatic animals/Amphibious mammals, like seals, otters, and hippopotamuses etc.

•The semi-aquatic mammals spend the majority of their time in the water (for food and shelter), but need to return to the land for important activities such as mating, breeding and moulting.

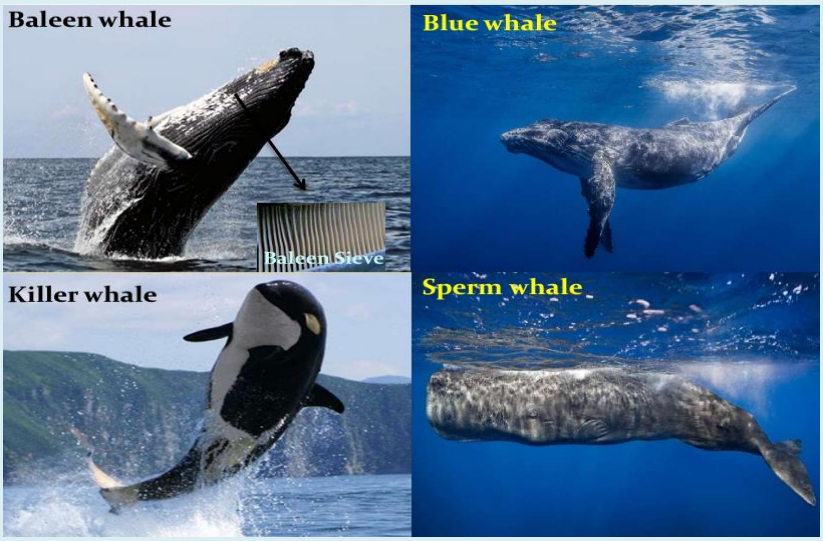
Adaptation and Modification in aquatic mammals

Completely aquatic mammals:

Group	Example
Cetacea	Whales, dolphins, porpoises
Sirenia	Dugongs, manatees

A great disadvantage of all aquatic mammals is retention of the lung breathing habit

Cetacea (Whale like mammals)



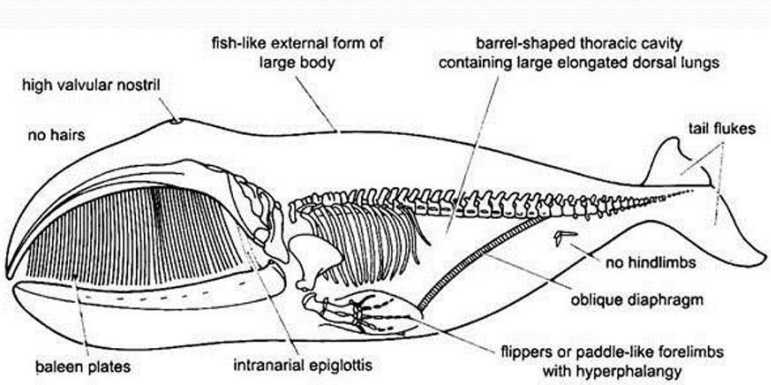
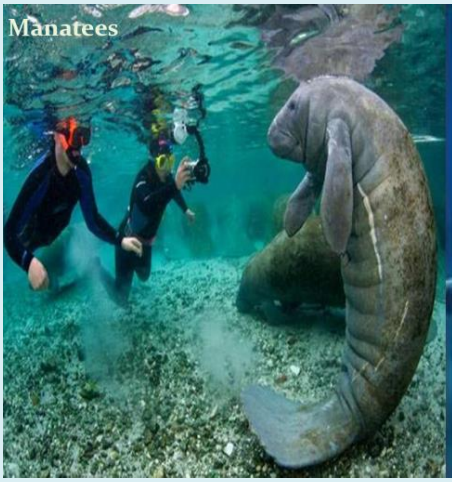
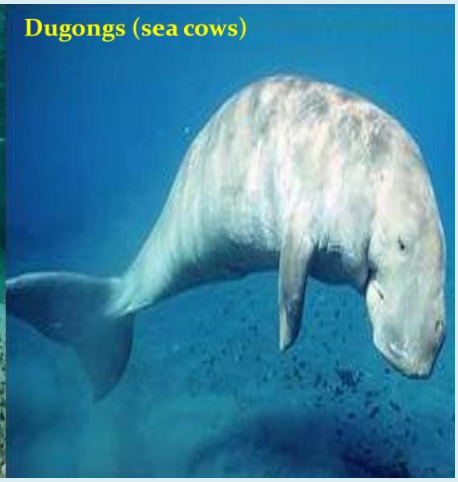


Fig. Body outline structure of the Whale.

Sirenia (aquatic herbivorous mammals)





SEMI-AQUATIC OR AMPHIBIOUS MAMMALS

Group	Example
Monotremata	Ornithorhynchus (Platypus)
Marsupialia	Chironectes
Artiodactyla	Hippopotamus
Pinnipidia	Walruses, otters, seals, sea lions
Rodentia	Beavers, Musk rats

Monotremata (Egg laying mammals Ornithorhynchus): , They also referred as duck-billed platypus, important features are pectoral girdles made of five bones, splayed legs and rudimentary ribs on the neck vertebrae. Both male and female platypuses are born with ankle spurs, only the male's spurs deliver venom.

Chironectes (Marsupialia): It is the only living member of its genus.

Beavers (**Rodentia**): Long incisors that grow continuously.

IMPORTANT AQUATIC ADAPTATIONS

Modification in Original structure	Characteristics
Body shape	Elongated skull, tapering and stream lined body help in swimming, reduced projecting structure like hind limb, pinnae, scrotum etc.
Integumentory modification	Mainly loss of hair, skin glands & the formation of blubber (fatty layer of adipose tissue, beneath the epidermis –thick coat), that maintained constant temperature and prevent heat loss. Hair around the mouth (except white whales)
Locomotor adaptation	Origin of flipper (swimming paddles), Forelimbs are modified into skin covered un jointed flipper , Formation of dorsal fin, tail flukes in cetaceans Hyperdactyly and hyperphalangy (development of extra fingers & extra phalanges)
Respiratory modifications	The nose opening is move to the dorsal side of the head that help animal to inhale atmospheric air ,without raising head, Nostrils are valvular (closed during under water stay), Epiglottis has become tubular, elongated .

Mammary gland	In lactation the mammary duct dilates and acts as storage of milk which is pumped directly into the mouth of the young.
Skeleton Modification	Endoskeleton is lighter by the presence of oil inside bones, Modification of skull bone, Cervical vertebrae are fused (neck region reduced).
Large lungs	Highly elastic & non lobular with high storage capacity, this allow the animal to stay under water for a longer period, High concentration of myoglobin in muscles that help to store oxygen.
Teeth	Teeth are simple, dentition is homodont and monophyodont, In baleen whales teeth are present only embryo.
Digestive System	Mastication is absent in aquatic animal oral cavity, Salivary glands are very much reduced, stomach having chambered & specialized for crushing and digesting the food.

Important points

•All kind of skin gland including (Lacrimal) are absent and skin is devoid of muscle and nerve

•Thy have foam like substance made up of fat mucus and gas in the middle ear which improve their hearing under water.

•Melon: It is a receptor organ present in front of nostril which detect pressure change in water.

•Baleen: In some whale the upper jaw develop rows of numerous triangular horny plate called baleen, serve as effective sieve to capture plankton.

•Harderian gland –This gland secretes a fatty substance which protect the eye under water.

•Nictitating membrane of eye is absent.
