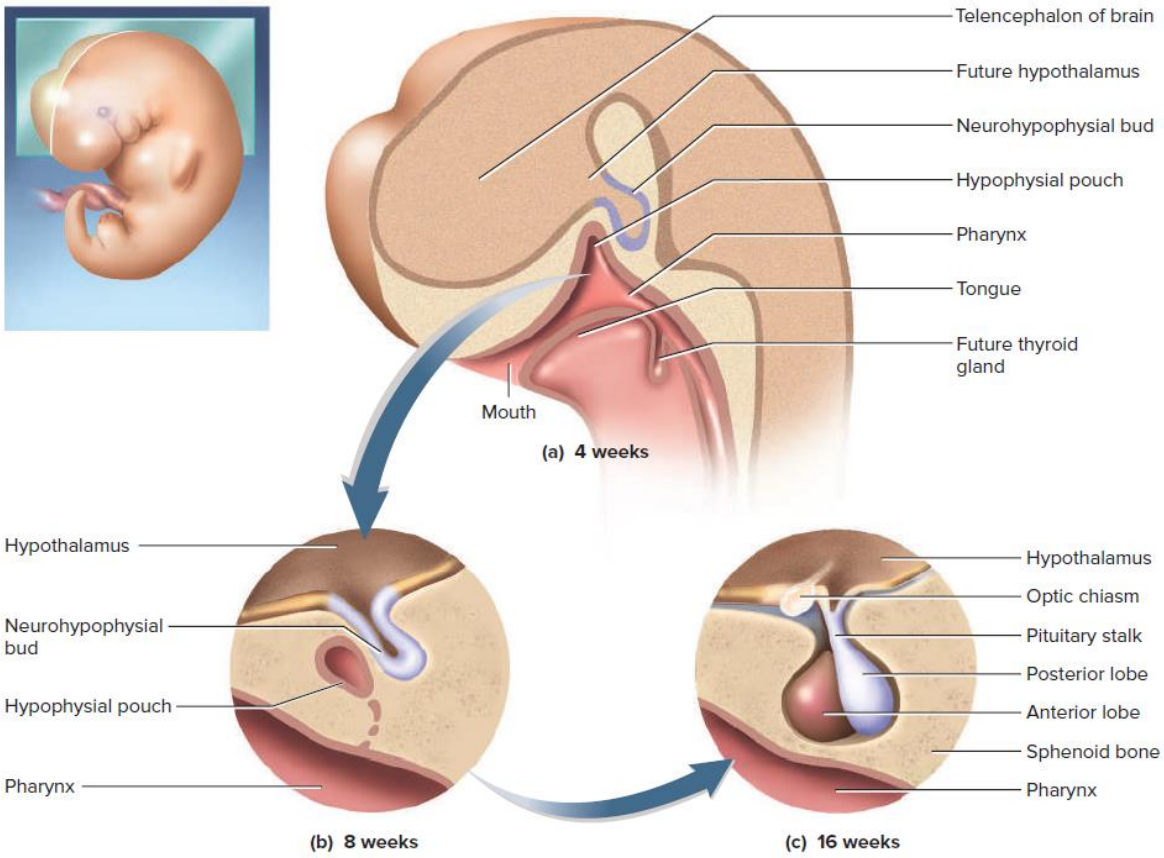
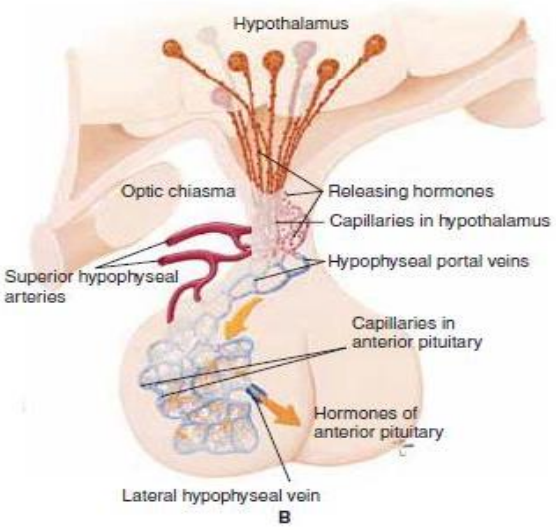
The pituitary gland

The **pituitary gland (or hypophysis)** is suspended from the floor of the hypothalamus by a **stalk (infundibulum)** and is enclosed by the **sella turcica** of the **sphenoid bone**. Despite its small size, the pituitary gland regulates many body functions. Pituitary gland is composed of two major portions which include **anterior pituitary gland (adenohypophysis)**, which is separate glandular tissue, and the **posterior pituitary gland (neurohypophysis)**, which is an extension of the nerve tissue of the hypothalamus.



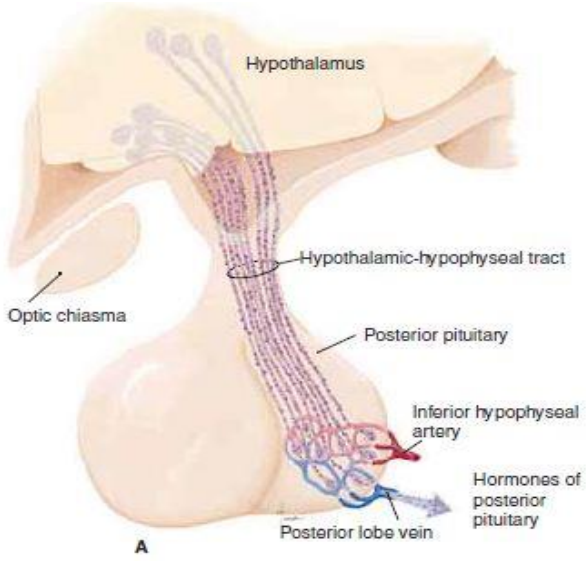
Anterior pituitary gland

Hormones of anterior pituitary gland are regulated by **releasing** and **inhibiting hormones** from the **hypothalamus**. Releasing and inhibiting hormones are secreted into capillaries in the hypothalamus and pass through the **hypophyseal portal veins** to another capillary network in the anterior pituitary gland. Here, the releasing hormones are absorbed and **stimulate** secretion of the anterior pituitary hormones. While, inhibiting hormones **suppress** anterior pituitary gland to secrete hormones. The hormones of the anterior pituitary gland regulate many body functions.



Posterior pituitary glands

The two hormones **(ADH** and **OT)** of the **posterior pituitary gland** are produced by the **hypothalamus** and simply stored in the **posterior pituitary gland** until needed. Their release is stimulated by **nerve impulses** from the hypothalamus. Hormones of the posterior pituitary are made by certain **neuroendocrine cells** in the hypothalamus. Their **axons** pass down the stalk as a bundle called the **hypothalamic-hypophysial tract** and end in the posterior lobe. **Hormones** are made in the **neuron cell bodies (soma)** and move down the **nerve fiber** to the posterior pituitary. Here they are **stored** in the **nerve endings** until a **nerve signal** coming down the same axons **triggers** their release.



Anterior pituitary gland hormones

1- Follicle-Stimulating Hormone

Follicle-stimulating hormone (FSH) is one of the **gonadotropic hormones**. FSH has effects on the **gonads**: the **ovaries** or **testes**. FSH is named for one of its functions in women. Within the ovaries are **ovarian follicles** that contain potential **ova (egg cells)**. FSH stimulates the growth of **ovarian follicles**; that is, it initiates **egg** development in cycles of approximately 28 days. FSH also stimulates the secretion of **estrogen** by the ovaries. In men, FSH initiates **sperm production** within the **testes**.

The secretion of FSH is stimulated by the **hypothalamus**, which produces **gonadotropin-releasing hormone (GnRH)**. FSH secretion is decreased by **inhibin**, a hormone produced by the ovaries or testes.

2- Luteinizing Hormone

Luteinizing hormone (LH) is another **gonadotropic hormone**. In women, LH is responsible for **ovulation**, the release of a mature ovum from an ovarian follicle. LH then stimulates that follicle to develop into the **corpus luteum**, which secretes **progesterone**. In men, LH stimulates the **interstitial cells** of the **testes** to secrete **testosterone**.

3- Growth Hormone

Growth hormone (GH) is also called **somatotropin**. GH is secreted by **somatotropic cells**, the most numerous cells of the anterior pituitary. The pituitary produces at least a thousand times as much GH as any other hormone. The general effect of GH is to stimulate **mitosis** and **cellular differentiation** and thus to promote tissue growth throughout the body.

The secretion of GH is regulated by two hormones from the hypothalamus. **Growth hormone-releasing hormone (GHRH)**, which increases the secretion of GH, is produced during **hypoglycemia** and **exercise**. Another stimulus for GHRH is a **high blood level of amino acids**; the GH then secreted will ensure the conversion of these amino acids into protein. **Somatostatin** may also be called **growth hormone inhibiting hormone (GHIH)**, and, as its name tells us, it decreases the secretion of GH. Somatostatin is produced during **hyperglycemia**.

4- Thyroid-Stimulating Hormone

Thyroid-stimulating hormone (TSH) is also called **thyrotropin**, and its target organ is the **thyroid gland**. TSH stimulates the normal **growth of the thyroid gland** and the secretion of **thyroxine (T4)** and **triiodothyronine (T3)**. The secretion of TSH is stimulated by **thyrotropin-releasing hormone (TRH)** from the hypothalamus. When metabolic rate (energy production) decreases, TRH is produced.

5- Adrenocorticotropic Hormone

Adrenocorticotropic hormone (ACTH) stimulates the secretion of **cortisol** and other hormones by the **adrenal cortex**. Secretion of ACTH is increased by **corticotropin-releasing hormone (CRH)** from the hypothalamus. CRH is produced in any type of physiological stress situation.

6- Prolactin

Prolactin, as its name suggests, is responsible for **lactation**. More precisely, prolactin initiates and maintains milk production by the **mammary glands**. The regulation of secretion of prolactin is complex, involving both **prolactin-releasing hormone (PRH)** and **prolactin-inhibiting hormone (PIH)** from the hypothalamus. The mammary glands must first be acted upon by other hormones such as **estrogen** and **progesterone**, which are secreted in large amounts by the **placenta during pregnancy**. Then, after delivery of the baby, prolactin secretion increases, and milk is produced. If the mother continues to breast-feed, prolactin levels remain high.

Posterior pituitary gland hormones

1- Antidiuretic Hormone

Antidiuretic hormone (**ADH**, also called **vasopressin**) increases the reabsorption of water by kidney tubules, which decreases the amount of urine formed. The water is reabsorbed into the blood, so as urinary output is decreased, blood volume is increased, which helps maintain normal blood pressure. ADH also decreases sweating, but the amount of water conserved is much less than that conserved by the kidneys.

The stimulus for the secretion of ADH is decreased water content of the body. If too much water is lost through sweating or diarrhea, for example, **osmoreceptors** in the hypothalamus detect the

increased “saltiness” of body fluids. The hypothalamus then transmits **impulses** to the **posterior pituitary** to increase the secretion of **ADH** and decrease the loss of more water in urine.

2- Oxytocin

Oxytocin stimulates **contraction of the uterus at the end of pregnancy** and stimulates the **release of milk from the mammary glands**.

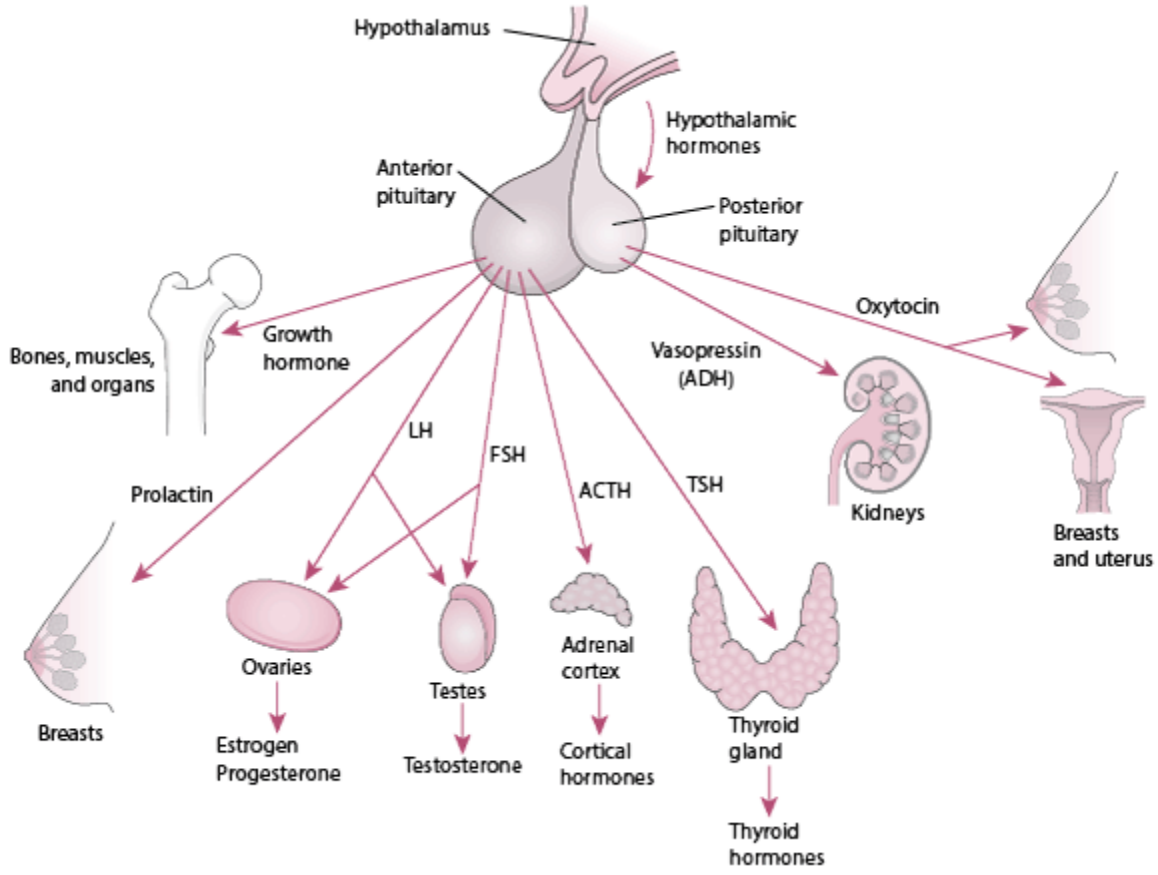
As labor begins, the cervix of the uterus is stretched, which generates sensory impulses to the hypothalamus, which in turn stimulates the **posterior pituitary** to release **oxytocin**. Oxytocin then causes strong contractions of the **smooth muscle (myometrium)** of the uterus to bring about delivery of the baby and the placenta.

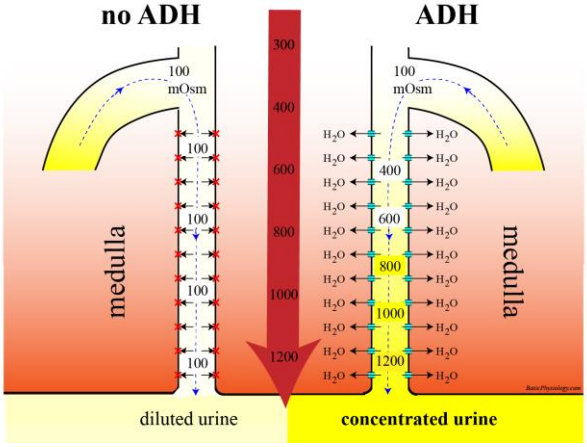
It has been discovered that the **placenta** itself secretes oxytocin at the end of gestation. Research is continuing to determine the exact mechanism and precise role of the placenta in labor.

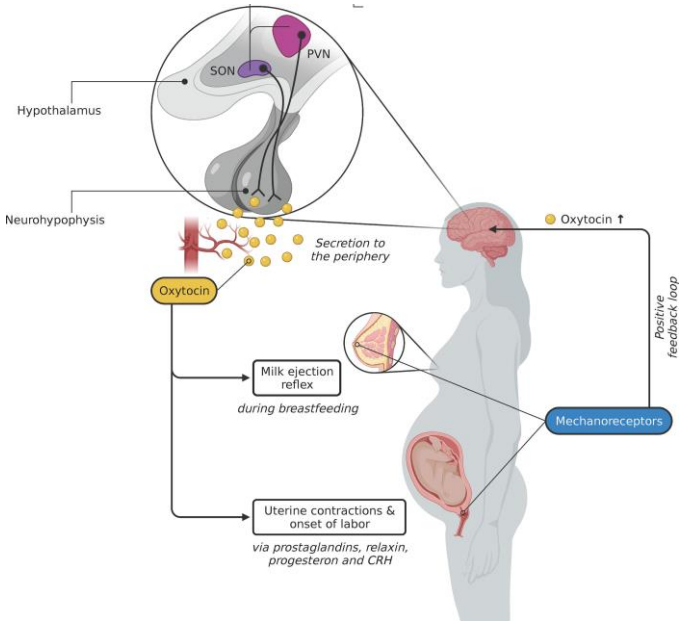
When a baby is breast-fed, the sucking of the baby stimulates sensory impulses from the mother’s nipple to the hypothalamus. Nerve impulses from the hypothalamus to the posterior pituitary cause the release of oxytocin, which stimulates the contraction of the **smooth muscle** cells around the mammary ducts to release milk.

Pituitary Hormones

Hormone	Target Organ or Tissue	Principal Effects
Anterior Pituitary		
Follicle-stimulating hormone (FSH)	Ovaries, testes	*Female:* Growth of ovarian follicles and secretion of estrogen *Male:* Sperm production
Luteinizing hormone (LH)	Ovaries, testes	*Female:* Ovulation, maintenance of corpus luteum *Male:* Testosterone secretion
Thyroid-stimulating hormone (TSH)	Thyroid gland	Growth of thyroid, secretion of thyroid hormone
Adrenocorticotropic hormone (ACTH)	Adrenal cortex	Growth of adrenal cortex, secretion of glucocorticoids
Prolactin (PRL)	Mammary glands	Milk synthesis
Growth hormone (GH)	Liver, bone, cartilage, muscle, fat	Widespread tissue growth, especially in the stated tissues
Posterior Pituitary		
Antidiuretic hormone (ADH)	Kidneys	Water retention
Oxytocin (OT)	Uterus, mammary glands	Labor contractions, milk release; possibly involved in ejaculation, sperm transport, sexual affection, and mother–infant bonding


Hypothalamus
Hypothalamic hormones
Anterior pituitary
Posterior pituitary
Bones, muscles, and organs
Growth hormone
Oxytocin
Vasopressin (ADH)
Kidneys
Breasts and uterus
LH
FSH
Prolactin
ACTH
TSH
Breasts
Ovaries
Testes
Adrenal cortex
Thyroid gland
Estrogen
Progesterone
Testosterone
Cortical hormones
Thyroid hormones


no ADH
ADH
100 mOsm
100 mOsm
medulla
medulla
300
400
600
800
1000
1200
400
600
800
1000
1200
diluted urine
concentrated urine


Hypothalamus
SON
PVN
Neurohypophysis
Secretion to the periphery
Oxytocin
Oxytocin ↑
Positive feedback loop
Milk ejection reflex
during breastfeeding
Mechanoreceptors
Uterine contractions & onset of labor
via prostaglandins, relaxin, progesteron and CRH