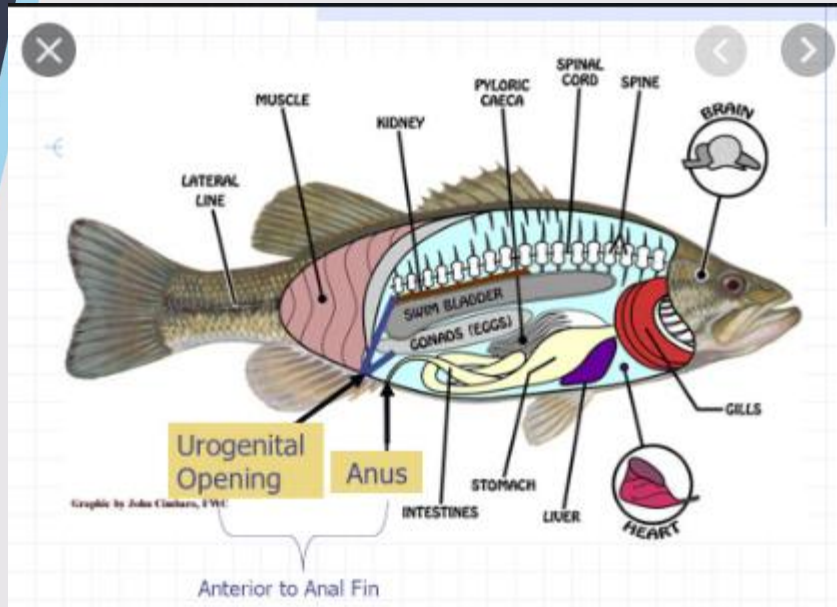




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Urino – Genital System



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Urino – Genital System

Urinary systems- excretory

Genital systems- reproductive

It is easiest to discuss the excretory and reproductive systems at the same time because they originate developmentally from adjacent tissues and utilize common ducts to allow passage of products outside of the body.



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Overview and function of the -excretory system

Kidneys are the primary adult excretory organs and work in association with auxiliary structures such as the gills, skin, parts of the digestive system and salt glands

Together they perform two primary functions for the body:

1. **Remove nitrogenous waste products** of protein metabolism and other harmful substances
2. Eliminate them in the form of **ammonia, uric acid or urea**
3. Eliminate controlled amounts of water and salts to help maintain the internal environment of the body



Excretory system

The primary excretory organ in fishes, as in other vertebrates, is the **kidney**.

In fishes some excretion also takes place in the digestive tract, skin, and especially the gills (where ammonia is given off).

Compared with land vertebrates, fishes have a special problem in maintaining their internal environment at a constant concentration of water and dissolved substances, such as salts.

Proper balance of the internal environment (**homeostasis**) of a fish is in a great part maintained by the excretory system, especially the kidney.



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The kidney, gills, and skin play an important role in maintaining a fish's internal environment and checking the effects of osmosis.

Marine fishes live in an environment in which the water around them has a **greater concentration of salts** than they can have inside their body and still maintain life.

Freshwater fishes, on the other hand, live in water with a much **lower concentration of salts** than they require inside their bodies.



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Osmosis tends to promote the loss of water from the body of a marine fish and absorption of water by that of a freshwater fish.

Mucus in the skin tends to slow the process but is not a sufficient barrier to prevent the movement of fluids through the permeable skin.

When solutions on two sides of a permeable membrane have different concentrations of dissolved substances, water will pass through the membrane into the more concentrated solution, while the dissolved chemicals move into the area of lower concentration (**diffusion**).



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The **kidney of freshwater fishes is often larger** in relation to body weight than that of marine fishes.

In both groups the kidney **excretes wastes** from the body, but that of freshwater fishes also excretes large **amounts of water**, counteracting the water absorbed through the skin.

Freshwater fishes tend to lose salt to the environment and must replace it.

They get some salt from their food, but the gills and skin inside the mouth actively absorb salt from water passed through the mouth.

This absorption is performed by special cells capable (like those of the kidney) of moving salts against the diffusion gradient. **Freshwater fishes drink very little water** and take in little water in their food.



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Marine fishes must conserve water, therefore their kidneys excrete little water.

To maintain their water balance marine fishes drink large quantities of seawater, **retaining most of the water** and **excreting the salt**.

By reabsorption of needed water in the kidney tubules, they discharge a more **concentrated urine** than do freshwater fishes.

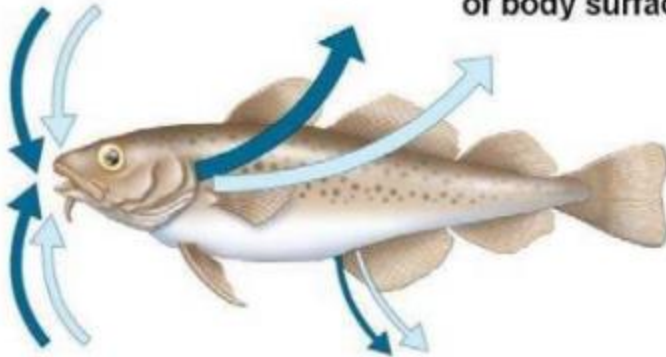
Most **nitrogenous waste** in marine fishes appears to be secreted by the **gills as ammonia**.

Some marine fishes, at least, can excrete salt by clusters of special cells in the gills and intestine.



(a) Osmoregulation in a marine fish

Gain of water and salt ions from food
 Excretion of salt ions from gills
 Osmotic water loss through gills and other parts of body surface



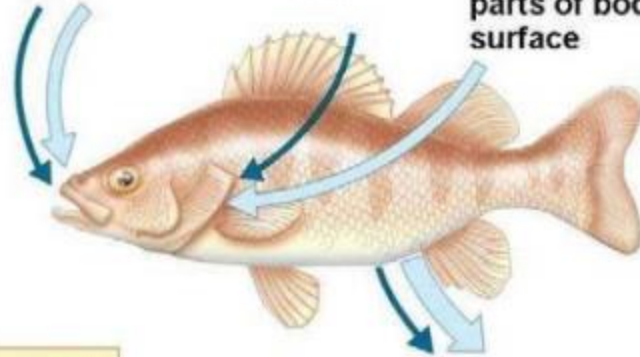
Gain of water and salt ions from drinking seawater
 Excretion of salt ions and small amounts of water in scanty urine from kidneys

Marine bony fish

have body fluids that are hypo-osmotic to seawater (less solutes, more water) and constantly lose water and gain salt. They balance this water loss by drinking lots of seawater. The gills and skin are used to get rid of excess salt (NaCl). The kidneys excrete little water.

(b) Osmoregulation in a freshwater fish

Gain of water and some ions in food
 Uptake of salt ions by gills
 Osmotic water gain through gills and other parts of body surface



Key

Light blue arrow: Water
 Dark blue arrow: Salt

Excretion of salt ions and large amounts of water in dilute urine from kidneys



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There are several teleosts-for example, the salmon-that travel between fresh water and seawater and must adjust to the reversal of osmotic gradients.

They adjust their physiological processes by spending time in the intermediate brackish environment.

Marine lampreys, hagfishes, sharks, and rays have osmotic concentrations in their blood about equal to that of seawater so do not have to drink water nor perform much physiological work to maintain their osmotic balance.

In sharks and rays the osmotic concentration is kept high by **retention of urea in the blood.**

Freshwater sharks have a lowered



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Kidney

The kidneys originate from lateral plate mesoderm that differentiates into the nephric ridges

which buds into blocks of tissue called **nephrotomes,**

which differentiate into **nephrons or renal tubules,**

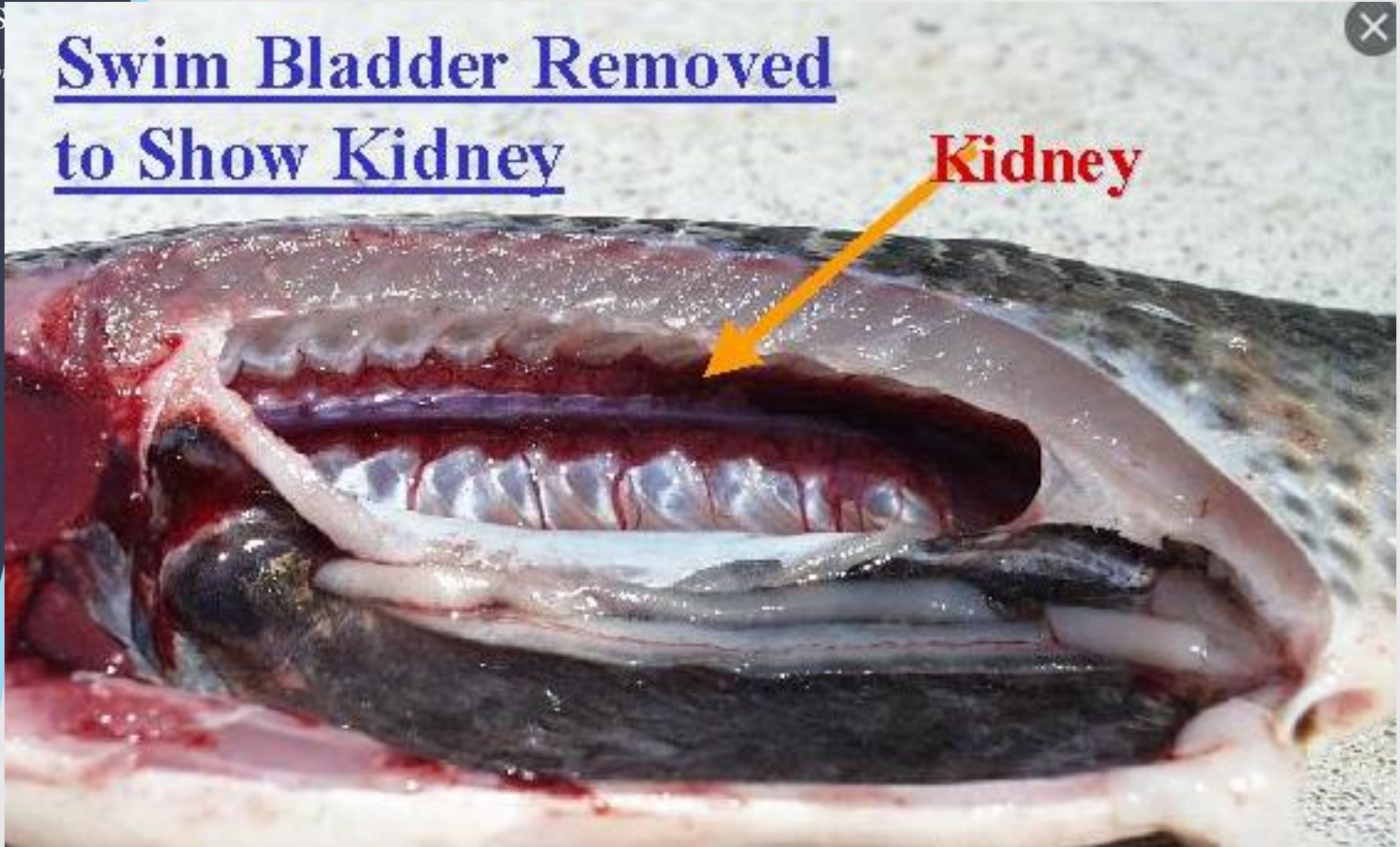
the structural and functional units of the kidney



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Swim Bladder Removed to Show Kidney

Kidney





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Structure of Kidney

“Kidney is the organ through which most of the metabolic wastes are excreted”.

The kidneys of fishes are reddish brown, soft elongated paired structures lying ventrally to the vertebral column.

Though paired, the two kidneys show multiple shapes in different fishes due to fusion at various positions.

Ventrally the kidneys are covered by coelomic epithelium.

The teleostean kidney may be divided into a “**head kidney**” and a “**trunk kidney**” but this differentiation sometimes is not possible by external observations.



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Anatomically fish kidney is of two types –
Pronephric and **Mesonephric**.

In fishes with kidney distinguishable to a head and trunk kidney show the pronephric part in the head region (generally non functional in terms of excretion)

and mesonephric part in the trunk region.

Generally there are no conspicuous differences in shape between the two sexes.

“Ogawa” (1961) has classified the marine teleostean kidney into **five (5) configurational classes**.



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Type 1:

The two sides of the kidney are completely fused throughout.

No clear distinction between trunk and head kidney.

Ex. Clupeidae (Herrings).

Type 2:

The middle and posterior portions only are fused.

Clear distinction between head and trunk kidney.

Ex. Plotosidae (Marine catfishes), Angulidae (Eels).

Type 3:

Posterior portion only is fused,

anterior portion represented by two slender branches,

clear distinction between head and trunk kidney.

Most marine fishes have this type of kidney.

Ex. Bellonidae, Mugilidae, Scombridae, Carringidae and Pleuronectidae.



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Type 4:

Extreme posterior portion only is fused and head kidney is not recognizable.

Ex. Syngnathidae (Pike fishes).

Types 5 :

The two kidneys are completely separate.

Eg: Lophidae (Angler fishes)

All the freshwater teleost species that he examined can be grouped into the first 3 or the 5 groups described above.

Examples are as follows.

Type 1 – Salmonidae – Salmons and trouts.

Type 2 – Cyprinidae – Carps and minnows

Type 3 – Cyprinodontidae (Killi fishes),

Gastrostidae and Cottidae.



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Generally the anterior part of the kidney (Head kidney) is pronephric

possesses lymphoid, haematopoietic internal and chromaffin tissue.

The nephron is generally absent in this region but when present it is devoid of renal corpuscle and glomerulus.

In most fishes the pronephrons is traditional and it is taken over by the mesonephrons in the later period of the life (Adult stage).

In other words the head kidney in majority of fishes is not functional and in some other it is functional only in the early stage of the individual (life).

Some teleosts, however, show the extension of posterior kidney (trunk kidney) towards the anterior kidney.



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In this part of the kidney typical nephrons are present with glomeruli, renal corpuscle, renal tubule and collecting ducts.

The variable amount of haematopoietic and pigment cells are distributed among the tubules and vascular spaces in the trunkate region.

The two **archinephric ducts** are always fused.

This fusion may occur at the posterior end of the kidney or at some point between the kidney and the urinary papilla.

Dilation of the **archinephric duct** may found a bladder like enlargement (Urinary bladder) in many bony fishes.



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Basic structure

The end of the renal tubule forms a cup-like structure called the **Bowmans capsule** that surrounds a knot of capillaries called the glomerulus

blood flow to the glomerulus comes from the **afferent arteriole** and leaves through the **efferent arteriole**

if the capillary bed is surrounded by the renal capsule it is called an **internal glomerulus**; if the capillary bed discharges into the coelom it is called an **external glomerulus**



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Osmoregulation

The **glomerulus** is a group of capillary loops and anastomoses that hangs into the Bowmans capsule –

the capsule is cup-shaped, with an outer parietal wall and an inner visceral wall

In the renal corpuscle, blood is driven through the capillaries at high pressure –

capillaries are composed of a thin endothelium with pores,

which creates a filter through which blood components can drain and be caught by the capsule



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Renal capsules are usually separated from nephric tubules by a narrow neck segment - nephric

tubules are divided into a **proximal tubule** and a **distal tubule**, separated by an intermediate tubule

1. the **proximal tubule** returns sugars, amino acids, vitamins and salts to the bloodstream
2. the **distal tubule** acidifies the filtrate and removes sodium and chloride ions; water is returned to the body by both tubules



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Details of tubule function are varied and complicated, and related to environmental factors influencing the organism:

Freshwater fishes and amphibians - water constantly enters bodies from the environment, and salt is lost through urine; short proximal and distal tubules to return

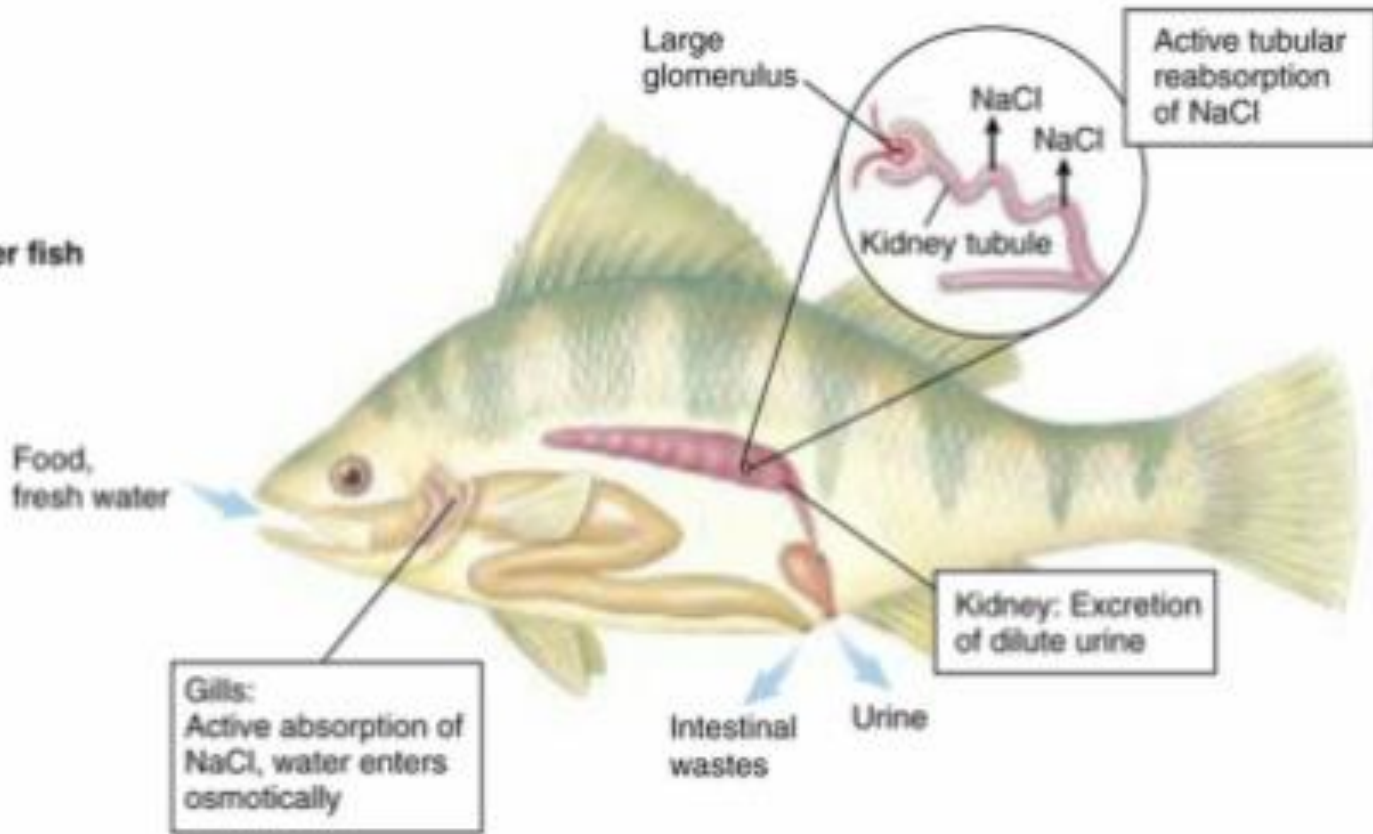
solute; nitrogen released as ammonia or urea

Marine bony fishes - body fluids constantly leak away to the sea; pass very little

urine, and drink freely to introduce more water (but also more salt); special cells in gills

excrete salt; little or no distal tubules

Freshwater fish



The kidney of a freshwater fish



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Thank you