

BONY FISH ANATOMY

Fish anatomy: is the study of the form or morphology of fishes, it can be contrasted with fish physiology, which is the study of how the component parts of fish function together in the living fish.

A/ External fish anatomy

1.The body: Divided into head, trunk and tail.



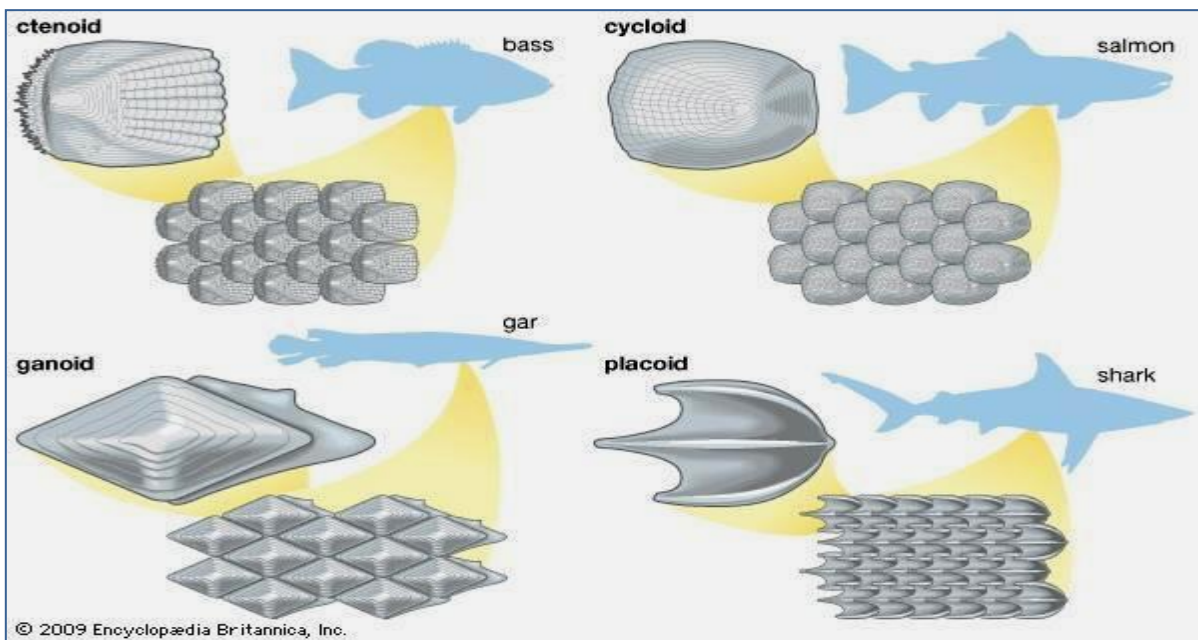
2.Skin: Fish skin typically have numerous mucus-secreting skin cells that called **mucous layer** and may also have poison glands. This layer is protecting the fish from parasites and diseases, and **Epidermis, Dermis** and **Scales** (calcified plates originating in the dermis and covered by the epidermis). The epidermis of fish is often relatively colourless. Instead, the colour of the skin is largely due to chromatophores in the dermis, which, in addition to melanin, may contain guanine or carotenoid pigments.

***Scales:** It is the outer body of many fish and act as protective layer. The scales originate from the dermis, and may be similar in structure to teeth, they give primary protection from pathogens, but still a place pathogens could infiltrate.



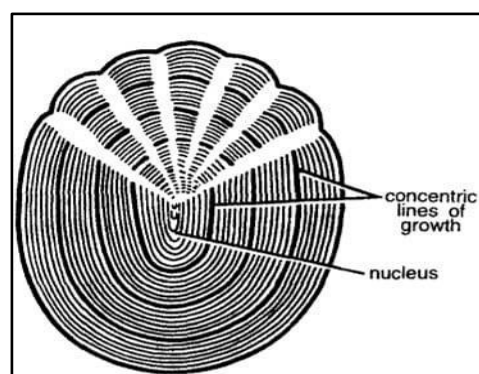
There are four principal types of fish scales:

- 1.Placoid scales:** are similar to teeth in that they are made of dentin.
- 2.Ganoid scales:** are flat shape, that cover a fish body with little overlapping.
- 3.Cycloid scales:** are small oval-shaped scales.
- 4.Ctenoid scales:** are similar to the cycloid scales. They are distinguished by spines that cover one edge.



Functions of scales:

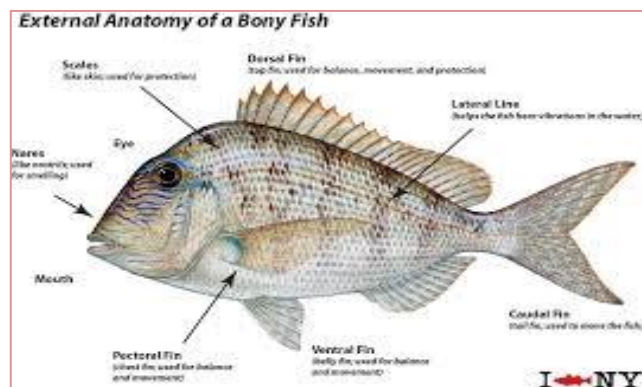
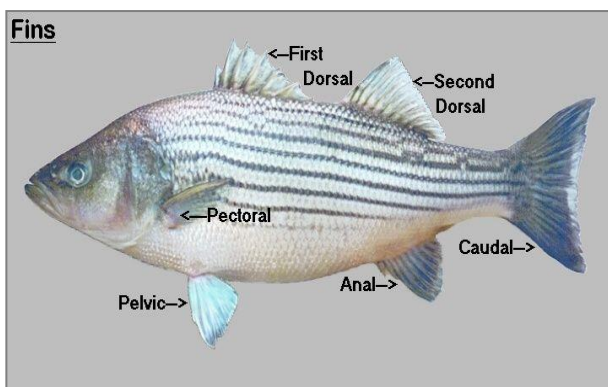
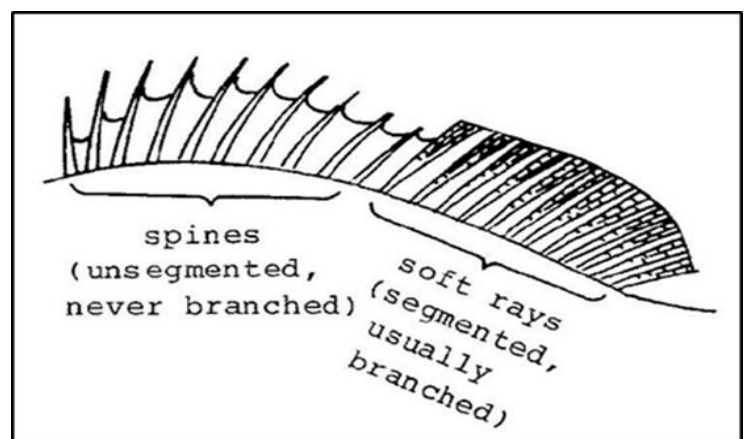
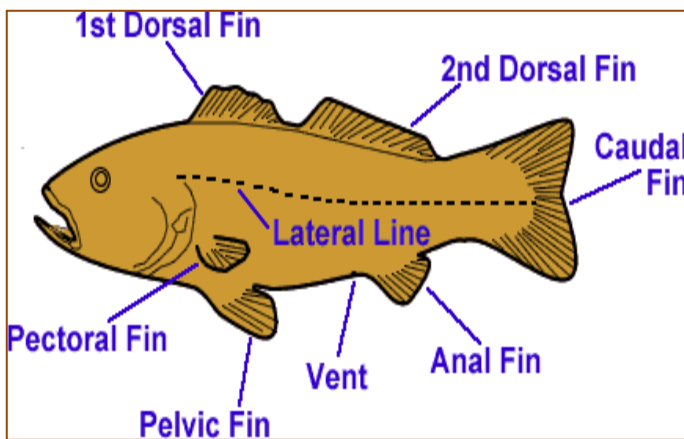
- 1. Fish classification:** The importance of scales in fish classification is very important. The number of scales varies from species to species. Along the lateral line of the fish, rows of scales above and below it are used to identify family, genera, and species.
- 2. Life history of fish:** With the growth of fish throughout life, scales also increase. As a result of growth, some concentric circular lines are seen on the scales which are called growth lines. These lines are also created to vary the physical growth of the fish in different seasons. During the winter, the growth of fish in the region is hampered in winter, resulting in the formation of a large line every year, known as the annulus. From these lines fish breeding, seasonal growth, annual growth etc.
- 3. In self-defense and food hunting:** The thorns that is formed by the transformation of scales plays an important role in fish self-defense and food hunting. In addition, the protect the fish from parasites as a protective coating.
- 4. Gender selection:** In the breeding season, some species of matured male fish have different colors.
- 5. Adaptation:** Different types of fish scales and their color help the fish to adapt in different environments.
- 6. Locomotion:** Some fish scales help the fish to move and give flexibility during the movement.
- 7. Osmosis:** they are help in controlling the infiltration by entering the body of the fish or discharging water from the body into the reservoir.

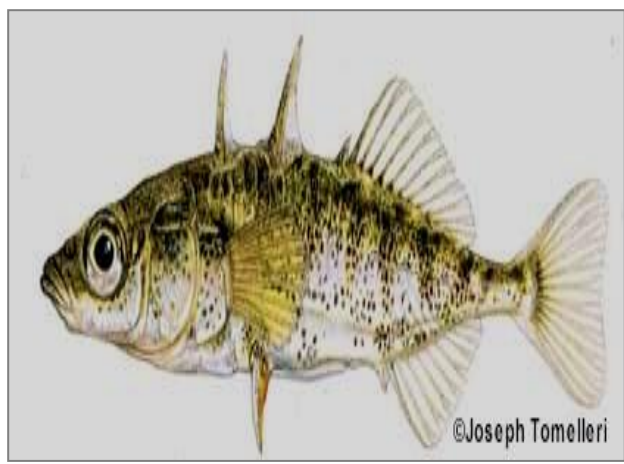


3.Lateral line: Is a sense organ used to detect movement, vibration in the surrounding water and is capable of determining the direction of their source. It is clearly visible is present along middle side of body. In most species, it consists of a line of receptors running along each side of the fish.



4.Fin: Fins located in different places on the fish serve different purposes, it is provide fish with balance, steering, and protection. Fins are either **single fins**: the dorsal fin, anal fin, and tail fin; **or paired fins**: the pectoral fins and Pelvic fins. Most fins have spines or rays. A fin may contain only spiny rays or soft rays, or a combination of both. Spines are generally stiff and sharp. Rays are generally soft, flexible, segmented, and may be branched. This segmentation of rays is the main difference that separates them from spines; spines may be flexible in certain.



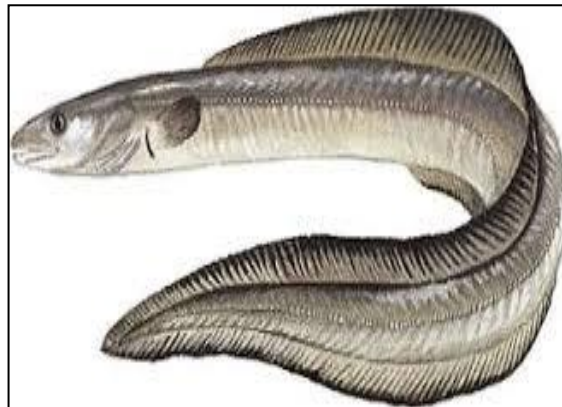
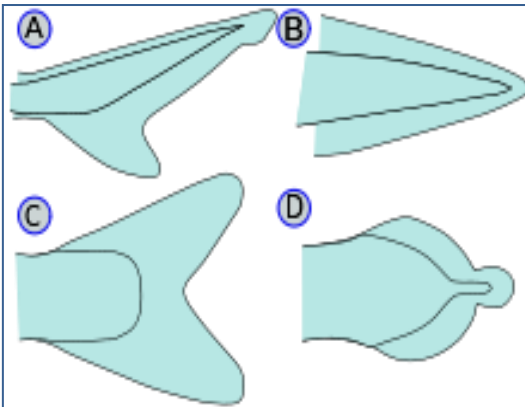


Types of fins:

Dorsal fins: are located on the back. Most fishes have one dorsal fin, but some fishes have two or three. The dorsal fins serve to protect the fish against rolling, and assists in sudden turns and stops. The bones that support the dorsal fin.



Caudal fin: or **tail fin**, located at the end of the caudal peduncle and is used for propulsion. This can be expressed in a variety of shapes.

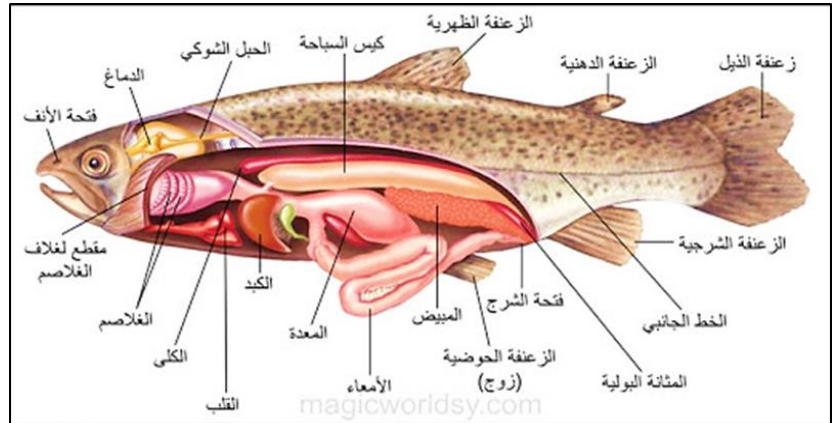


Anal fin: is located on the ventral surface behind the anus. This fin is used to stabilize the fish while swimming.

Pectoral fins: are paired located on each side, usually just behind the operculum, used for balance and steering and maintaining depth and also enables the "flight" for flying fish.

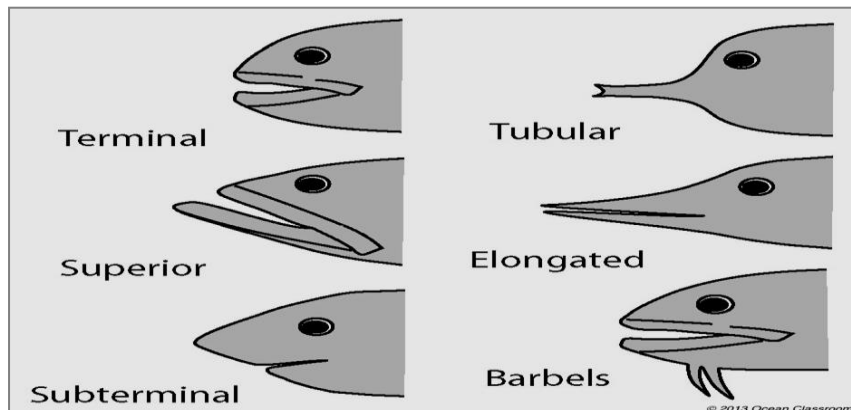
Pelvic fins: or **ventral fins** are paired located ventrally below the pectoral fins. The pelvic fin assists the fish in going up or down through the water, turning sharply, and stopping quickly.

Adipose fin: is a soft found on the back behind the dorsal fin and just forward of the caudal fin. It is absent in many fish families, but is found in Salmonidae and catfishes. In some researches suggested that the fin may be vital for the detection of and response to stimuli such as touch, sound and changes in pressure.



5.Head: The head in fish includes many parts:

***Mouth:** The mouth in fish will vary in size and shape may or may not contain teeth, depending on what the fish eats and on the species of fish. Using for feeding, breathing and incubation eggs in some species .The location of the mouth on a fish’s body can also give us a clue as to what the fish’s diet.



***Nares (Nostrils):** Is organ uses to smell and to detect odors in water and can be quite sensitive; but not used for breathing. It is located on dorsal side of the anterior end of head.



***Eyes:** located in lateral position at anterior end of head. The eyes are adapted for seeing underwater and have only local vision. Some fish can see ultraviolet and some can see polarized light. It is without eyelids

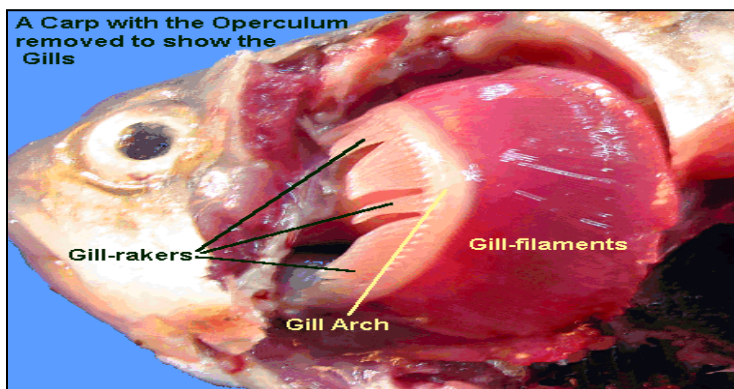
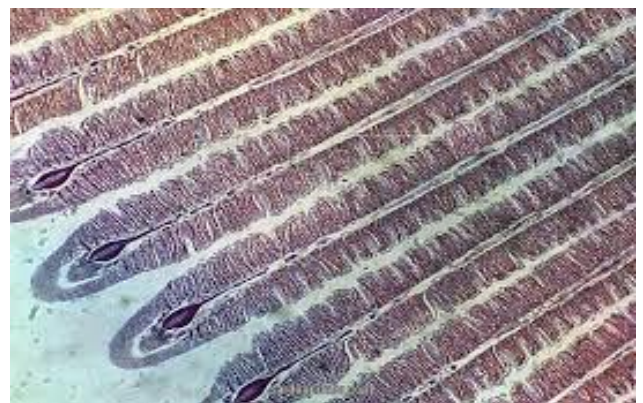
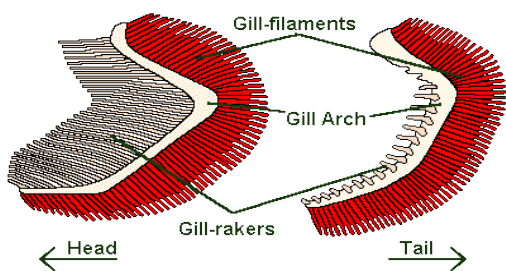
***Ears:** There is an inner ear but no external or middle ear, have sensory function.

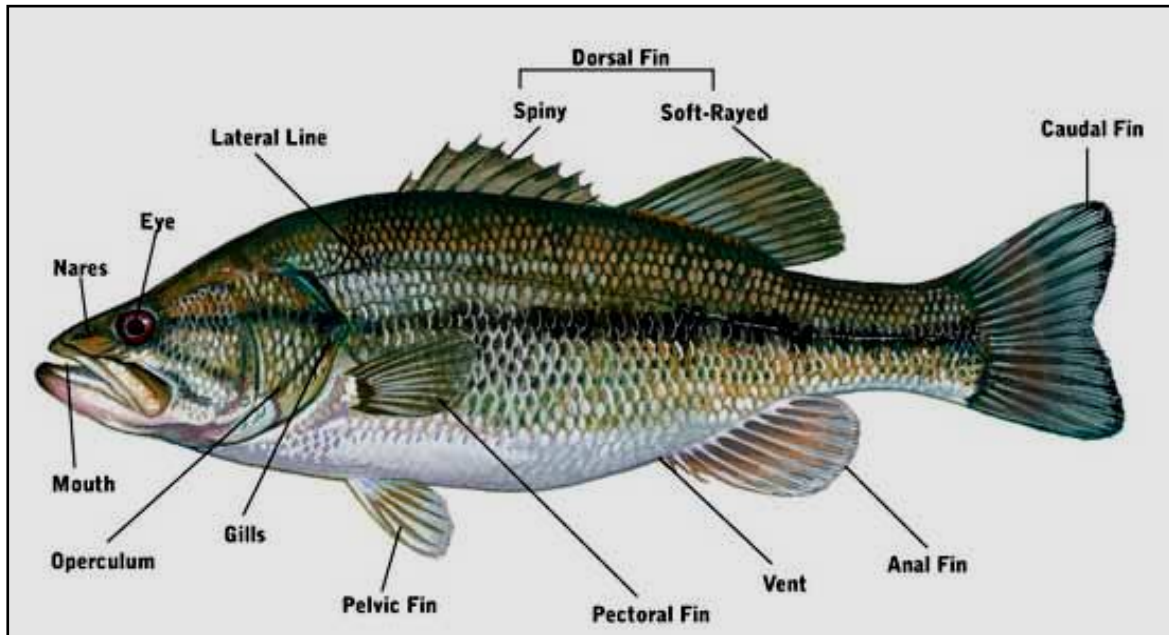
***Operculum:** Is the hard bony flap covering and protecting the gills, located at the posterior and lateral positions of the head. The rear edge of the operculum roughly marks the division between the head and the body.



***Gills:** Most fish have 4 gills on each side located under the operculum, they are a respiratory organ for the extraction of oxygen from water and for the excretion of carbon dioxide. Gill are consist of **paired gill filaments**, each filament consists of numerous lamellae. These filaments have many functions including the transfer of ions water, as well as the exchange of oxygen, carbon dioxide, acids and ammonia. Each filament contains a capillary network that provides a large surface area for exchanging.

paired gill filaments is supported by a **gill arch** and protected by **gill rakers**, tooth-like projections that help make sure that no extraneous material gets into the gill filaments to clog them up (filter-feeders).



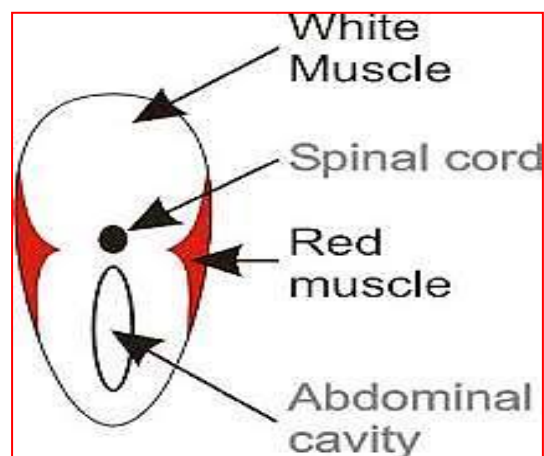


External fish anatomy

B/ Internal fish anatomy

1. Musculoskeletal system:

Muscle: there are two type of muscles in fish, **red** and **white muscle**.The colours of these muscles show is related to the amount of haemoglobin present in the muscles, with red muscle having plenty of haemoglobin present because it has a high number of capillaries and and white very little, if any. Red muscle, also known as **slow muscle**, being well supplied with oxygen, red muscle is used for steady, constant-effort swimming. White muscle, or **fast muscle**, has thicker fibres than red muscle and possesses many less capillaries, therefore, a reduced oxygen availability. Most white muscle activity is anaerobic and can only work for short periods of time used for quickly swimming.

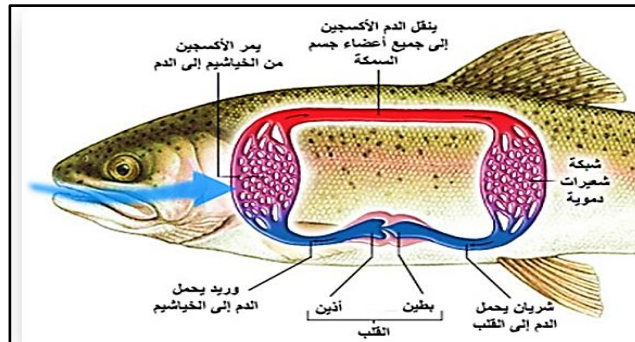


Bone.
Cartilage.

2. Cardiovascular system:

Heart.

Circulation: blood flows from the heart to the ventral aorta to the afferent branchial arteries to the gills for oxygenation and progresses via the efferent arteries to the dorsal aorta.



3. Digestive system: carnivorous fish have a short digestive tract when compared with Herbivorous fish.

Pharynx

Esophagus

Stomach.

pyloric ceca: This organ with fingerlike projections is located near the junction of the stomach and the intestines.

Intestine.

Liver.

Spleen.

Vent.

Pancreas. (may be interspersed with mesentery of pyloric ceca or along portal veins of liver).

4. Lymphoreticular system:

5. Urinary system:

Kidney: A primary function of the kidney is osmoregulation. In fresh water the kidney saves ions and excretes water. In saltwater fish, the kidney excretes ions and conserves water.

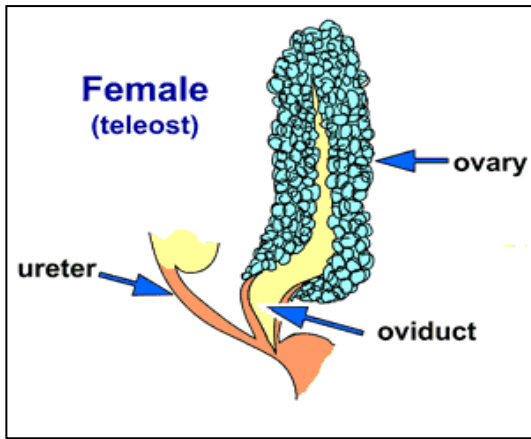
Ureter

Urinary bladder

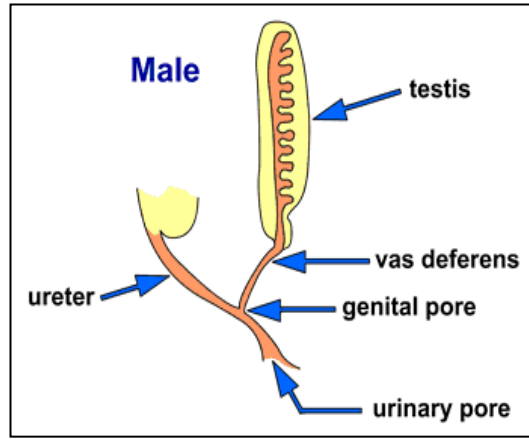
6. Reproductive system:

Ovaries.

Testes.



Ovary



Testes

7. Endocrine system:

8. Nervous system:

Brain.

Cranial nerves.

Spinal cord.

9. Swim bladder (Air bladder):

gas-filled balance organ that allows a fish to conserve energy by maintaining neutral buoyancy (suspending) in water. Fish caught from very deep water sometimes need to have air released from their swim bladder before they can be released and return to deep water, due to the difference in atmospheric pressure at the water's surface. Species of fish that do not possess a swim bladder sink to the bottom if they stop swimming.



