Endocrine System

Endocrine Glands and Hormones

The endocrine system consists of glands and tissues that secrete hormones.

Hormones are chemicals that affect other glands or tissues, many times far away from the site of hormone production.

Endocrine glands

- Secrete hormones into the bloodstream
- Hormones cause specific changes in target cells

The Endocrine System

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<th>Hormone Released</th>
<th>Chemical Class</th>
<th>Target Tissues/Organs</th>
<th>Chief Functions of Hormone</th>
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<td>Hypothalamic releasing hormones</td>
<td>Peptide</td>
<td>Anterior pituitary</td>
<td>Regulates secretions of pituitary hormones</td>
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<tr>
<td>Pituitary</td>
<td>Anterior pituitary hormones</td>
<td>Peptide</td>
<td>Luteinizing hormone (LH)</td>
<td>Stimulates ovulation and follicular development</td>
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<td>Adrenal cortex</td>
<td>Adrenal cortex hormones</td>
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<td>Adrenocorticotrophic hormone (ACTH)</td>
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<td>Thyroid</td>
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<td>Increases metabolic rate, regulates body temperature</td>
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<td>Adrenal cortex</td>
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<td>Maintains blood pressure</td>
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<td>Gonadal hormones</td>
<td>Peptide</td>
<td>Gonadal hormones</td>
<td>Stimulates growth and development of organs</td>
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</table>

TABLE 20.1: Principal Endocrine Glands and Hormones

- Anterior pituitary hormones
- Adrenal cortex hormones
- Thyroid hormones
- Parathyroid gland hormones
- Pancreatic hormones
- Gonadal hormones
- Hypothalamic hormones
- Hormones are secreted by endocrine glands and neurosecretory cells

- All hormone-secreting cells make up the endocrine system
  - Which works with the nervous system in regulating body activities

- A few chemicals (e.g. adrenaline/epinephrine) serve both as hormones in the endocrine system and as chemical signals in the nervous system

- Water-soluble hormones such as proteins and amines
  - Bind to plasma-membrane receptors on target cells
Lipid-soluble hormone (testosterone)

Target cell

Receptor protein

Hormone-receptor complex

Nucleus

DNA

mRNA

Transcription

New protein

Cellular response: activation of a gene and synthesis of new protein

- Steroid hormones, such as the sex hormones estrogen and testosterone
  - Diffuse through the plasma membrane of target cells and bind to intracellular receptors

Some endocrine glands and their functions

Hypothalamus: Hormones released by the posterior pituitary gland and those that regulate the anterior pituitary gland

Pituitary gland
  - posterior lobe: Oxytocin, Antidiuretic Hormone (ADH),
  - anterior lobe: Growth Hormone (GH), Thyroid stimulating Hormone (TSH), ACTH (Adrenocorticotropic Hormone)

Pineal gland: Melatonin

Thyroid gland: Thyroxine (T4) and Triiodothyronine (T3), Calcitonin

Adrenal gland: Epinephrine (Adrenaline), Norepinephrine

Pancreas: Insulin and Glucagon

Testes: Androgens (Testosterone)

Ovaries: Estrogens

The hypothalamus, closely tied to the pituitary, connects the nervous and endocrine systems

- The hypothalamus exerts master control over the endocrine system
  - By using the pituitary gland to relay directives to other glands

- The posterior pituitary
  - Secretes oxytocin and antidiuretic hormone (ADH)
• The anterior pituitary
  – Secretes TSH, ACTH, FSH and LH, growth hormone, prolactin, and endorphins

• Releasing and inhibiting hormones from the hypothalamus
  – Control the secretion of several other hormones
  – TSH for instance controls the secretion of T4 and T3 from the Thyroid gland

• Secretion of thyroxine by the thyroid gland
  – Is controlled by a negative-feedback mechanism

HORMONES AND HOMEOSTASIS

The thyroid regulates development and metabolism
• Two hormones from the thyroid gland, T4 and T3
  – Regulate an animal’s development and metabolism
• Thyroid imbalance can cause disease like Grave’s disease

Marty Feldman

Hormones from the thyroid and parathyroids maintain calcium homeostasis
• Blood calcium level is regulated by a tightly balanced antagonism
  – Between calcitonin from the thyroid and parathyroid hormone from the parathyroid glands

• Negative feedback
  – Maintains homeostatic levels of T4 and T3 in the blood

• Calcium homeostasis
Pancreatic hormones regulate blood glucose levels

- The pancreas secretes two hormones, insulin and glucagon that control blood glucose

- Insulin
  - Signals cells to use and store glucose

- Glucagon
  - Causes cells to release stored glucose into the blood

Diabetes is a common endocrine disorder

- Diabetes mellitus
  - Results from a lack of insulin or a failure of cells to respond to it

Glucose homeostasis

Blood glucose level declines to a set point; stimulus for insulin release diminishes

Stimulus: Declining blood glucose level (e.g., after skipping a meal)

Alpha cells of pancreas stimulated to release glucagon into the blood

Glucagon

Liver breaks down glycogen and releases glucose to the blood

Blood glucose level rises to a set point; stimulus for glucagon release diminishes

Stimulus: Rising blood glucose level (e.g., after eating a carbohydrate-rich meal)

Beta cells of pancreas stimulated to release insulin into the blood

Liver takes up glucose and stores it as glycogen

Blood glucose level declines to a set point; stimulus for insulin release diminishes

Stimulus: Declining blood glucose level (e.g., after eating a carbohydrate-rich meal)

Beta cells take up more glucose

Figure 26.8

Diabetes can be detected

- By a test called a glucose tolerance test

Diabetic

Normal

Figure 26.8
The adrenal glands mobilize responses to stress

- Hormones from the adrenal glands
  - Help maintain homeostasis when the body is stressed

- ACTH from the pituitary causes the adrenal cortex to secrete glucocorticoids and mineralocorticoids
  - Which boost blood pressure and blood glucose in response to long-term stress

- Nerve signals from the hypothalamus
  - Stimulate the adrenal medulla to secrete epinephrine and norepinephrine, which quickly trigger the fight-or-flight responses

- How the adrenal glands control our responses to stress
Glucocorticoids offer relief from pain, but not without serious risks

- Glucocorticoids relieve inflammation and pain
  - But they can mask injury and suppress immunity

The gonads secrete sex hormones

- Estrogens, progestins, and androgens are steroid sex hormones
  - Produced by the gonads in response to signals from the hypothalamus and pituitary

- Estrogens and progestins stimulate the development of female characteristics and maintain the female reproductive system

- Androgens, such as testosterone
  - Trigger the development of male characteristics
• Establishing links between androgens and human male aggression
  – Has been found to be problematic