
Endocrine System – Day 2

Thought for the Day

"You can't aim a duck to death."

Gael Boardman

Humoral Stimuli

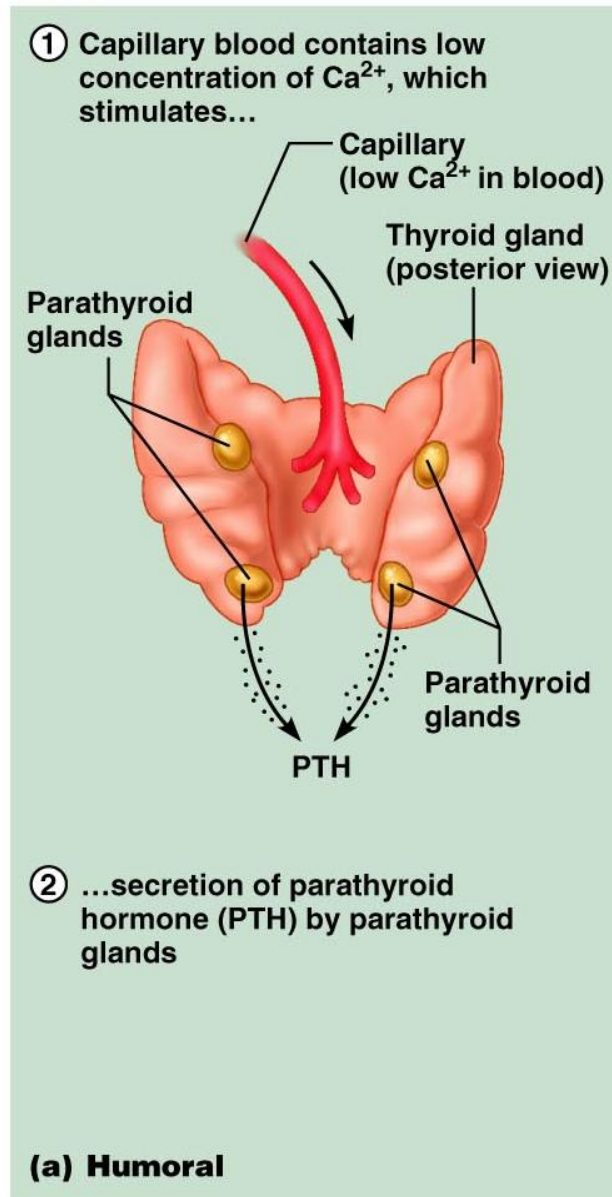
Humoral stimuli – secretion of hormones in direct response to changing blood levels of ions and nutrients

Example: concentration of calcium ions in the blood

Declining blood Ca^{2+} concentration stimulates the parathyroid glands to secrete PTH (parathyroid hormone)

PTH causes Ca^{2+} concentrations to rise and the stimulus is removed

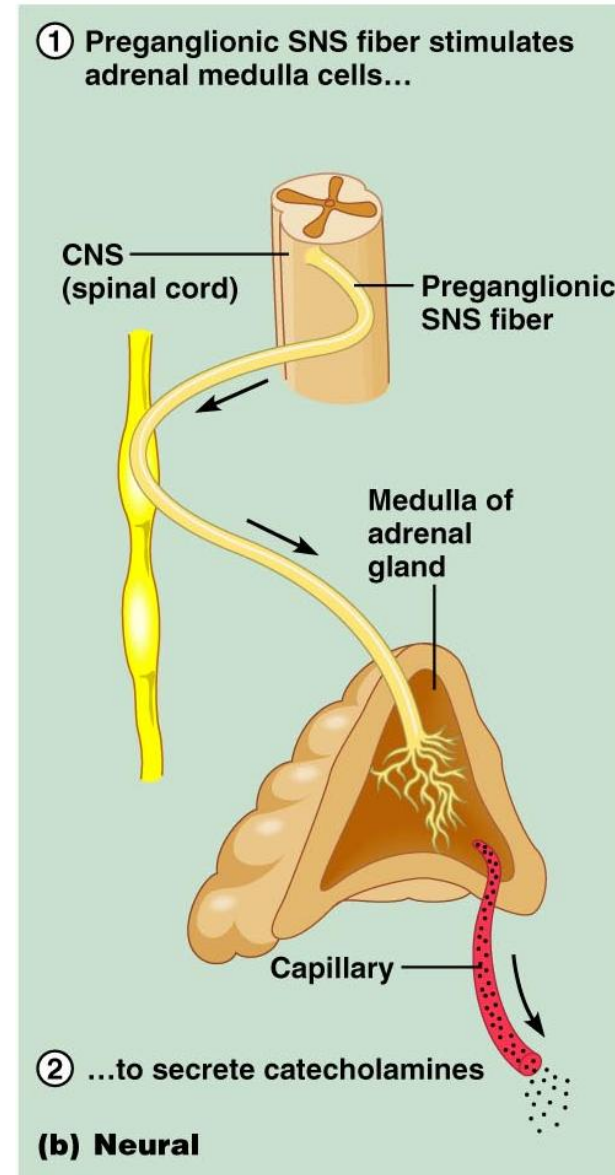
Humoral Stimuli



Neural Stimuli

Neural stimuli – nerve fibers stimulate hormone release

Preganglionic sympathetic nervous system (SNS) fibers stimulate the adrenal medulla to secrete catecholamines



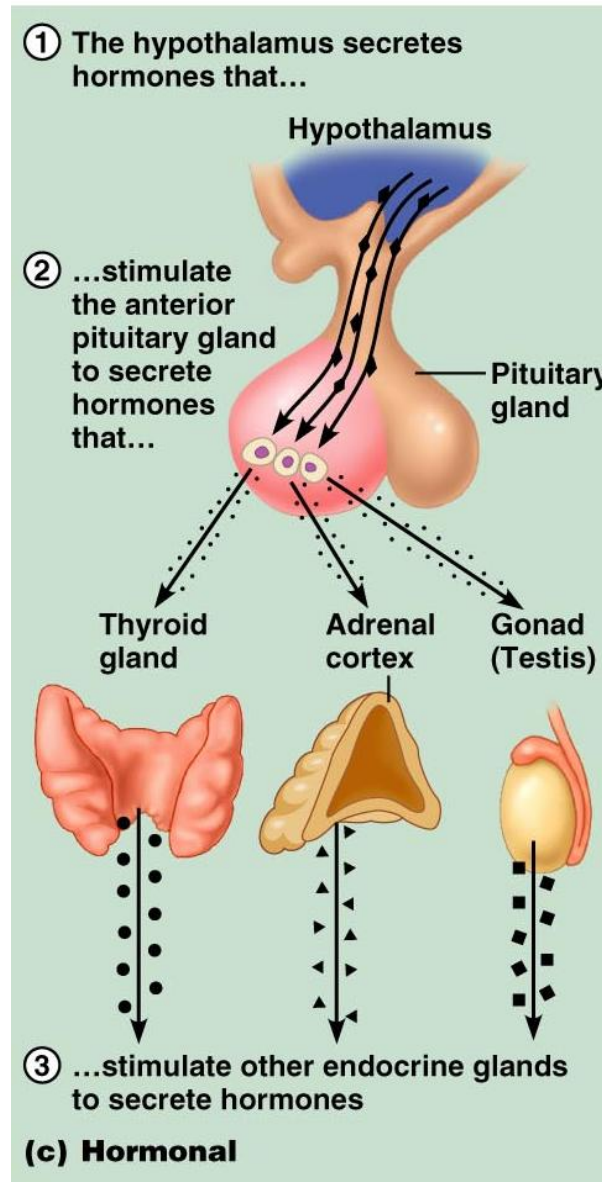
Hormonal Stimuli

Hormonal stimuli – release of hormones in response to hormones produced by other endocrine organs

The hypothalamic hormones stimulate the anterior pituitary

In turn, pituitary hormones stimulate targets to secrete still more hormones

Hormonal Stimuli



Nervous System Modulation

The nervous system modifies the stimulation of endocrine glands and their negative feedback mechanisms

Nervous System Modulation

The nervous system can override normal endocrine controls

For example, control of blood glucose levels

Normally the endocrine system maintains blood glucose

Under stress, the body needs more glucose

The hypothalamus and the sympathetic nervous system are activated to supply ample glucose

HOW? ACTH - - Cortisol == Gluconeogenesis

Amino Acid based hormones

Water soluble

May be stored and release later

Most are free – metabolized quickly

Shorter half-life

Example - Thyroxin

Steroid Hormones

Lipid-soluble

Cannot be stored

Transported by plasma proteins

Half life is longer

Less fluctuation in blood

Example: Estrogen, progesterone, testosterone, aldosterone, cortisol

Major Endocrine Organs: Pituitary (Hypophysis)

Pituitary gland – two-lobed organ that secretes nine major hormones

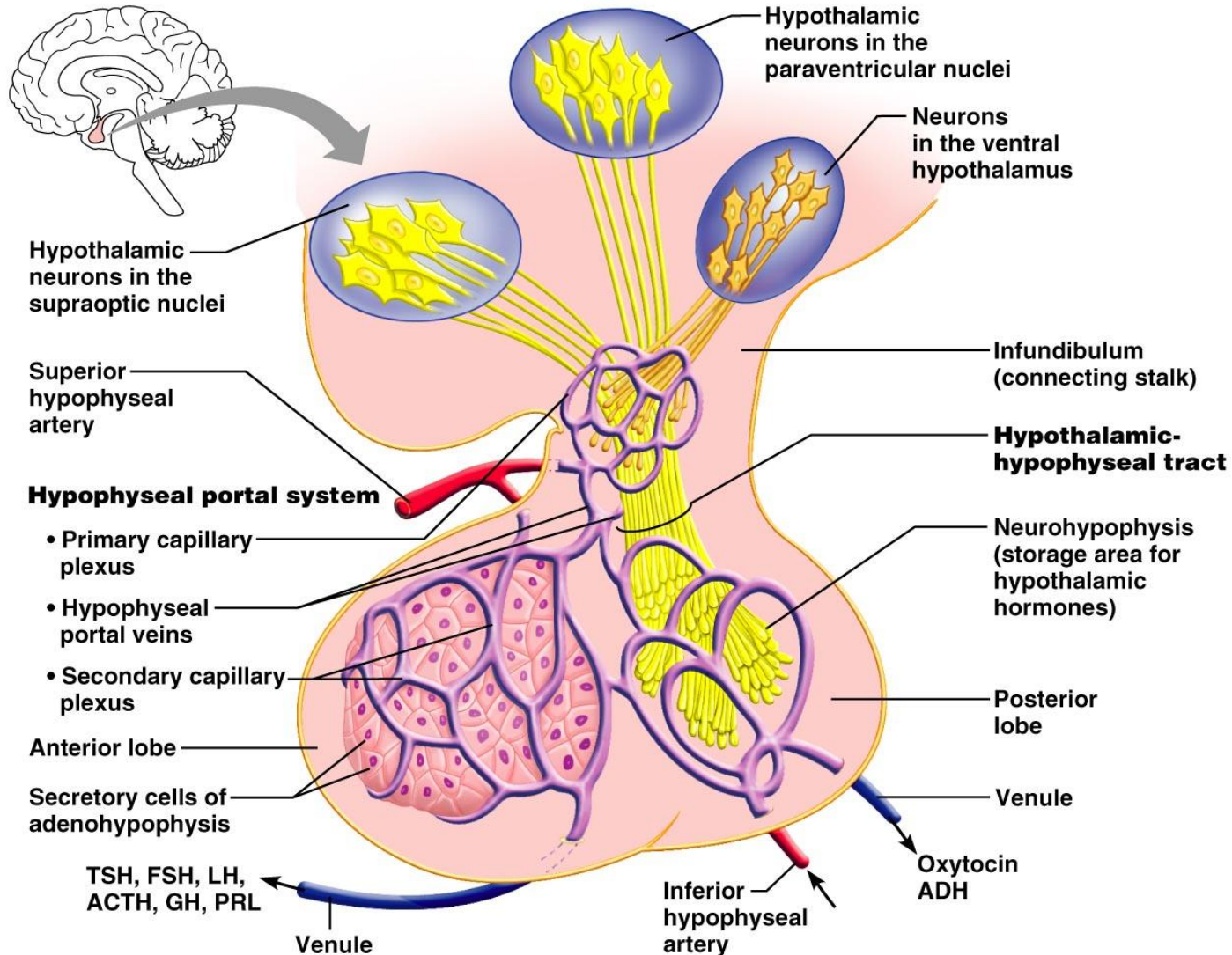
Neurohypophysis – posterior lobe (neural tissue) and the infundibulum

Receives, stores, and releases hormones from the hypothalamus

Adenohypophysis – anterior lobe, made up of glandular tissue

Synthesizes and secretes a number of hormones

Major Endocrine Organs: Pituitary (Hypophysis)



Pituitary-Hypothalamic Relationships: Posterior Lobe

The posterior lobe is a downgrowth of hypothalamic neural tissue

Has a neural connection with the hypothalamus (hypothalamic-hypophyseal tract)

Nuclei of the hypothalamus synthesize oxytocin and antidiuretic hormone (ADH)

These hormones are transported to the posterior pituitary

Pituitary-Hypothalamic Relationships: Anterior Lobe

The anterior lobe of the pituitary is an outpocketing of the oral mucosa

There is no direct neural contact with the hypothalamus

Pituitary-Hypothalamic Relationships: Anterior Lobe

There is a vascular connection, the hypophyseal portal system, consisting of:

The primary capillary plexus

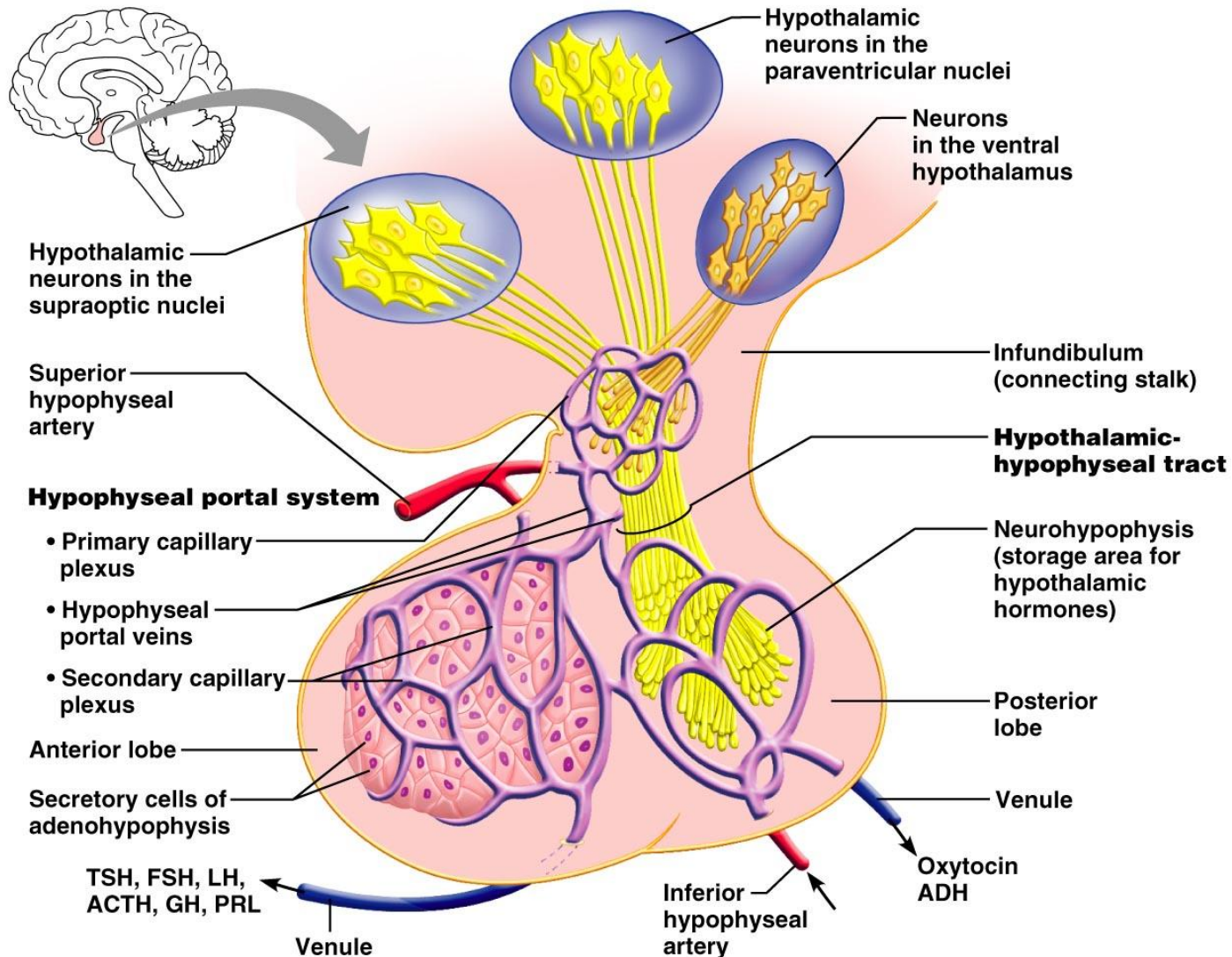
The hypophyseal portal veins

The secondary capillary plexus

PLAY

InterActive Physiology®: The Hypothalamic Pituitary Axis

Pituitary-Hypothalamic Relationships: Anterior Lobe



Adenophyphyseal Hormones

The six hormones of the adenohypophysis:

Abbreviated as GH, TSH, ACTH, FSH, LH, and PRL

Regulate the activity of other endocrine glands

In addition, pro-opiomelanocortin (POMC):

Has been isolated from the pituitary

Is split into ACTH, opiates, and MSH

Activity of the Adenophypophysis

The hypothalamus sends a chemical stimulus to the anterior pituitary

Releasing hormones stimulate the synthesis and release of hormones

Inhibiting hormones shut off the synthesis and release of hormones

Activity of the Adenophypophysis

The tropic hormones that are released are:

Thyroid-stimulating hormone (TSH)

Adrenocorticotropic hormone (ACTH)

Follicle-stimulating hormone (FSH)

Luteinizing hormone (LH)

Growth Hormone (GH)

Produced by somatotrophic cells of the anterior lobe that:

Stimulate most cells, but target bone and skeletal muscle

Promote protein synthesis and encourage the use of fats for fuel

Most effects are mediated indirectly by somatomedins

Growth Hormone (GH)

Antagonistic hypothalamic hormones regulate GH

Growth hormone–releasing hormone (GHRH)
stimulates GH release

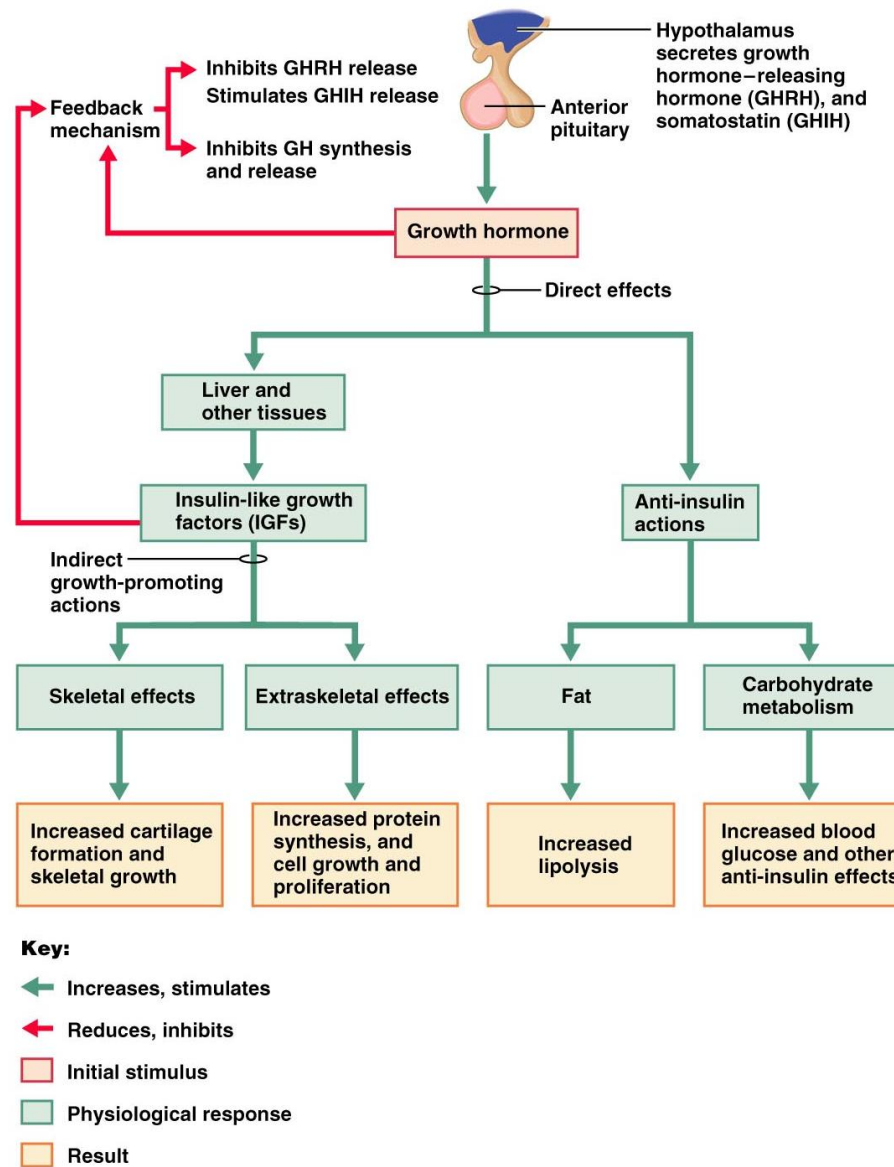
Growth hormone–inhibiting hormone (GHIH)
inhibits GH release

Metabolic Action of Growth Hormone

GH stimulates liver, skeletal muscle, bone, and cartilage to produce insulin-like growth factors

Direct action promotes lipolysis and inhibits glucose uptake

Metabolic Action of Growth Hormone (GH)



Thyroid Stimulating Hormone (Thyrotropin)

Stimulates the normal development and secretory activity of the thyroid

Triggered by hypothalamic peptide thyrotropin-releasing hormone (TRH)

Rising blood levels of thyroid hormones act on the pituitary and hypothalamus to block the release of TSH

Adrenocorticotrophic Hormone (Corticotropin)

Stimulates the adrenal cortex to release corticosteroids

Triggered by hypothalamic corticotropin-releasing hormone (CRH) in a daily rhythm

Internal and external factors such as fever, hypoglycemia, and stressors can trigger the release of CRH

Gonadotropins

Gonadotropins – follicle-stimulating hormone (FSH) and luteinizing hormone (LH)

Regulate the function of the ovaries and testes

FSH stimulates gamete (egg or sperm) production

Absent from the blood in prepubertal boys and girls

Triggered by the hypothalamic gonadotropin-releasing hormone (GnRH) during and after puberty

Functions of Gonadotropins

In females

LH works with FSH to cause maturation of the ovarian follicle

LH works alone to trigger ovulation (expulsion of the egg from the follicle)

LH promotes synthesis and release of estrogens and progesterone

Functions of Gonadotropins

In males

LH stimulates interstitial cells of the testes to produce testosterone

LH is also referred to as interstitial cell-stimulating hormone (ICSH)

Prolactin (PRL)

In females, stimulates milk production by the breasts

Triggered by the hypothalamic prolactin-releasing hormone (PRH)

Inhibited by prolactin-inhibiting hormone (PIH)

Blood levels rise toward the end of pregnancy

Suckling stimulates PRH release and encourages continued milk production

The Posterior Pituitary and Hypothalamic Hormones

Posterior pituitary – made of axons of hypothalamic neurons, stores antidiuretic hormone (ADH) and oxytocin

ADH and oxytocin are synthesized in the hypothalamus

ADH influences water balance

Oxytocin stimulates smooth muscle contraction in breasts and uterus

Both use PIP-calcium second-messenger mechanism