

## Excretion

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## Introduction

vertebrates is the kidney.

In fishes some excretion also takes place in the gills where the waste materials produced during metabolism are given off.

## **Excretory System Functions**

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### water and filter body fluids.

Remove and concentrate waste products from body fluids and return other substances to body fluids as necessary for homeostasis.

Eliminate excretory products from the body.

## Structure of the kidney

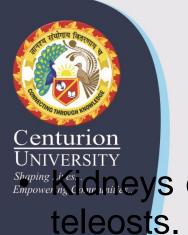
close to the vertebral column.

In teleosts, the kidneys are elongated structures usually divided into 2 parts called the head kidney and the trunk kidney.

Type I: 2 kidneys are completely fused and there is no distinction between head and trunk part of the kidney.

## clearly demarcated as they are fused in the middle and posterior regions only.

- Type III: The kidneys are fused in the posterior region only and the head and trunk potions are clearly demarcated.
- Type IV: Only the extreme posterior parts of the kidneys are fused.
- Type V: There is no fusion and the kidneys are completely separate.



Strapping Lifest dunleys of type I, II, III are usually seen in freshwater teleosts.

- Kidneys of type II are seen in the Cyrinidae in which the middle and posterior parts are fused.
- In the carps, as Labeo, Cirrhinus and Barbus the trunk kidney (Fig) is broad in the middle and becomes narrow in the posterior part.
- Each kidney has a mesonephric duct (opisthonephric duct) running along its outer border.

Supposed of a large number of tubules or nephrons, which develop first in the anterior region of the trunk and proceed posteriorly.

- The collection of nephrons constitutes the kidney.
- During development in fishes a pronephros is replaced by mesonephros (opisthonephros), which opens into the nephric duct called the opisthonephric duct.

## to 10,000) of tubular nephrons or uriniferous tubules each of which produces urine.

- Each nephron is made up of or consists of renal corpuscle or malpighian capsule and the tubule.
- A typical nephron of freshwater teleosts is called glomerular nephron and generally consists.
- A renal corpuscle containing a well developed vascularized glomerulus.

the tubule.

In the marine teleosts, the distal segment is probably absent.

In the freshwater teleosts, the kidney has a large number of renal corpuscles each containing a highly vascular glomerulus, hence called glomerular nephron.

## Mechanisms of excretion/ function

remove excess of water, salts, waste material and foreign substances from the blood.

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For this blood, is filtered under high pressure through the glomerulus and the Bowman's capsule which work as ultra filters.

Glomerulus is composed of a leaky capillary endothelium, a fine porous basement membrane and the epithelium of the Bowman's capsule.

## inorganic ions, organic molecules, glucose, urea, amino acids are filtered into the tubule.

- 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.

## excretory organ for nitrogenous compounds such as creatine and uric acid.

- Thus copius urine, 5-12% of body weight/day is produced in freshwater fishes.
- In marine teleosts, the kidney performs the function of removing magnesium and sulphate ions along with Na, Cl, K and Ca.
- Trimethyl amine oxide (TMAO) is also excreted but only traces of ammonia and urea.

excretion removing ammonia and urea along with carbon dioxide.

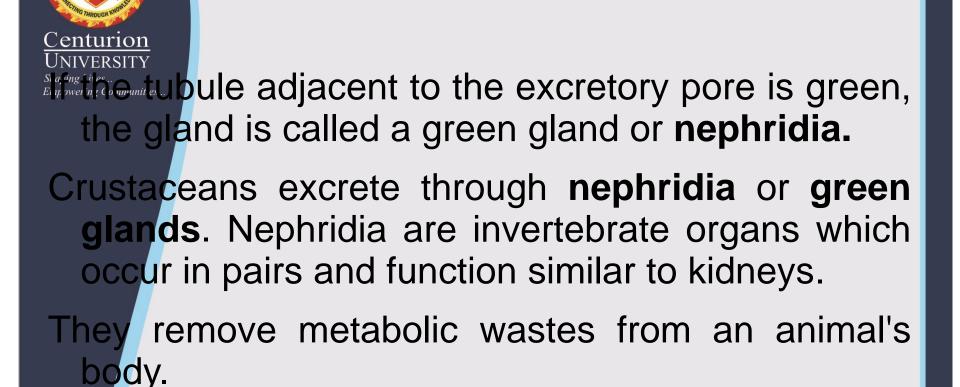
Marine fishes excrete common marine salts via the salt excreting glands located on the lamellae of the gills while in the freshwater fishes it is through kidney.

Freshwater fishes drink very little water and take in little water in their food.

excretory glands are located in the head.

They are called antennal glands or maxillary glands, depending on whether they open at the base of the antennae or at the maxillae.

The two glands are probably never functional together in the same animal, though one may replace the other in the course of development.



#### UNIVERSITY Sin pring Gives ... Serve 2 functions, osmoregulatory and excretory.

- A metanephridium is a type of excretory gland or nephridium found in many types of invertebrates such as Annelids, Arthropods and Molluscs.
- Most insects and spiders have a excretory system called Malpigian tubes which collects liquid wastes in the gut.



weight for flight.

Malpighian tubules filter the uric acid and other nitrogenous waste out of the blood in the hemocoel, and dump these materials into the hindgut, from which they are expelled as feces.

Most aquatic arthropods and some terrestrial ones also have organs called nephridia ("little kidneys"), which extract other wastes for excretion as urine.

## Mollusca

UNIVERSITY Support of the renal gland varies from one class of molluscs to another, but a common plan is clearly evident.

- Like most other molluscs, the excretory organs of bivalves are nephridia.
- There are two nephridia, each consisting of a long, glandular tube, which opens into the body cavity just beneath the heart, and a bladder.
- Blood is forced through the walls of the heart into the pericardium. From there it passes into the kidneys where wastes are removed, producing urine.

## **Schapter 4. Osmoregulation**

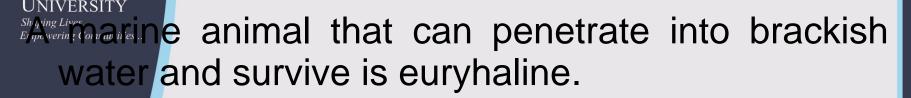
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Most marine invertebrates have body fluids with the same osmotic pressure as the sea water; they are isosmotic or isosmotic.

One way is to change the osmotic concentration of its body fluids to conform with that of the medium, thus remaining isosmotic with the medium; such an animal is an osmo-conformer. concentration is spite of external concentration changes; such an animal is called an osmoregulator.

Fresh-water animals have body fluids that are osmotically more concentrated than the medium; these animals are *hyperosmotic*.

Some aquatic animals can tolerate wide variations in the concentration of the water in which they live; they are called euryhaline animals.



An extremely euryhaline animal may even be able to tolerate shorter or longer periods in fresh water.

There is no sharp separation between euryhaline and stenohaline animals.



## Osmoregulation

maintenance of water and salt balance of the body tissues in fishes, whether they live in fresh, marine or brackish waters.

## Osmoregulatory problem in freshwater fishes

reptiles and mammals that live in freshwater are osmoregulators.

Their body fluids (1/3<sup>rd</sup> of the concentration of seawater) have a greater concentration than their surrounding environment (hyperosmotic).

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.

#### University Sin pine Lives... Generation of the continous inflow of water through gills, freshwater fishes produce a large amount of dilute urine.

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## **Osmoregulatory problem in marine** fishes

Comparison to freshwater fishes because their internal salt content is less than that of the surrounding water.

Marine teleosts are hypoosmotic (body fluids 1/3 of that seawater) and live in a medium ing high concentration of salts.

marine fish has an internal osmotic concentration lower than that of the surrounding seawater, so it tends to lose water and gain salt.



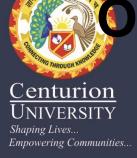
single of the gills.

Marine fishes are faced with the problem of continuous loss of water and gain salts.

As marine fish drinks seawater and Na and Cl ions are actively absorbed through the gut.

Many species are reported to drink water >25% of their body weight/day, of which 80% is absorbed.

# water by the special cells in the gills, oral membrane and inner surface of the operculum.



# Construction of the second state of the second

The chondrichthyes maintain osmotic concentration of blood nearly at the same level as that of seawater (isoosmotic) and are not in danger of dehydration and do not drink seawater

This is achieved by retaining nitrogen containing compounds, mainly urea and trimethylamine oxide (TMAO) in the blood, which is slightly hyperosmotic to seawater. so that it is retained in the blood in large quantity to raise the osmotic concentration of blood to a slightly higher level than seawater.

The osmotic balance in these fishes is maintained by retention of high level of urea in the blood.

Whereas, freshwater sharks have a lowered concentration of urea in the blood.

# elasmobranchs which helps in osmoregulation by excreting NaCl.

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Migratory fish are hyperosmotic to their environment during some periods and hypeosmotic at other times.

To complete their life cycle, amphihaline fishes show remarkable adaptation in being able to migrate from the sea to freshwater bodies or vice versa.

They have to survive in 2 different environments for the sake of their progeny.

**becoming reproductively mature starts migrating** to breed in riverine or land locked freshwater.

The young born in freshwater migrate into seawater and live there until they are in turn mature and ready to spawn in freshwater.

These fish eg. Salmon and hilsa are known as amphihaline potemotocous.

spends several years in these surroundings and undergoes important morphological, biochemical and physiological modifications before undertaking downstream migration to marine feeding grounds.