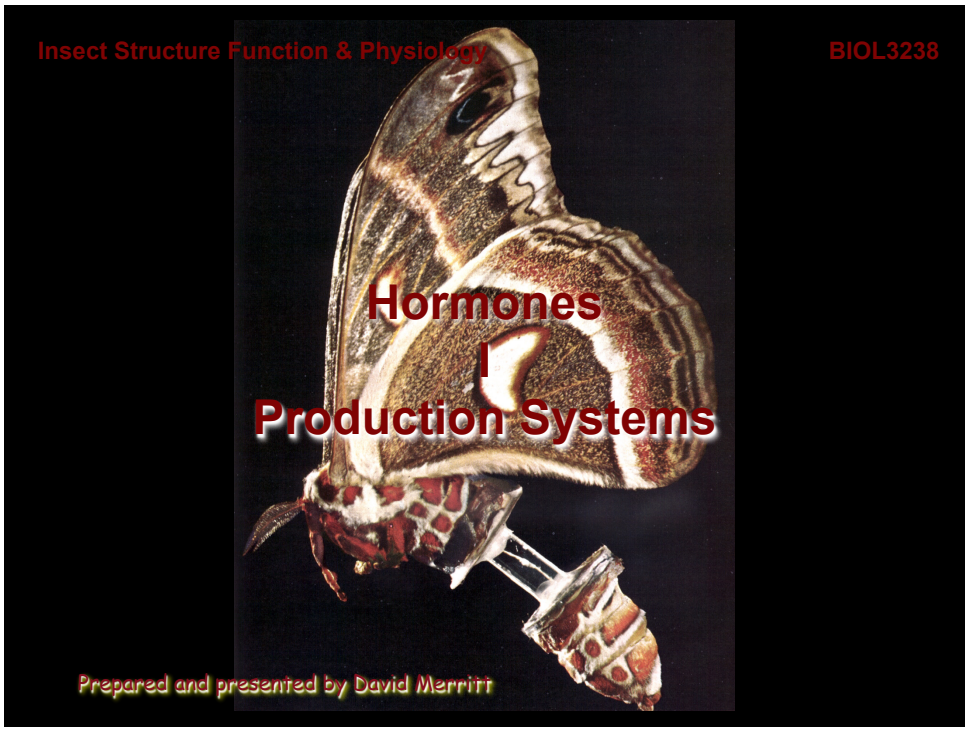


Topics

- Hormone production systems
- Hormone types
- Brain-retrocerebral complex
- Hormone-modulated processes

Objectives

- Know the major types of hormones and the types of tissues that produce them
- Compare the roles of the nervous and hormonal systems in the regulation of insect physiology
- Overview of the types of physiological functions that come under hormonal control
- Know the main components of the hormonal system and where they are produced

Hormones

- Hormones play an important regulatory role in insect physiology.
- The chemical signal (messenger) enters the circulatory system and is distributed throughout the body. By comparison with the nervous system this is slow and it produces a dispersed rather than localised effect.
- Coordinating role. Many behavioural and physiological processes can be coordinated by hormonal control: moulting, for example
- Involves a single effector (a gland or group of glands) rather than a highly complex nervous response in which a similar response would be hardwired.
- Products can be accumulated before distribution (doesn't happen in all cases)

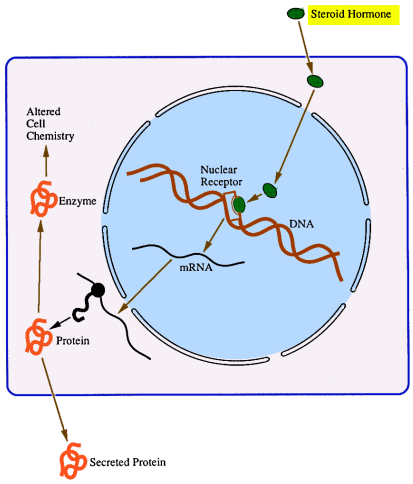
The **nervous system** is the prime regulator of the hormonal system, thus sensory input—both internal and external—is integrated into the regulation of hormone release.

Hormone Types

1. Lipid hormones

   Pass through membranes and bind to receptors within the cell, to DNA for example, and thus can directly regulate transcription.

   - Ecdysone (a steroid)
   - Juvenile hormone (JH) (a terpenoid)



Hormone Types

2. Peptide hormones

   Polypeptides: mode of action

   Bind to membrane-bound receptor molecules in the receiving cell

   Act via a "second messenger" system to activate or depress enzymes or proteins and change the physiology of the cell.

   2nd messengers are cAMP or cGMP.

   Hormone-receptor complexes can also act on Ca++ ion concentrations within the cell via a 2nd messenger system

   Examples: Eclosion hormone and prothoracicotropic hormone

3. Biogenic Amines

   Also called neurohormones

   Released from neurons: seem to act as neurotransmitters and hormones

   Examples: octopamine, serotonin, dopamine, histamine

   Involved in: learning, aggression, fight or flight, arousal

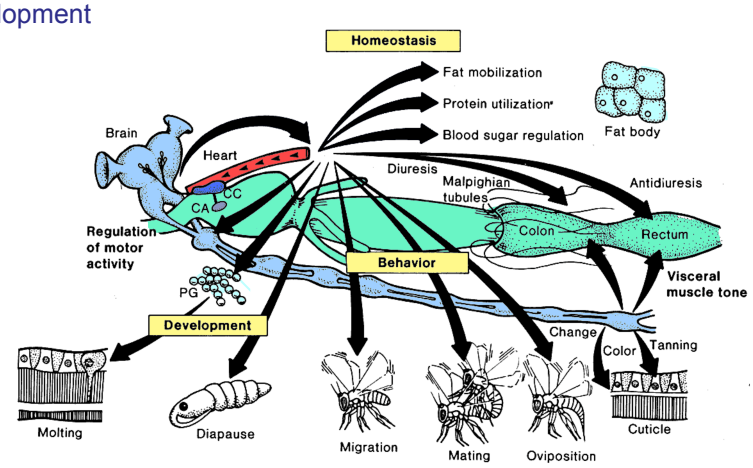
Physiological Functions of Hormones

Homeostasis

Behaviour

Development

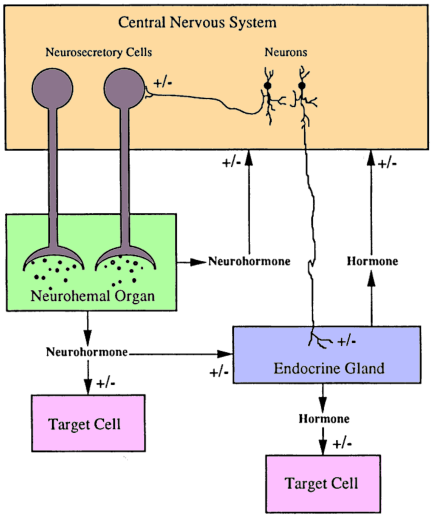
Major physiological functions regulated by neurohormones in insects. Hormonal distribution is accomplished chiefly by release into the haemolymph, but localized secretion from nerves does occur. CC = corpora cardiaca; CA = corpora allata; PG = prothoracic gland. From Romoser and Stoffolano, 1994.



Hormone production systems

Neurosecretory cells

- Produce polypeptides such as octopamine and dopamine instead of neurotransmitters
- Found primarily in the CNS. Usually large cell bodies and dispersed axons



A general scheme for pathways of neuroendocrine regulation in insects. The central nervous system is the source of a large variety of neurosecretory hormones. From Nijhout, 1994.

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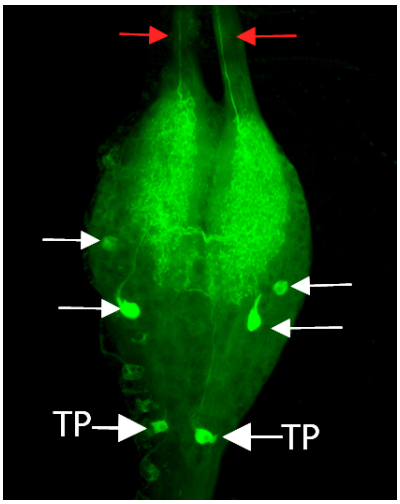


Immunostain of serotonin in an abdominal ganglion of an insect, the glowworm larva *Arachnocampa flava*. Some serotonergic cell bodies are indicated by arrows. Single serotonergic axons running anteriorly (red arrows) through the connective. Lisa Rigby

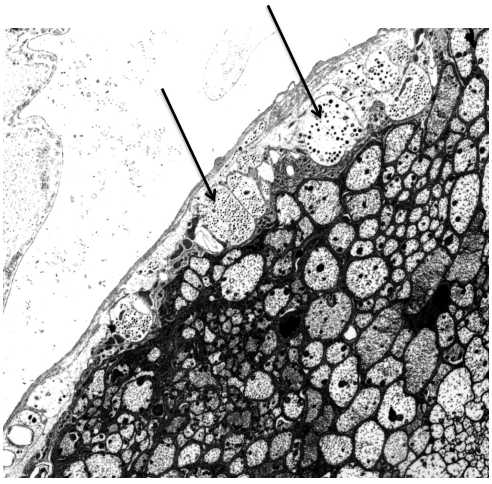
Hormone production systems

Neurosecretory cells

- Electron-dense granules in cells, usually densely distributed in cell body and around periphery of nerves and ganglia.

  Under the electron microscope the peptide "packets" are large electron-dense vesicles.

Neurohaemal organs found in the peripheral nerves or on the periphery of ganglia.

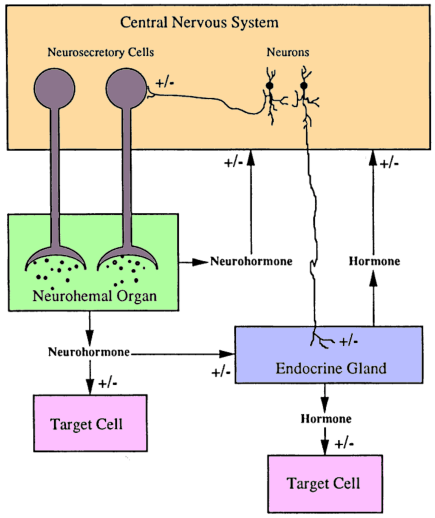


Transmission electron micrograph of a cross-section through a segmental nerve of a blowfly. Merritt.

Hormone production systems

Endocrine glands

- Prothoracic glands are the primary source of ecdysteroids.
- Gonads: ovaries and testes
- Secretory activity of endocrine glands is controlled via release of *neurohormones* from the CNS

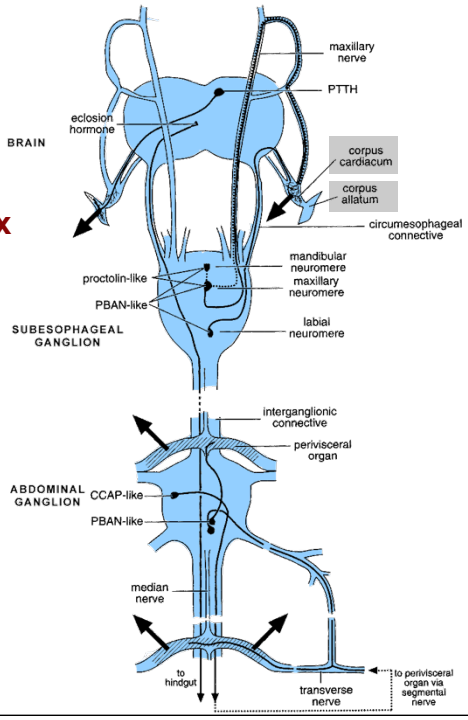


A general scheme for pathways of neuroendocrine regulation in insects. The central nervous system is the source of a large variety of neurosecretory hormones. From Nijhout, 1994.

Brain-retrocerebral complex

Composed of:

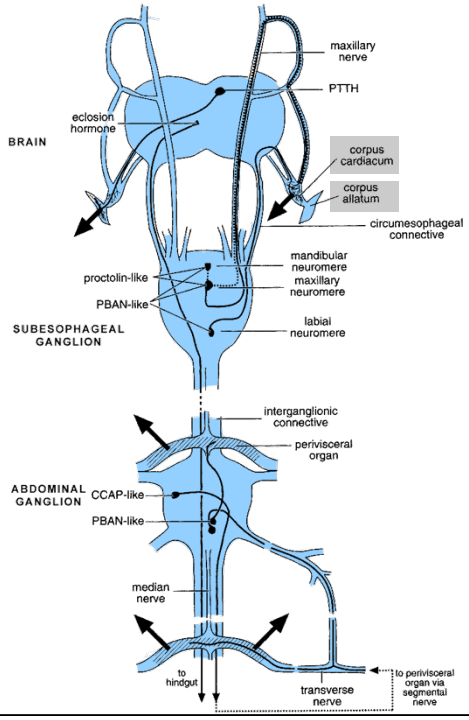
1. Brain neurosecretory cells
2. corpora cardiaca (sing. corpus cardiacum)
3. corpora allata (sing. corpus allatum)



Corpora cardiaca

Located near the heart in many insects: allows the released products to be immediately distributed with the circulation of haemolymph.

1. the principle neurohaemal organ for brain neurosecretory cells
2. Also possess intrinsic neurosecretory cells (e.g. those producing adipokinetic hormone)

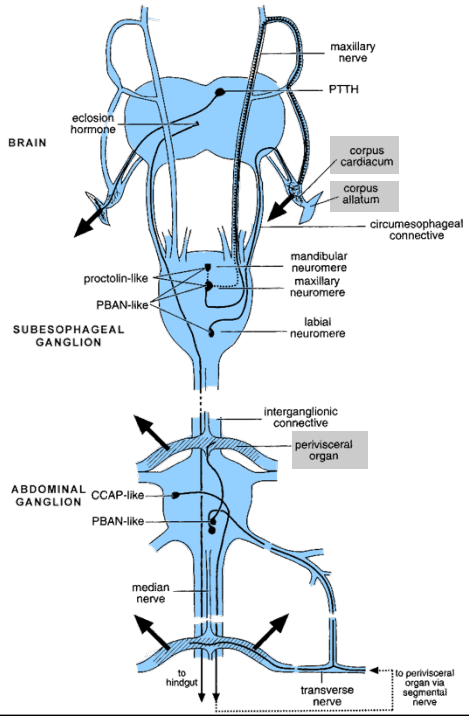


Corpora allata

- Glands that are innervated from brain, via the corpora cardiaca
- Secretory cells synthesize juvenile hormone

Perivisceral organs

- Perivisceral organs: neurohaemal organs for segmental ganglionic neurosecretory cells



References

Chapman, RF (1998) Chapter 21 Endocrine System. Cambridge University Press

Nijhout, H. F. (1994). Insect Hormones. Princeton, Princeton University Press.