12.4: Pituitary Gland

Milk on Demand

This adorable nursing infant is part of a positive feedback loop. When he suckles on the nipple, it sends nerve impulses to his mother’s hypothalamus, which “tell” her pituitary gland to release the hormone prolactin into her bloodstream. Prolactin travels to the mammary glands in the breasts and stimulates milk production, which motivates the infant to keep suckling.

What Is the Pituitary Gland?

The pituitary gland is the master gland of the endocrine system, the system of glands that secrete hormones into the bloodstream. Endocrine hormones control virtually all physiological processes. For example, they control growth, sexual maturation, reproduction, body temperature, blood pressure, and metabolism. The pituitary gland is considered the
master gland of the endocrine system because it controls the rest of the endocrine system. Many pituitary hormones either promote or inhibit hormone secretion by other endocrine glands.

Figure \(\PageIndex{2}\): The pituitary gland in the endocrine system is closely connected to the hypothalamus in the brain. Image used with permission (CC BY-NC; Laura Guerin @ CK-12 Foundation).
**Structure and Function of the Pituitary Gland**

The pituitary gland is about the size of a pea. It protrudes from the bottom of the hypothalamus at the base of the inner brain (Figure \(\PageIndex{2}\)). The pituitary is connected to the hypothalamus by a thin stalk (called the infundibulum). Blood vessels and nerves in the stalk allow direct connections between the hypothalamus and pituitary gland. The pituitary gland consists of two bulb-like lobes: an anterior lobe and a posterior lobe (Figure \(\PageIndex{3}\)).

![Diagram of the pituitary gland](https://bio.libretexts.org/Courses/Butte_College/BC%3A_BIOL_2_-_Introduction_to_Human_Biology_(Grewal)/Text/12%3A_E...

Figure \(\PageIndex{3}\): Both anterior and posterior lobes of the pituitary gland are directly connected to the hypothalamus by capillaries (anterior lobe) and nerve axons (posterior lobe). Image used with permission (CC BY-SA 3.0 Unported; Diberri @ Wikicommons).

**Anterior Lobe**

The **anterior pituitary** is the lobe is at the front of the pituitary gland. It synthesizes and releases hormones into the blood. The table below shows some of the endocrine hormones released by the anterior pituitary, including their targets and effects.

<table>
<thead>
<tr>
<th>Hormone</th>
<th>Target</th>
<th>Effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrenocorticotropic hormone (ACTH)</td>
<td>Adrenal glands</td>
<td>Stimulates the cortex of each adrenal gland to secrete its hormones</td>
</tr>
<tr>
<td>Thyroid-stimulating hormone (TSH)</td>
<td>Thyroid gland</td>
<td>Stimulates the thyroid gland to secrete thyroid hormone</td>
</tr>
<tr>
<td>Growth hormone (GH)</td>
<td>Body cells</td>
<td>Stimulates body cells to synthesize proteins and grow</td>
</tr>
<tr>
<td>Follicle-stimulating hormone (FSH)</td>
<td>Ovaries, testes</td>
<td>Stimulates the ovaries to develop mature eggs; stimulates the testes to produce sperm</td>
</tr>
<tr>
<td>Luteinizing hormone (LH)</td>
<td>Ovaries, testes</td>
<td>Stimulates the ovaries and testes to secrete sex hormones; stimulates the ovaries to release eggs</td>
</tr>
<tr>
<td>Prolactin (PRL)</td>
<td>Mammary</td>
<td>Stimulates the mammary glands to produce milk</td>
</tr>
</tbody>
</table>

https://bio.libretexts.org/Courses/Butte_College/BC%3A_BIOL_2_-_Introduction_to_Human_Biology_(Grewal)/Text/12%3A_E…

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The anterior pituitary gland is regulated mainly by hormones from the hypothalamus. The hypothalamus secretes hormones called releasing hormones and inhibiting hormones that travel through capillaries directly to the anterior lobe of the pituitary gland (you can see the capillary connection in the diagram above). The hormones stimulate the anterior pituitary to either release or stop releasing particular pituitary hormones. Several of these hypothalamic hormones and their effects on the anterior pituitary are shown in the table below.

### Hypothalamic Hormones and Their Effects on the Anterior Pituitary

<table>
<thead>
<tr>
<th>Hypothalamic Hormone</th>
<th>Effect on Anterior Pituitary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thyrotropin releasing hormone (TRH)</td>
<td>Release of thyroid stimulating hormone (TSH)</td>
</tr>
<tr>
<td>Corticotropin releasing hormone (CRH)</td>
<td>Release of adrenocorticotropic hormone (ACTH)</td>
</tr>
<tr>
<td>Gonadotropin releasing hormone (GnRH)</td>
<td>Release of follicle-stimulating hormone (FSH) and luteinizing hormone (LH)</td>
</tr>
<tr>
<td>Growth hormone releasing hormone (GHRH)</td>
<td>Release of growth hormone (GH)</td>
</tr>
<tr>
<td>Growth hormone inhibiting hormone (GHIH) (Somatostatin)</td>
<td>Stopping of growth hormone release</td>
</tr>
<tr>
<td>Prolactin releasing hormone (PRH)</td>
<td>Release of prolactin</td>
</tr>
<tr>
<td>Prolactin inhibiting hormone (PIH) (Dopamine)</td>
<td>Stopping of prolactin release</td>
</tr>
</tbody>
</table>

**Posterior Lobe**

The **posterior pituitary** is the lobe at the back of the pituitary gland. This lobe does not synthesize any hormones. Instead, the posterior lobe stores hormones that come from the hypothalamus along the axons of nerves connecting the two structures (Figure \(\PageIndex{3}\)). The posterior pituitary then secretes the hormones into the bloodstream as needed. Hypothalamic hormones secreted by the posterior pituitary include vasopressin and oxytocin.

- Vasopressin (also called antidiuretic hormone, or ADH) helps to maintain homeostasis in body water. It stimulates the kidneys to conserve water by producing more concentrated urine. Specifically, vasopressin targets ducts in the
kidneys and makes them more permeable to water. This allows more water to be resorbed by the body rather than excreted in the urine.

- Oxytocin (OXY) targets cells in the uterus to stimulate uterine contractions, for example, during childbirth. It also targets cells in the breasts of a nursing mother to stimulate the letdown of milk.

**Summary**

- The pituitary gland is the master gland of the endocrine system because most of its hormones control other endocrine glands.
- The pituitary gland is at the base of the brain, where it is connected to the hypothalamus by nerves and capillaries. It has an anterior (front) lobe that synthesizes and secretes pituitary hormones and a posterior (back) lobe that stores and secretes hormones from the hypothalamus.
- Hormones synthesized and secreted by the anterior pituitary include growth hormone, which stimulates cell growth throughout the body, and thyroid stimulating hormone (TSH), which stimulates the thyroid gland to secrete its hormones.
- Hypothalamic hormones stored and secreted by the posterior pituitary gland include vasopressin, which helps maintain homeostasis in body water; and oxytocin, which stimulates uterine contractions during birth and the letdown of milk during lactation.

**Review**

1. Explain why the pituitary gland is called the master gland of the endocrine system.
2. Compare and contrast the two lobes of the pituitary gland and their general functions.
3. Identify two hormones released by the anterior pituitary, their targets, and their effects.
4. Explain how the hypothalamus influences the output of hormones by the anterior lobe of the pituitary gland.
5. Name and give the function of two hypothalamic hormones released by the posterior pituitary gland.
6. *True or False.* The pituitary gland only secretes hormones that are involved in reproduction.
7. *True or False.* The brain does not produce hormones, only glands produce hormones.
8. If a releasing hormone is secreted from the hypothalamus to the pituitary gland, which part of the pituitary receives it? Explain your answer.
9. Answer the following questions about prolactin releasing hormone (PRH) and prolactin inhibiting hormone (PIH).
   a. Where are these hormones produced?
   b. Where are their target cells located?
   c. What are their effects on their target cells?
   d. What are their ultimate effects on milk production? Explain your answer.
   e. When a baby nurses, which of these hormones is most likely released in the mother? Explain your answer.
10. For each of the following hormones, state whether it is synthesized in the pituitary or the hypothalamus.
a. Gonadotropin releasing hormone (GnRH)

b. Growth hormone (GH)

c. Oxytocin

d. Adrenocorticotropic hormone (ACTH)

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Because the pituitary gland controls the entire endocrine system, disorders of the pituitary can affect virtually any body system. The most common pituitary disorders are pituitary tumors. You can learn about pituitary tumors by watching these brief, interesting videos:

Media, iframe, embed and object tags are not supported inside of a PDF.
Diagnosing and Treating Pituitary Tumors - California Center for Pituitary Disorders at UCSF