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Endocrine system

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Introduction

Fishes possess a well developed endocrine system comparable to that of other vertebrate .

The **endocrine system** is the collection of glands that produce hormones that regulate metabolism, growth and development, tissue function, sexual function, reproduction, sleep, and mood, among other things.

The glands that secrete their products into the bloodstream and body tissues along with the central nervous **system** to control and regulate many kinds of body functions are known as **endocrine gland**.

In **fishes** various **endocrine gland** has been found associated with different tasks and functions.



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Defenitions

The endocrine system or internal secretion system is a set of organs and tissues of dissimilar origin, structure and location, which secretions called hormones, enter the bloodstream directly without a duct so they can reach distant organs.

Hormones are signalling molecules that regulate many physiological and behavioural functions including growth, reproduction and water and mineral balance, among others.



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The endocrine system mediates four types of effects:

kinetic (e.g., pigment migration),

metabolic (e.g., carbohydrate balance),

morphogenic (e.g., sexual differentiation) and
behavioural (e.g., reproductive, migrations).



Following are important endocrine glands found in fishes

Pituitary gland.

Thyroid gland.

Adrenal gland.

Gonads.

Ultimobranchial tissue.

Intestinal mucosa.

Following are main tissue with possible endocrine function

Carpuscles of stanius.

Pineal organ.

Thymus

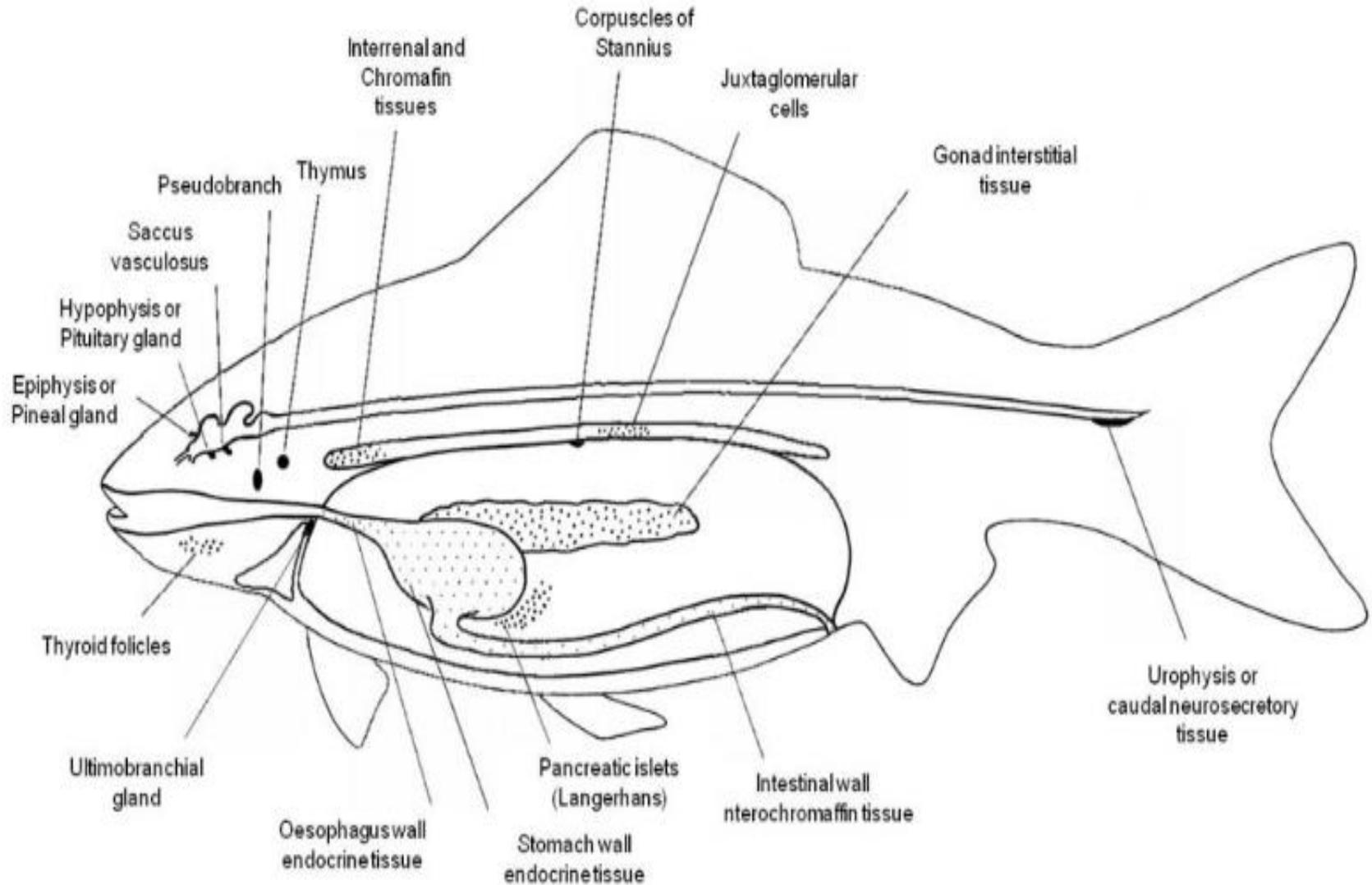
Urohypophysis

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Endocrine system





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The pituitary gland or Hypophysis:

Location: Ventral surface of brain below optic chiasma.

Origin: Two parts of pituitary gland are derived from two different components.

Neurohypophysis develops from the floor of the embryonic diencephalons.

Adenohypophysis develops from the dorsal evagination of the ectodermal part of buccal cavity called Rathke's pouch.

This pouch later loses its connection from the buccal cavity and remains permanently connected to neurohypophysis during the rest of the life.

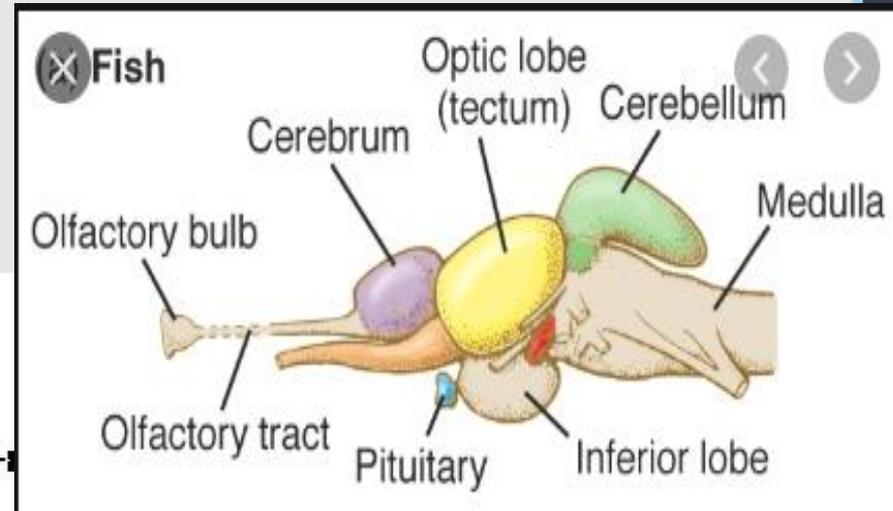
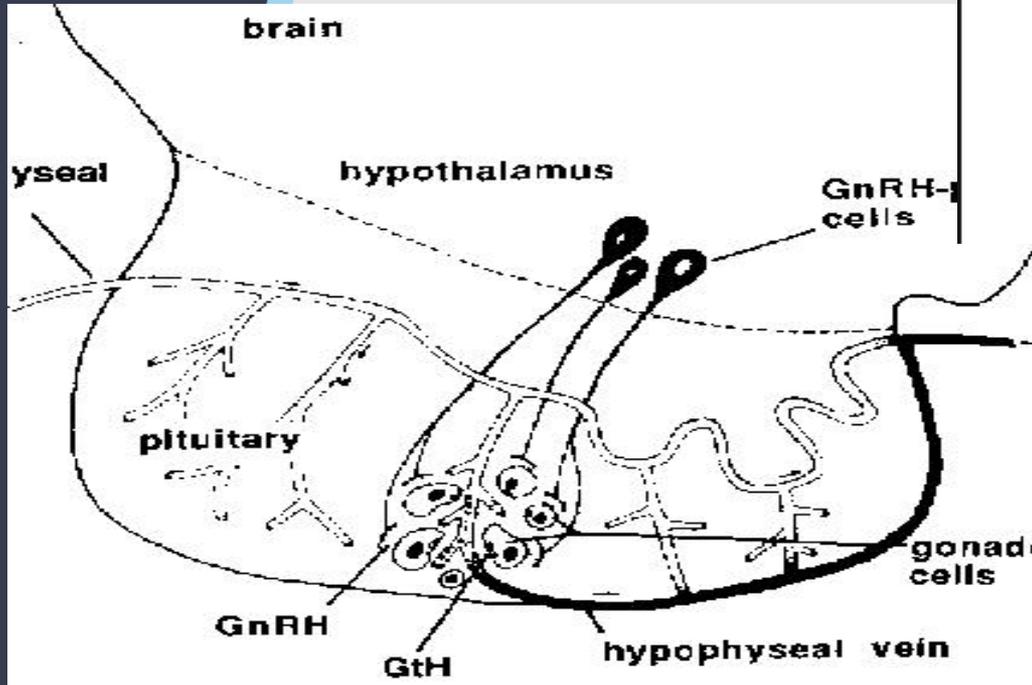


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The hypophysis in adult fish remains attached with it by a stalk is called **infundibular stalk** or **neurohypophyseal stalk** and occupies a position on the underside of the brain;

in the region of diencephalon.





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Part and division of pituitary, their cell types, secretions and action of their hormones: The part of this gland their division, cell types, secretion and functions are given below in a tabular form-

Part of Pituitary	Division	Cell types	Secretions	Functions
Adenohypophysis	Proximal pars distalis	Thyrotrophs	Thyrotropins e.g TSH	Regulates the growth and secretion from thyroid
		Gonadotrophs	Gonadotropin e.g. FSH (follicular stimulating hormone) and LH (leutinizing hormone)	Regulates secretion of gonadal hormone, spermatogenesis and oogenesis
		Somatotrophs	Somatotropins e.g.GH (Growth hormone)	Increase growth and BMR of the fish body
	Rostral pars distalis	Lactotrophs	Prolactin	Regulation of osmoregulation and melanogenesis
		Corticotrophs	Corticotropin viz. ACTH	Regulates secretion of corticotropins from adrenal gland.
	Pars intermedia		MSH and MCH (melanophore dispersing and melanophore contracting hormone)	Regulates the concentration and dispersion of pigments within melanophores.
Neurohypophysis	Pars-nervosa		Vasopression and oxytocin	Regulates osmoregulation, salt-water balance, mating and egg laying



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Thyroid gland

Origin: The thyroid gland in fishes arises from the floor of the pharynx as a median evagination.

Location: The location of thyroid gland varies considerably in different fish species; such as-

In cyclostomes, follicles of thyroid are dispersed around the ventral aorta and do not form compact capsulated structure.

In bony fishes, it may lie under the 1st branchial arch on each side.

In many teleosts, it is found along the afferent branchial arteries of the gills.

In other teleosts, the follicles of thyroid migrate to



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Shape of Thyroid Gland in Fishes

Shape: The shape of the gland is also variable depending on various fish group; such as –

In cyclostomes, the thyroid is in the form of follicles.

In many teleosts, thyroid becomes a diffused structure as small masses of follicles.

In elasmobranches and bony fishes, thyroid is compact structure.



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Secretion: Chiefly thyroxine

Function:

Thyroid hormone's role is oxygen consumption in fishes have been pointed out though it lacks consistency.

Thyroid hormone influences osmoregulation in *salmon* and *Gastrosteus*.

Thyroid along with other endocrine glands also influences migration in fishes.

It is also known to effect growth and nitrogen metabolism in gold fish.

Thyroxine brings about maturation in fishes.

Scale and bone formation in fishes is also influenced by thyroxine



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Adrenal gland:

Adrenal gland in fishes is quite different from that of mammals. The two components of adrenal gland i.e. cortex and medulla are separately found.

Location: One of three layers of cells lying along cardinal veins in the region of the hemapoietic head kidney.

Origin: Mesodermal layer of embryo

Secretion: Adrenaline, Cortisol

Function:

Promote utilization of steroid fat

Carbohydrate metabolism

Water metabolism

Protein catabolism



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Gonads

In fishes, the maturation and possibly also the elaboration of gametes requires the presence of sex hormones in addition to secondary sex characteristics such as coloration, breeding tubercles and the maturation of gonopodium depends upon the pressure of endocrine substances from the sex glands.



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Testis

Testis is made up of lobular units.

In teleost lobular unit may be short and long tubules and internally divided space with their apex at the center of the organ and their broader ends directed towards the periphery.

In most of fishes however the complex network of elongated and intergreatly divided lobules, and lobular spaces are bound together forming a compact organ.

Septum and covering contain much elastic but no muscle.

the lobules open into a spermatic duct which may be long and tortuous with a lining of secretory



Ovary

The ovary is made up of numerous ovarian follicles embedded in connective tissue.

The ovary in most teleost fishes is a hollow sac-like organ into which extend numerous ovigerous folds lined by germinal epithelium.

The germ cells, the endodermally derived oogonia, multiply mitotically and get transformed into nonyolky primary oocytes whose, nuclei are arrested at the prophase of the first meiotic division until maturation.

These processes can take place even in the absence of the pituitary.



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Primary oocytes, covered generally by two layers of follicle cells, an outer thecal layer and an inner granulosa layer, undergo vitellogenesis when yolk is deposited in the ooplasm.

During maturation, the first polar body is given cut and the second meiotic division is arrested at metaphase.

The eggs are spawned by the fish at this stage and the **second polar body** is released **only after fertilization**.



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Islets of Langerhans

Islets of Langerhans, also called islands of Langerhans, irregularly shaped patches of endocrine tissue located within the pancreas of most vertebrates.

The islets consist of four distinct cell types, of which three (alpha, beta, and delta cells) produce important hormones; the fourth component (C cells) has no known function.

Within the pancreas of higher forms of sharks, islets of Langerhans develop from the tubules of the otherwise called digestive gland. islets tissue in the actinopterygian fishes



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Pancreatic islets:

Location: Gut walls in larval Lampreys;
hepatopancreas, most bony fishes

Embryonic Origin: Mesoderm

Secretion: Insulin

Function: Carbohydrate metabolism



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Thymus

In the actinopterygian fishes a rather massive thymus is observed in the medial wall of the branchial cavity.

this thymus apparently arises from contributions of several of the branchial pouches.

the thymus of Latimeria is comparable to that of the actinopterygian but is lobular.

in the cyclostomes all of the gill pouches give rise to thymus tissue dorsally.

the anterior pouches also have ventral anlagen. In the adult only the dorsal parts remain.



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The Ultimobranchial bodies:

It is also known as post-branchial bodies or suprapericardial bodies or ultimobranchial bodies.

Location: Sac-like structures between ventral wall of esophagus and sinus venosus.

Origin: Ultimobranchial gland develops embryologically from the epithelium of the last or ultimate gill pouch.

Secretion: Calcitonin

Function: Regulates calcium level in blood.



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Intestinal mucosa

The intestinal mucosa being producing hormones which join with nervous controls to regulate the pancreatic secretions.

the intestinal hormones are secretin and pancreozymin.

secretin produces flow of the enzyme carrying liquids from the pancreas and pancreozymin enhances flow of the zymogens.

both hormones are found in the anterior portion of the small intestine and other tissue with possible endocrine function.



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Corpuscles of Stannius

The Corpuscles of Stannius:

Location: Attached to or embedded in kidneys of holosteans and teleosts

Origin: the corpuscles of stannius originate as outgrowths from the pronephric or the mesonephric duct of the kidney.

Nature: Proteinous

Secretion: Hypocalcin

Colour: Pink or white

Function: Regulates calcium balance



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Pineal Gland

Pineal gland:

Location/Origin: The Pineal organ of the fish arises as a posteromid dorsal evagination of the epithalamus.

Secretion: Melatonin

Function: Photosensory and secretory function, may play a role in controlling reproduction, growth, and migration.



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Urohypophysis

Urohypophysis : It is also known as Urophysis or caudal Neusecretory organ.

Location: This gland is in the form of a swelling at the posterior end of the caudal spinal cord i.e. in the tail of the teleosts.

Secretion: Urotensins

Function: Metabolic regulations.



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Thank you