

**Subject: Physiology of Coordination
(BS Zoology 6th Semester)**

Invertebrate Endocrine Structures

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Introduction to Invertebrate Endocrinology

- Invertebrates, despite lacking complex endocrine glands like vertebrates, possess diverse and effective hormonal systems that regulate growth, development, reproduction, metabolism, and behavior.
- Hormones in invertebrates are often neurohormones secreted by neurosecretory cells, typically located in the brain or central nervous system.
- Unlike vertebrates, many invertebrates combine neural and endocrine functions, especially in simpler body plans.

Introduction to Invertebrate Endocrinology

- Invertebrates are grouped into several phyla, including **Porifera** (sponges), **Cnidaria** (jellyfish, corals, etc.), **Platyhelminthes** (flatworms), **Nematoda** (roundworms), **Annelida** (segmented worms), **Arthropoda** (insects, spiders, etc.), **Mollusca** (snails, clams, etc.), and **Echinodermata** (starfish, sea urchins, etc.).
- **Porifera** does not have any endocrine gland or neurosecretory cells. It uses local chemical messengers like Cyclic AMP (cAMP), GABA and Serotonin for signaling.

Introduction to Invertebrate Endocrinology

- **Nematodes** lack discrete endocrine glands like those seen in vertebrates or arthropods. However, they do possess neurosecretory cells and diffuse endocrine-like systems which produces insulin-like peptides that regulate growth, reproduction, and metabolism.
- **Platyhelminthes** also does not have well-defined endocrine glands, but neurosecretory cells are present in the central nervous system which produces some peptides, and use chemical signals to regulate regeneration, reproduction, and growth.

Endocrine Systems in Major Invertebrate Phyla

- **1. Phylum Arthropoda**

- (Insects, Crustaceans, Arachnids)

- **2. Phylum Mollusca**

- (Snails, Octopuses, Clams)

- **3. Phylum Cnidaria**

- (Jellyfish, Corals, Hydra)

- **4. Phylum Annelida**

- (Segmented Worms like Earthworms, Leeches)

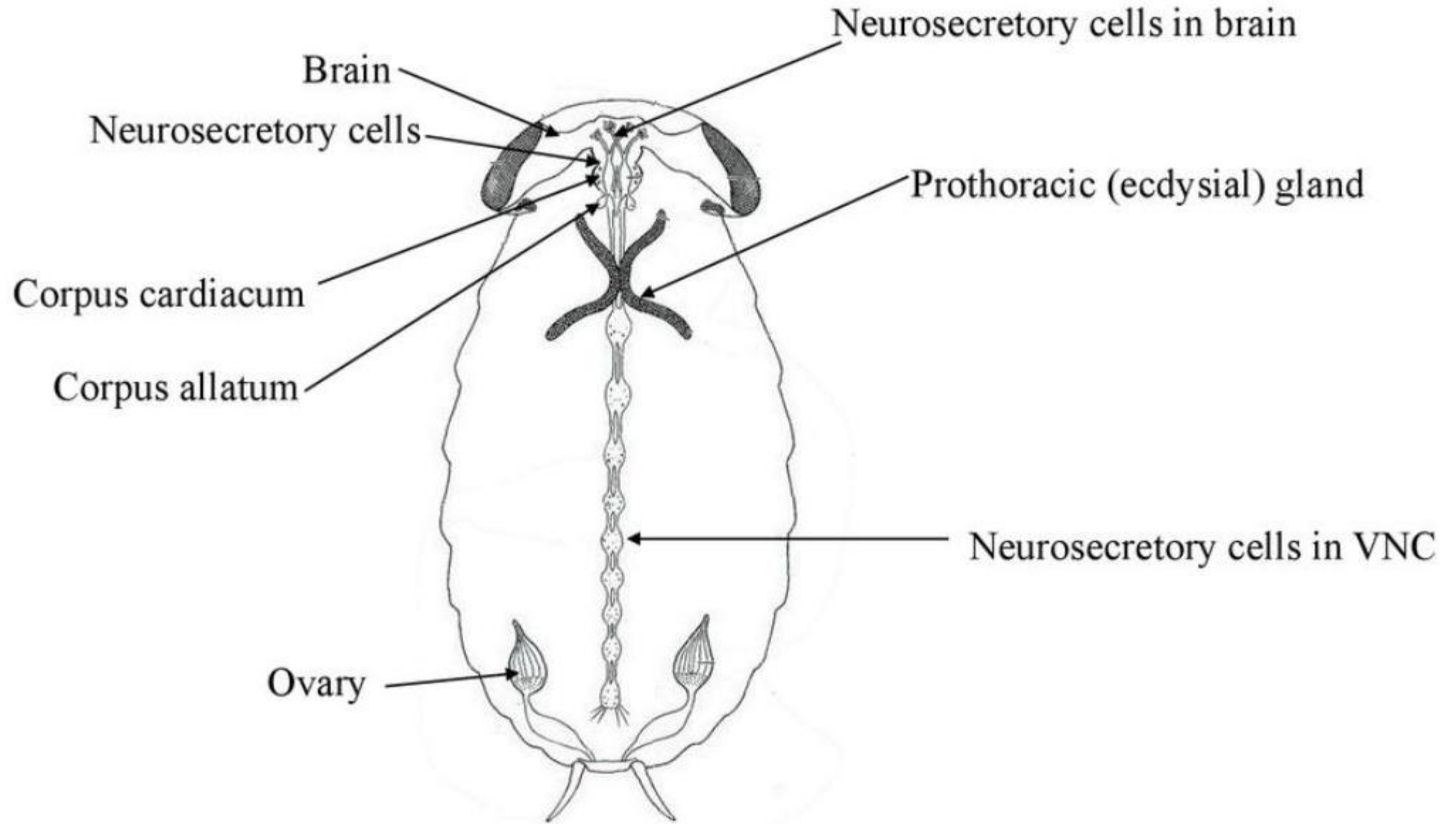
- **5. Phylum Echinodermata**

- (Sea Stars, Sea Urchins)

1. Phylum Arthropoda

- **Endocrine Structures:**
- **Neurosecretory cells** (in brain and ventral nerve cord)
- **Corpora cardiaca** (paired structures behind the brain; store and release neurohormones)
- **Corpora allata** (paired glands near corpora cardiaca; produce juvenile hormone)
- **Prothoracic glands** (secrete ecdysteroids in insects; absent in adult insects)
- **Y-organs** (in crustaceans; similar to prothoracic glands)
- **X-organ**—sinus gland complex (in crustaceans; located in the eyestalk)

Main Endocrine Centres



Major Hormones & Functions

Hormone	Source	Function
Ecdysone / Ecdysteroids	Prothoracic glands (insects), Y-organs (crustaceans)	Regulate molting (ecdysis) and metamorphosis
Juvenile Hormone (JH)	Corpora allata	Controls developmental stages; high JH → larval stages; low JH → pupation/adult
Bursicon	Neurosecretory cells	Controls cuticle hardening post- molting
Allatotropin / Allatostatin	Brain	Stimulate or inhibit corpora allata activity

Major Hormones & Functions

Hormone	Source	Function
Molt-inhibiting hormone (MIH)	X-organ/sinus gland (crustaceans)	Inhibits ecdysone secretion; regulates molting timing
Gonad-inhibiting hormone (GIH)	X-organ/sinus gland	Regulates reproduction by inhibiting gonad development
Hyperglycemic hormone	Sinus gland	Mobilizes energy by increasing glucose in hemolymph
Diuretic and Antidiuretic hormones	Brain	Control water and ion balance

2. Phylum Mollusca

- **Endocrine Structures:**
- **Neurosecretory cells:**
 - (Mainly in cerebral and pedal ganglia)
- **Optic glands:**
 - (In cephalopods)
- **Gonadotropic hormones:**
 - (Cerebral ganglia)

Hormones & Functions

Hormone	Source	Function
Gonadotropin-like hormones	Cerebral ganglia	Stimulate gametogenesis and gonad maturation
Optic gland hormones (cephalopods)	Optic glands	Regulate sexual maturation and reproduction
Egg-laying hormone (ELH)	Abdominal ganglion	Triggers oviposition and associated behaviors
Growth hormone-like peptides	Ganglia	Influence shell growth and tissue maintenance

3. Phylum Cnidaria

- **Endocrine-Like Features**
- Lack distinct glands but use neuropeptides and neurotransmitters for regulation.

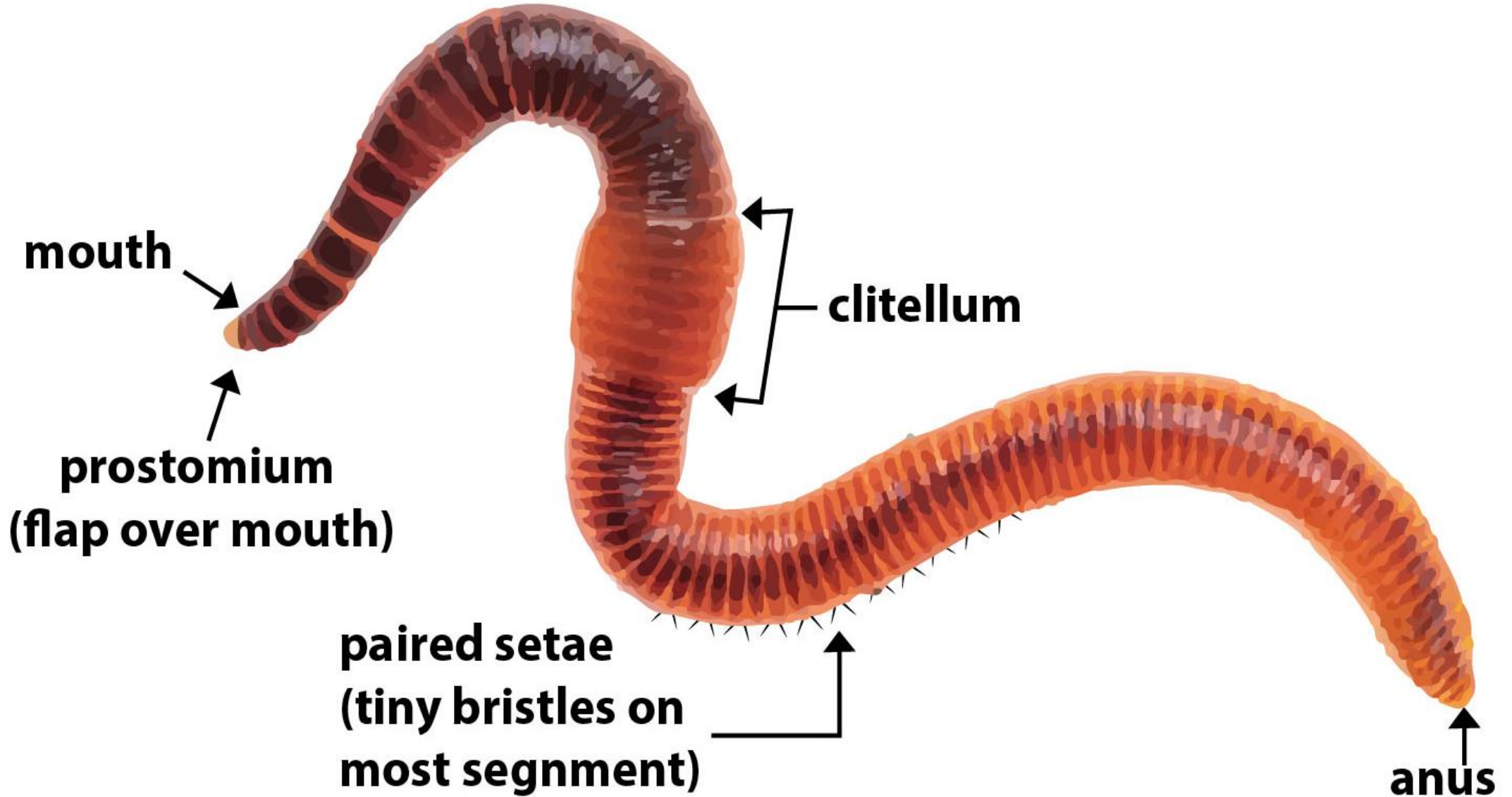
Hormones & Functions

Hormone	Function
Neuropeptides	Control muscle contraction, feeding behavior, larval development
Maturation-inducing hormones	Trigger gamete release or larval metamorphosis

4. Phylum Annelida

- **Endocrine Structures**
- **Neurosecretory cells:**
- Present in the brain and segmental ganglia
- **Clitellum:**
- Produces mucous during reproduction.

Earthworm



Hormones & Functions

Hormone	Source	Function
Neurohormones	Brain	Control regeneration, osmoregulation, reproduction
Reproductive hormones	Brain & clitellum	Stimulate gametogenesis and cocoon formation
Diuretic hormones	Ganglia	Influence water balance and excretion

5. Phylum Echinodermata

- **Endocrine-Like Functions:**
- Largely regulated by neuropeptides and hormone-like substances from the radial nerve and other tissues.

Hormones & Functions

Hormone	Function
Gonad-stimulating substance (GSS)	Stimulates spawning and gamete maturation
Relaxin-like peptides	Involved in larval development and metamorphosis
Steroid-like substances	May influence growth and tissue regeneration

General Roles of Invertebrate Hormones

Function	Hormones Involved
Molting and Metamorphosis	Ecdysteroids, Juvenile Hormone, MIH
Growth	Growth peptides, ecdysteroids
Reproduction	Gonadotropic hormones, GSS, JH
Osmoregulation and Ion Balance	Diuretic hormones, CHH
Behavior and Neuroregulation	Neuropeptides (FMRFamide, ELH)
Pigmentation and Circadian Rhythms	Chromatophore-regulating hormones (in crustaceans and mollusks)

Summary

- Invertebrate hormones often have parallels to vertebrate systems (e.g., neuropeptides, gonadotropin-like activity).
- Many invertebrate endocrine mechanisms have been studied for pest control (e.g., insect growth regulators) and aquaculture (e.g., crustacean growth and reproduction).
- Invertebrate endocrine systems, although less centralized than vertebrate ones, are highly sophisticated. They rely heavily on neuroendocrine integration, using hormones to regulate essential life processes from molting and metamorphosis to reproduction and osmoregulation.

THANK YOU