Chapter 14 – Endocrine

Objectives

Given the synopsis in this chapter, competence in each objective will be demonstrated by responding to multiple choices or matching questions, completing fill-in questions, or writing short answers, at the level of 75% or greater proficiency for each student.

A. To define endocrine glands and hormones.
B. To explain the similarities and differences of neurotransmitters and hormones.
C. To locate and name major endocrine glands of the body.
D. To name representative hormones and explain their major function.

In the previous two chapters we explored how the nervous system (brain, spinal cord, nerves, and neurotransmitters) is involved in control of movement and in sensory communication. We will now examine how the endocrine system (endocrine glands and hormones) is involved in control of our internal organs. Curiously, nerves and neurotransmitters and glands and hormones function in many similar ways.

Neural vs. Hormonal Communication

General Neural Communication

In neural communication, electrical signals and chemical messengers are sent by neurons directly to other neurons, as shown in Figure 14.1.

- Neural signals are transmitted along an axon to the synaptic bulb of the neuron.
- From the synaptic bulb chemical messengers are released directly onto the dendrite of another neuron.
- By definition the chemical messenger is called a **neurotransmitter**.
- Neurotransmitters are **water soluble**.
- The neurotransmitter exerts its influence by attaching to extracellular **receptors** in the dendrite of the neuron (or other specific cell).

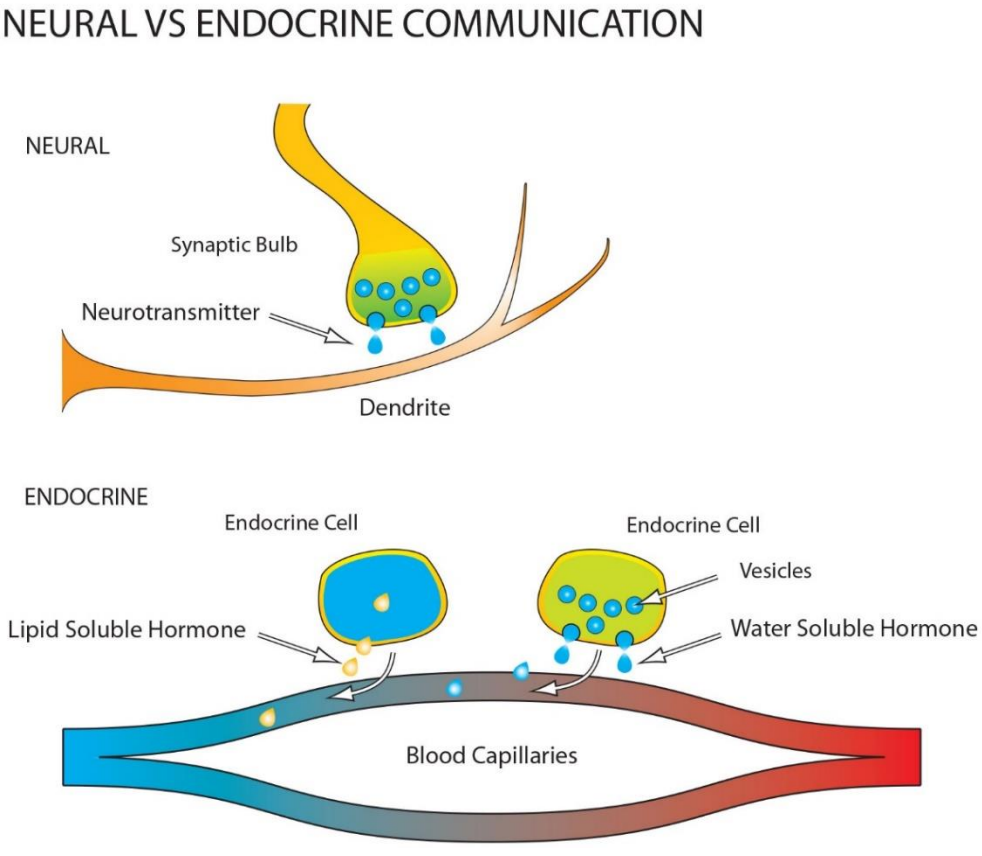

Figure 14.1 © 2014 David G. Ward, Ph.D., Synopsis of Physiology for Allied Health

General Endocrine Communication

In endocrine communication, chemical messengers are sent from endocrine cells (and sometimes neurons) through the blood to reach other cells, as shown in Figure 14.1. Chemical messengers in the blood are called hormones. Endocrine communication is characterized by the following features.

- Endocrine cells are sensitive to chemical signals.
- The endocrine cells release chemical messengers into the blood, which will carry the messengers to specific cells in other parts of the body.
- By definition the chemical messenger is called a **hormone**.
- Some hormones are water soluble, other hormones are lipid soluble.
- The **water soluble** hormones exert their influence by attaching to extracellular **receptors** in the membrane of specific cells.
- The **lipid soluble** hormones exert their influence by penetrating cells and attaching to intracellular **receptors** in the cytosol or nucleus of specific cells.

General Actions of Neurohormones and Hormones

After a hormone enters the blood it will be carried to a target organ to cause a response, or to another endocrine gland to cause the release of another hormone, as shown in Figure 14.2. Hormones that stimulate secretion of a hormone by another endocrine gland are called **tropic hormones**.

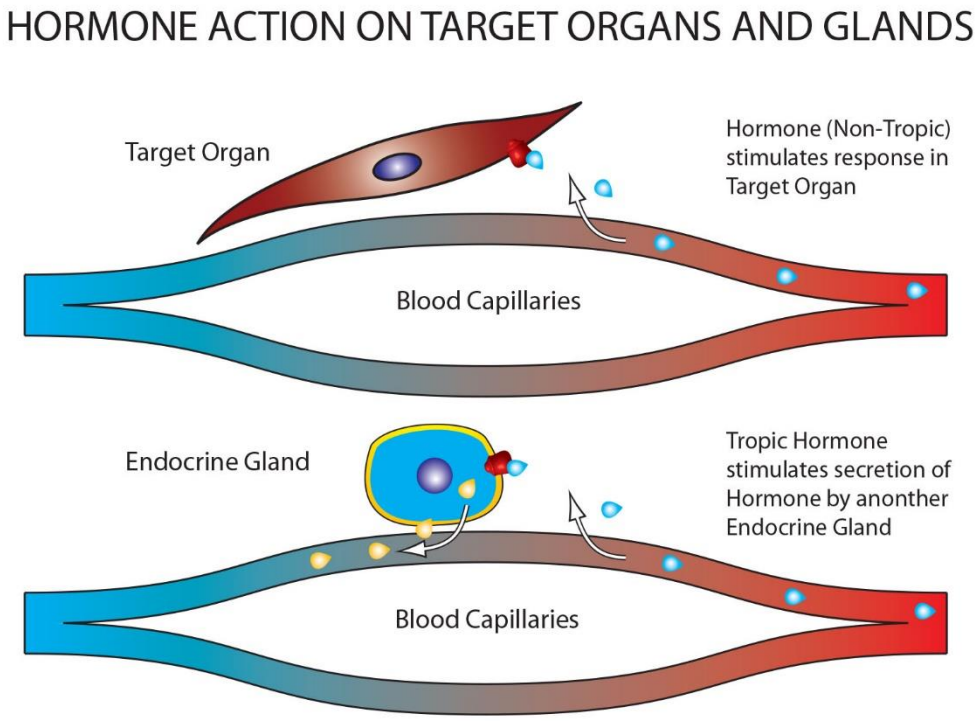

Figure 14.2 © 2014 David G. Ward, Ph.D., Synopsis of Physiology for Allied Health

Overview of Endocrine Glands and Hormones

The major endocrine glands and their location are shown in Figure 14. 3. In this section we will identify some of the hormones produced by these glands. In addition we will briefly examine the function of these hormones.

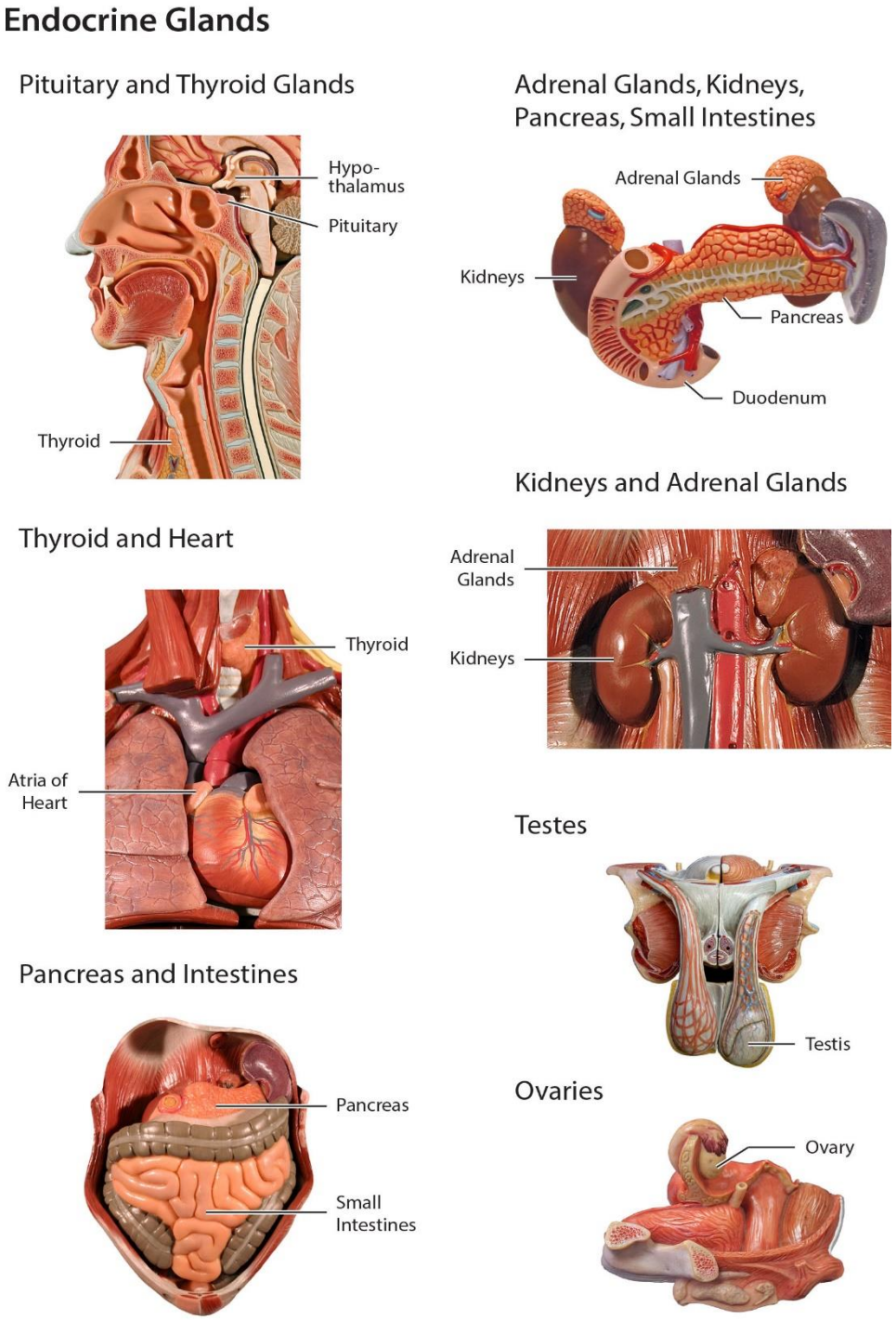

Figure 14.3© 2014 David G. Ward, Ph.D., Atlas of Anatomy for Allied Health, 3rd Ed.

Hypothalamus and Pituitary

The hypothalamus produces at least nine different hormones. Two of these, vasopressin and oxytocin, are transported to and secreted in the posterior part of the pituitary. The remaining seven are tropic hormones, delivered to the anterior part of the pituitary where they control the production and secretion of six different hormones.

"Posterior pituitary hormones"

- Produced by the hypothalamus, secreted from the posterior pituitary
- Vasopressin – constricts blood vessels, stimulates water retention by kidney.
- Oxytocin – stimulates uterine contraction, milk ejection, bonding.

Hypothalamic regulatory hormones

- Produced by the hypothalamus, transported to the anterior pituitary.
- Corticotropin releasing hormone (CRH) – stimulates corticotropin
- Thyrotropin releasing hormone (TRH) – stimulates thyrotropin
- Somatotropin releasing hormone (SRH, GHRH) – stimulates somatotropin
- Somatostatin (SS) – inhabits somatotropin
- Gonadotropin releasing hormone (GnRH) – stimulates the gonadotropins
- Prolactin releasing hormone (PRL) – stimulates prolactin
- Dopamine (DA) – inhibits prolactin

Anterior pituitary hormones

- Produced and secreted by the anterior pituitary.
- Corticotropin (ACTH) – stimulates adrenal cortex
- Thyrotropin (TSH) – stimulates thyroid
- Somatotropin (GH) – stimulates liver, bone, muscle
- Gonadotropins (FSH and LH) – stimulate ovaries and testes
- Prolactin (PRL) – stimulates milk production by breasts

Relationship of hypothalamus and Pituitary with other glands

As we can see from the information above, the majority of the anterior pituitary hormones control other endocrine glands, especially the adrenal cortex, the thyroid, the liver, the ovaries, and the testes. A minority of the anterior pituitary hormones directly control other organs, especially, bone, muscle, and breasts.

Corticotropin (ACTH), thyrotropin (TSH), and somatotropin (GH) are central to the control of metabolism, as summarized on the next page in Figure 14.4.

The two gonadotropins (FSH and LH), and prolactin (PRL) are central to the control of reproductive functions, as summarized at the end of the chapter in Figure 14.5.

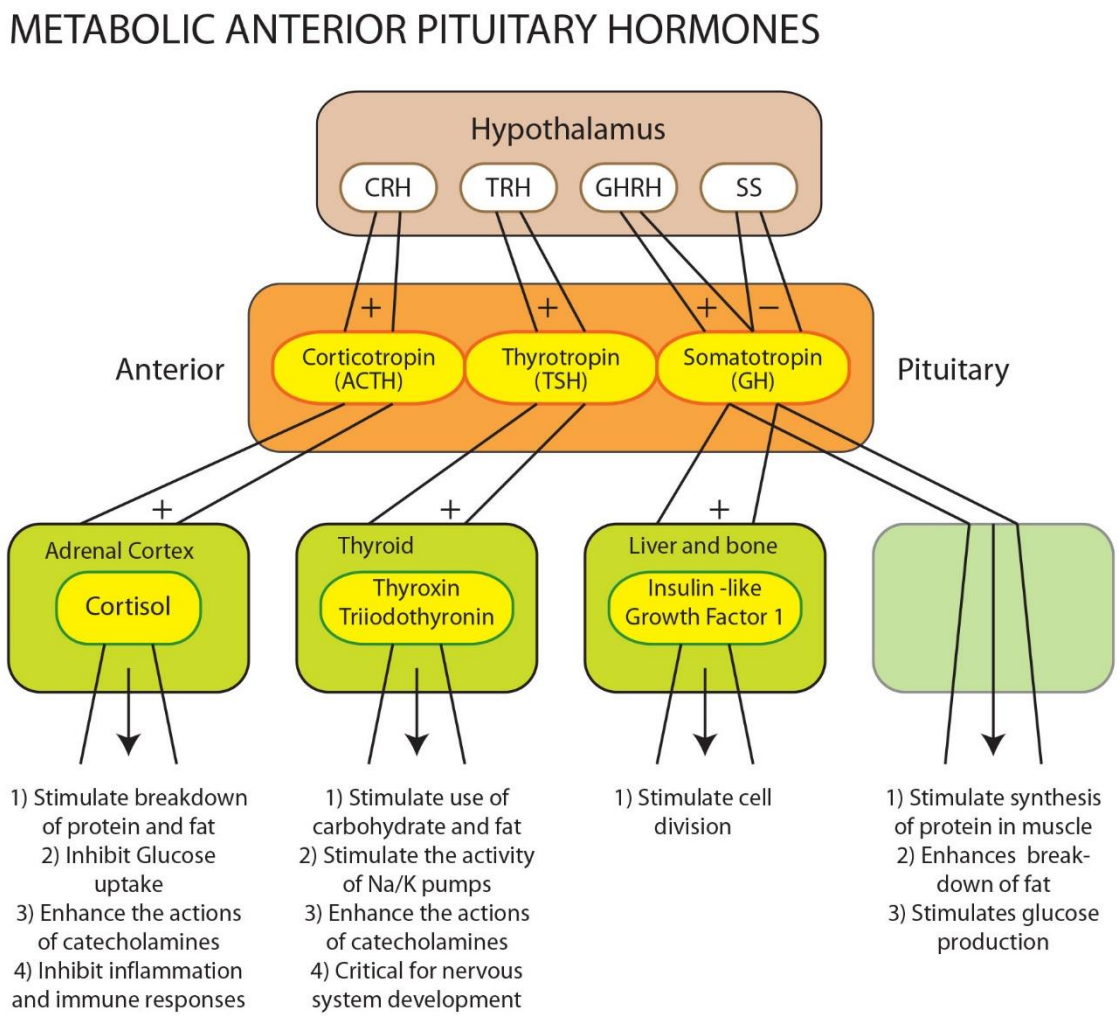

Figure 14.4 © 2014 David G. Ward, Ph.D., Synopsis of Physiology for Allied Health

Adrenal Gland

The adrenal gland produces two major groups of hormones, the adrenal cortical hormones and the adrenal medullary hormones.

Adrenal cortical hormones

- Aldosterone (Aldo) – stimulates sodium retention and sodium appetite
- Hydrocortisone (Cortisol) – modifies metabolism, moderates inflammation, stress responses
- Dehydroepiandrosterone (DHEA) – stimulates muscle growth

Adrenal medullary hormones

- Epinephrine (E, Epi) – stimulates metabolism, stress responses
- Norepinephrine (NE, NorEpi) – stimulates metabolism, stress responses

Thyroid and Parathyroid

The thyroid produces two major hormones, thyroxin and triiodothyronin. The parathyroid produces one major hormone.

Thyroid hormones

- Thyroxin (T4) – stimulates metabolism, stress responses
- Triiodothyronin (T3) – stimulates metabolism, stress responses

Parathyroid hormones

- Parathyroid hormone (PTH) – stimulates bone breakdown, increases blood calcium

Pancreas

The pancreas produces two major hormones, insulin and glucagon.

Pancreatic hormones

- Insulin – stimulates transport of glucose into most cells (except brain), storage of glucose
- Glucagon – stimulates breakdown of glycogen (stored glucose) to glucose

Diabetes Mellitus

- Glucose is a major energy source for the cells of our body. The transport of glucose into most cells of our body (except brain) requires a transport protein that is regulated by insulin.
- Diabetes mellitus is a disease where glucose is not adequately transported into our cells.

Gonads

The gonads produce two major groups of hormones, the ovarian steroid hormones and the testicular steroid hormones.

Ovarian steroid hormones

- Estrogens – stimulates growth of uterus, stimulates anterior pituitary
- Progesterone – inhibits growth of uterus, inhabits hypothalamus

Testicular steroid hormones

- Testosterone (T) – stimulates muscle growth, sperm production, inhibits hypothalamus

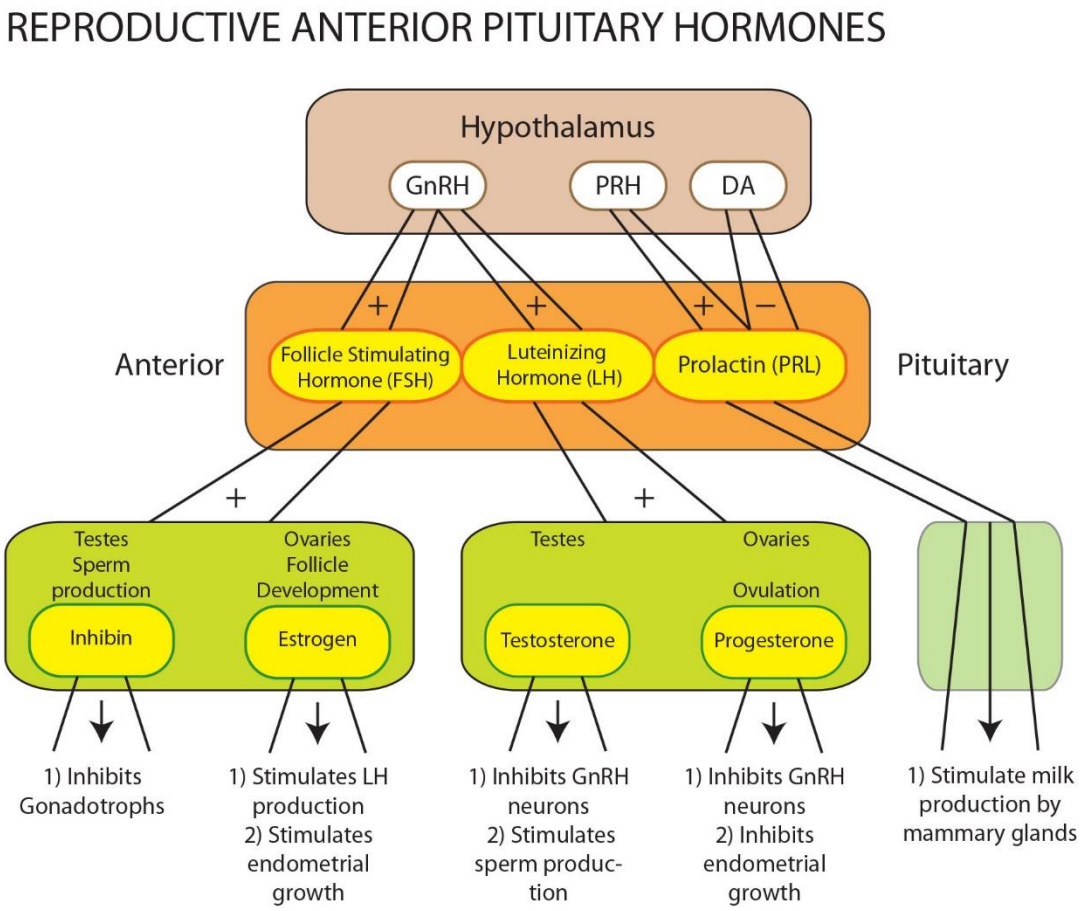

Figure 14.5 © 2014 David G. Ward, Ph.D., Synopsis of Physiology for Allied Health