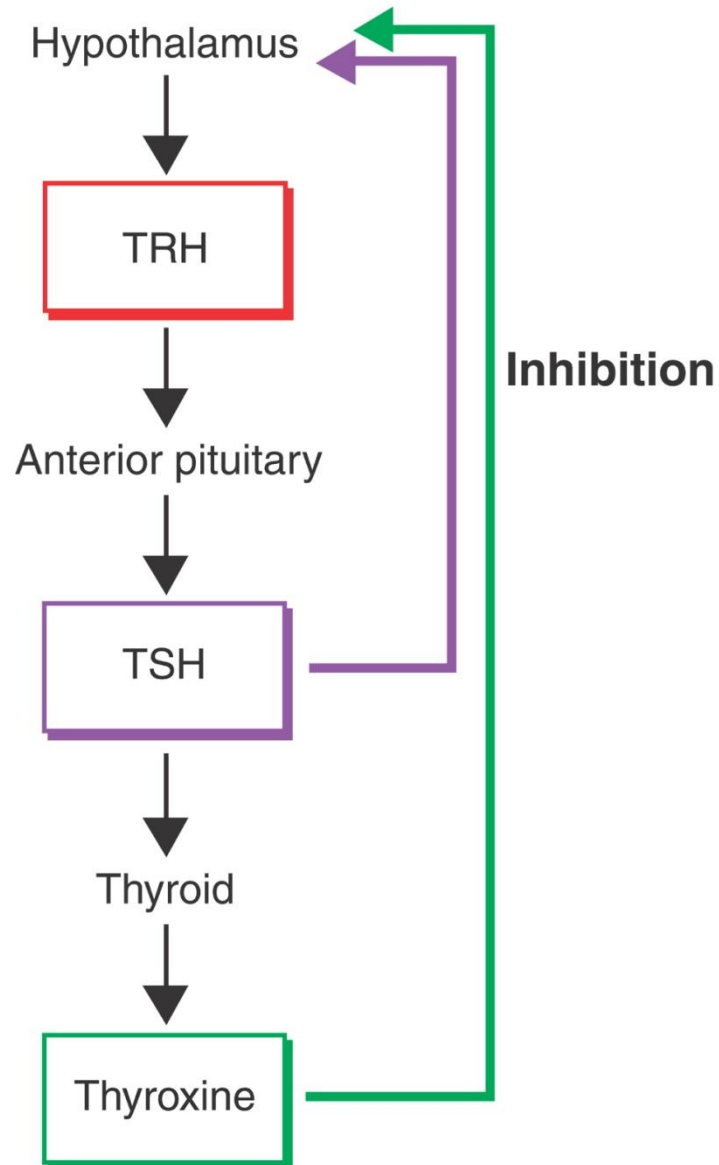


39-1 The Endocrine System





The endocrine system is made up of glands that release their products into the bloodstream. These products deliver messages throughout the body.

The chemicals released by the endocrine system can affect almost every cell in the body.

Hormones

Hormones are chemicals released in one part of the body that travel through the bloodstream and affect the activities of cells in other parts of the body.

Hormones bind to specific chemical receptors on cells.

Cells that have receptors for a particular hormone are called **target cells**.

If a cell does not have receptors or the receptors do not respond to a hormone, that hormone has no effect on it.

Glands

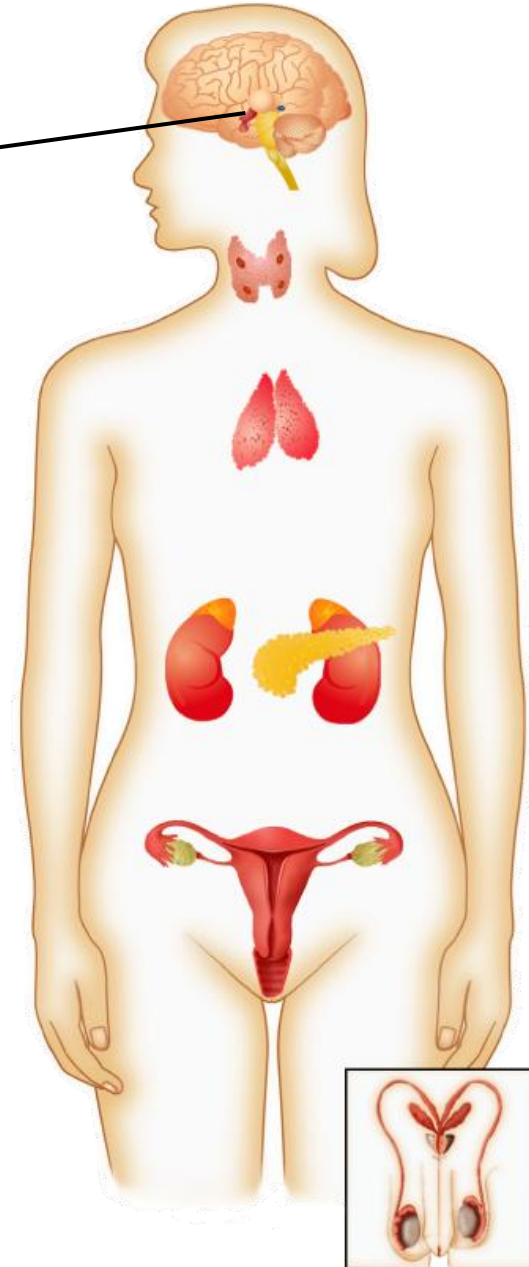
A gland is an organ that produces and releases a secretion. There are two kinds of glands:

Exocrine glands release secretions through ducts directly to the organs that use them.

Endocrine glands release their secretions directly into the bloodstream.

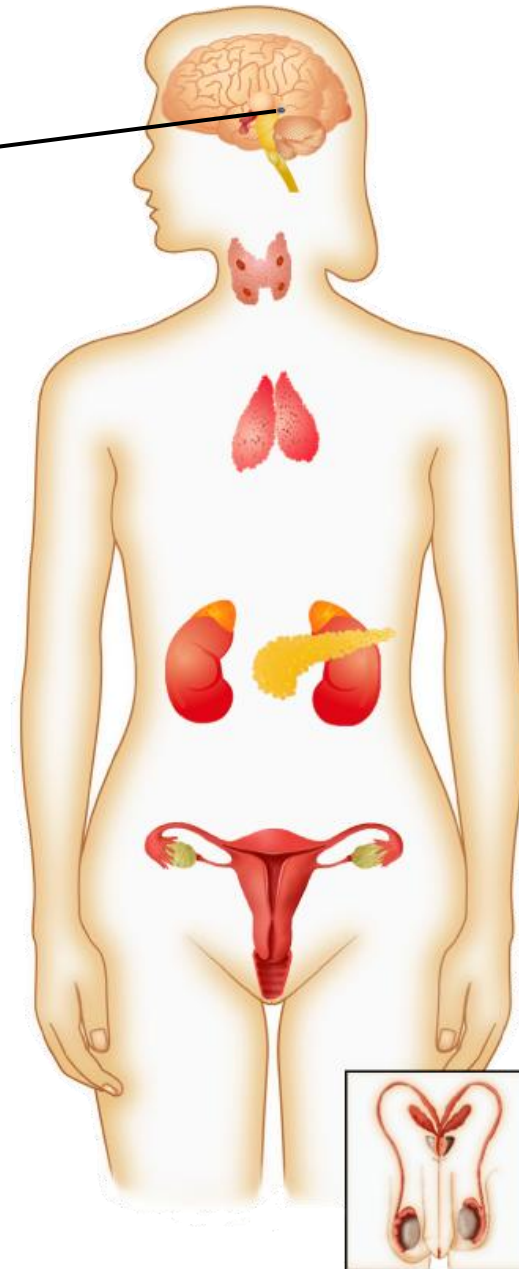
Hypothalamus

The hypothalamus makes hormones that control the pituitary gland. In addition, the hypothalamus makes hormones that are stored in the pituitary gland.



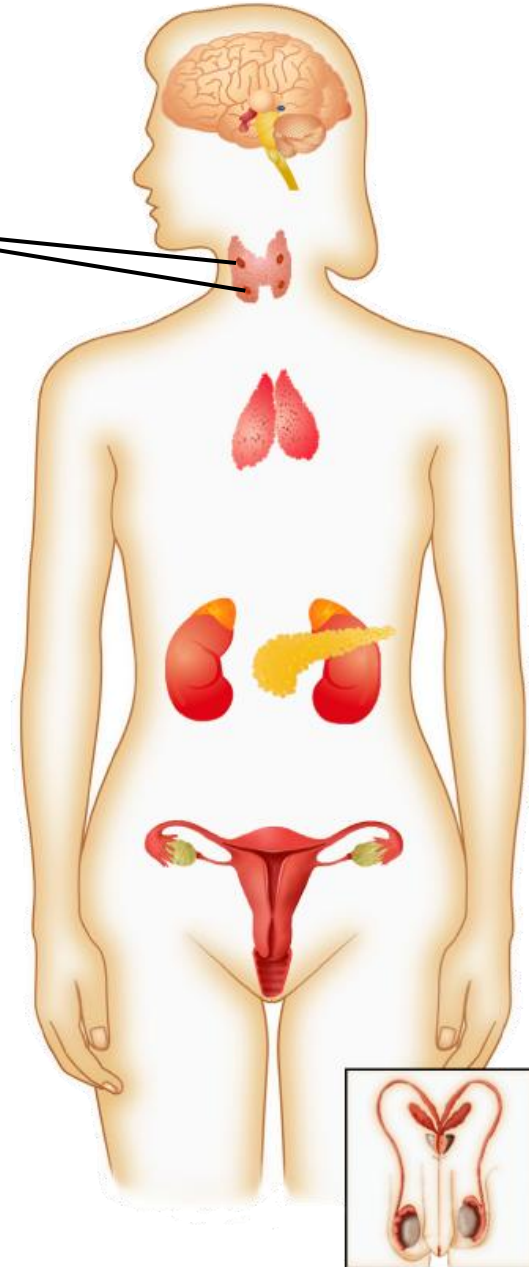
Pituitary gland

The pituitary gland produces hormones that regulate many of the other endocrine glands.



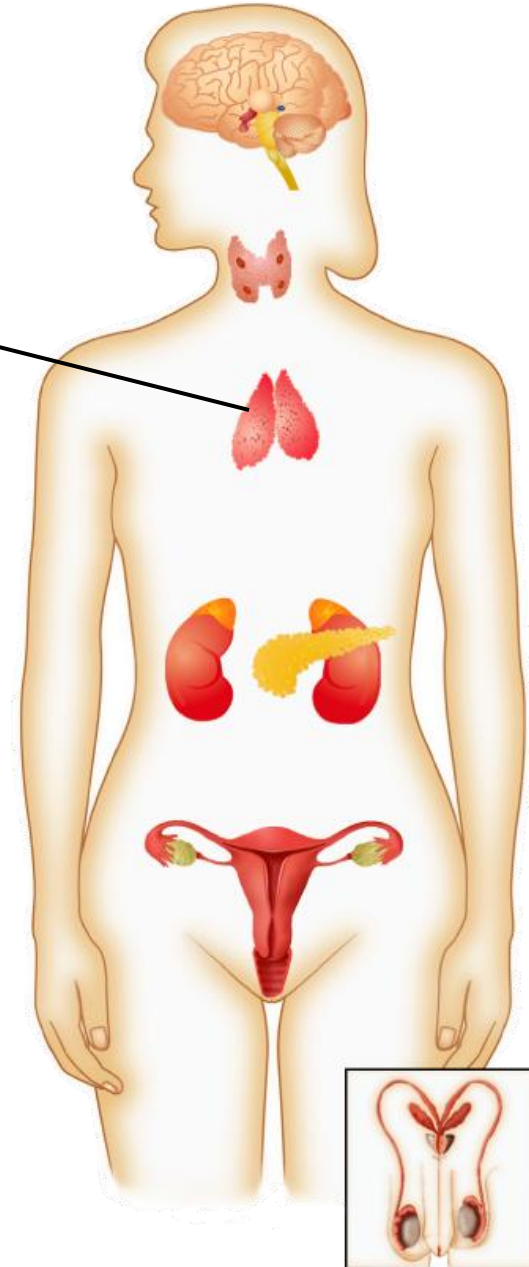
Parathyroid glands

The parathyroid glands release parathyroid hormone, which regulates the level of calcium in the blood.



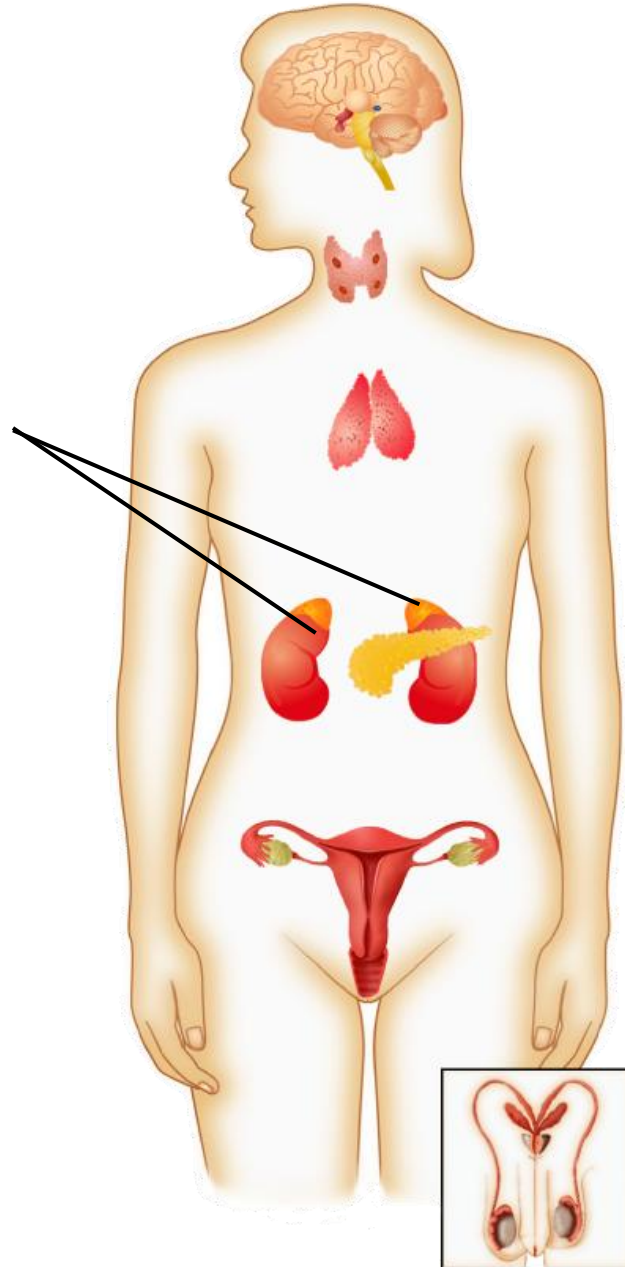
Thymus

During childhood, the thymus releases thymosin, which stimulates T cell development and proper immune response.



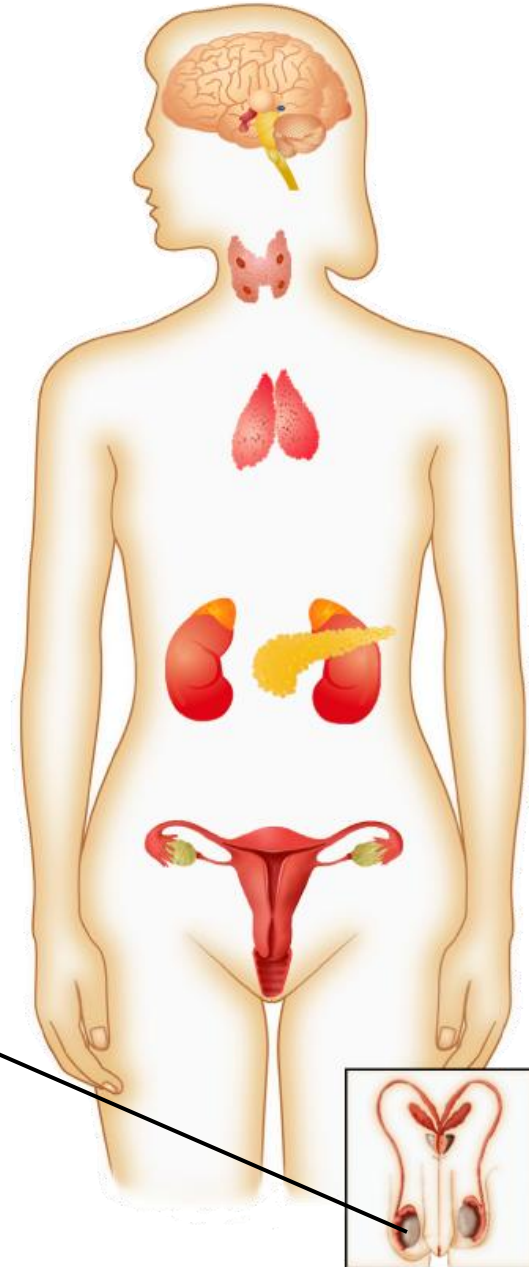
Adrenal glands

The adrenal glands release epinephrine and norepinephrine, which help the body respond to stress.



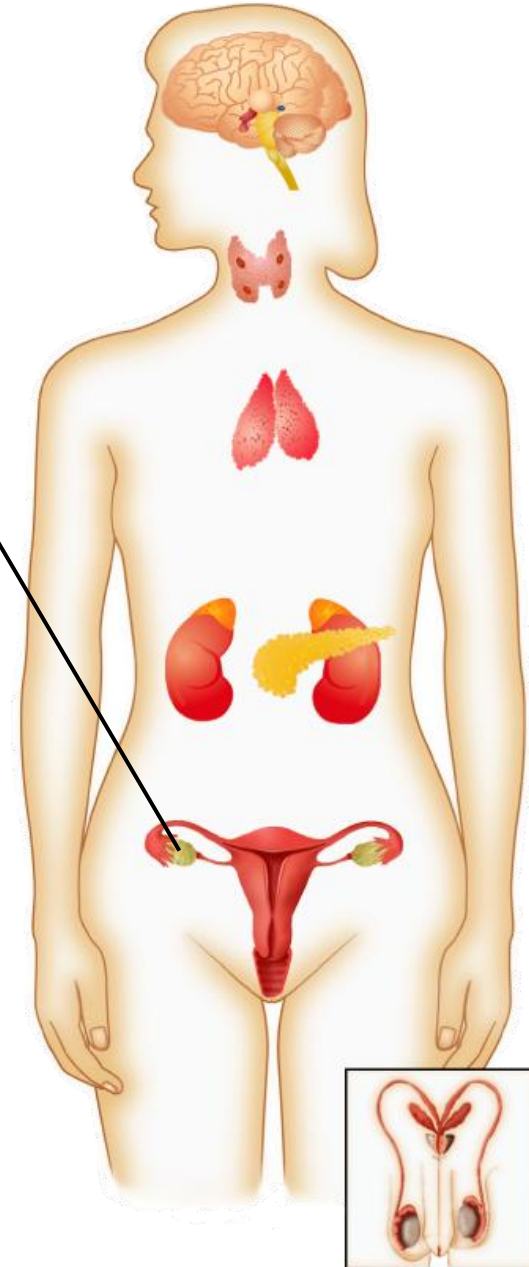
Testis

The testes produce testosterone, which is responsible for sperm production and the development of male secondary sex characteristics.



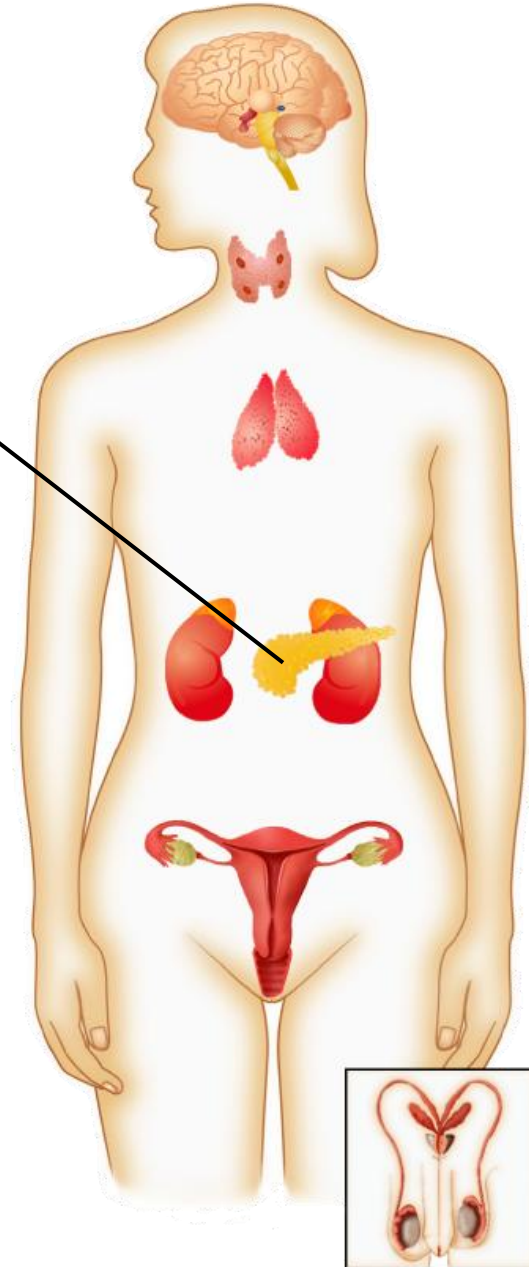
Ovary

Ovaries produce estrogen and progesterone. Estrogen is required for the development of female secondary sex characteristics and for the development of eggs. Progesterone prepares the uterus for a fertilized egg.



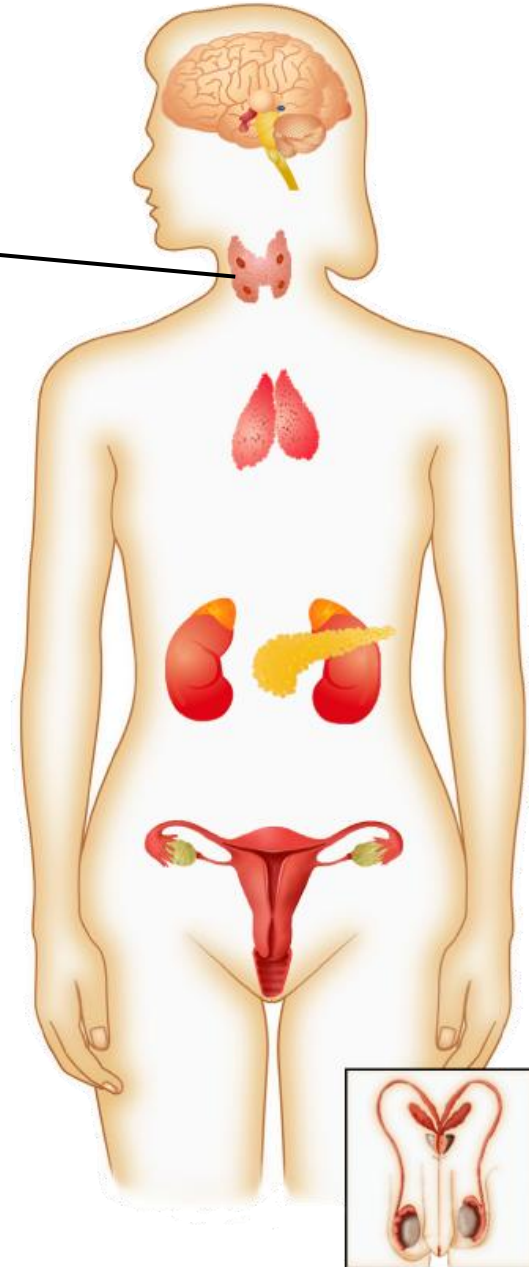
Pancreas

The pancreas produces insulin and glucagon, which regulate the level of glucose in the blood.



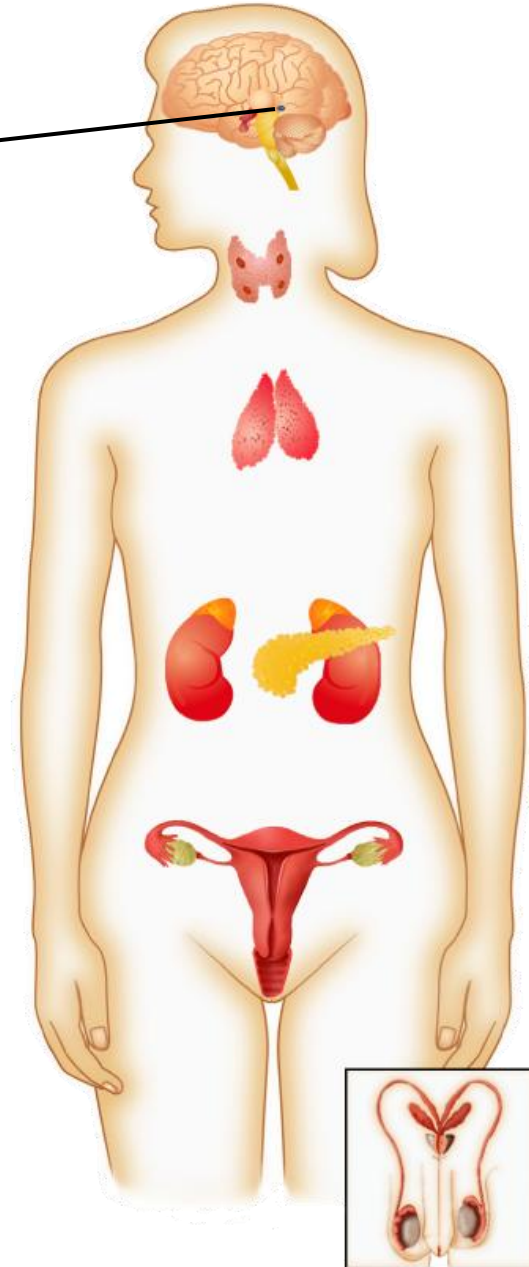
Thyroid

The thyroid produces thyroxine, which regulates metabolism throughout the body.



Pineal gland

The pineal gland releases melatonin, which is involved in rhythmic activities, such as daily sleep-wake cycles.



Hormone Action

Hormones are classified as either steroids or nonsteroids.

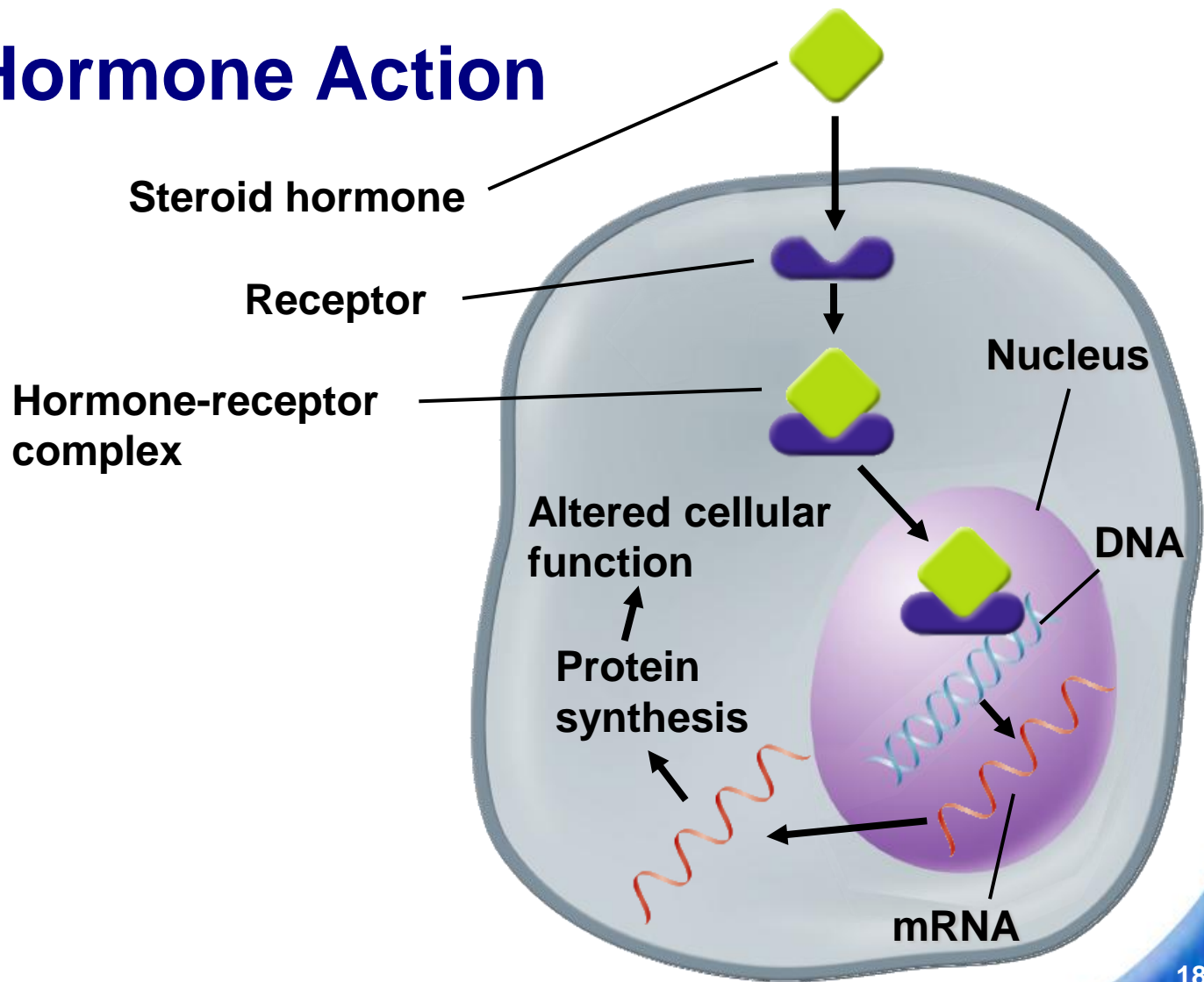
Steroid hormones are produced from a lipid called cholesterol.

Nonsteroid hormones include proteins, small peptides, and modified amino acids.

Steroid Hormones

Steroid hormones can cross cell membranes easily.

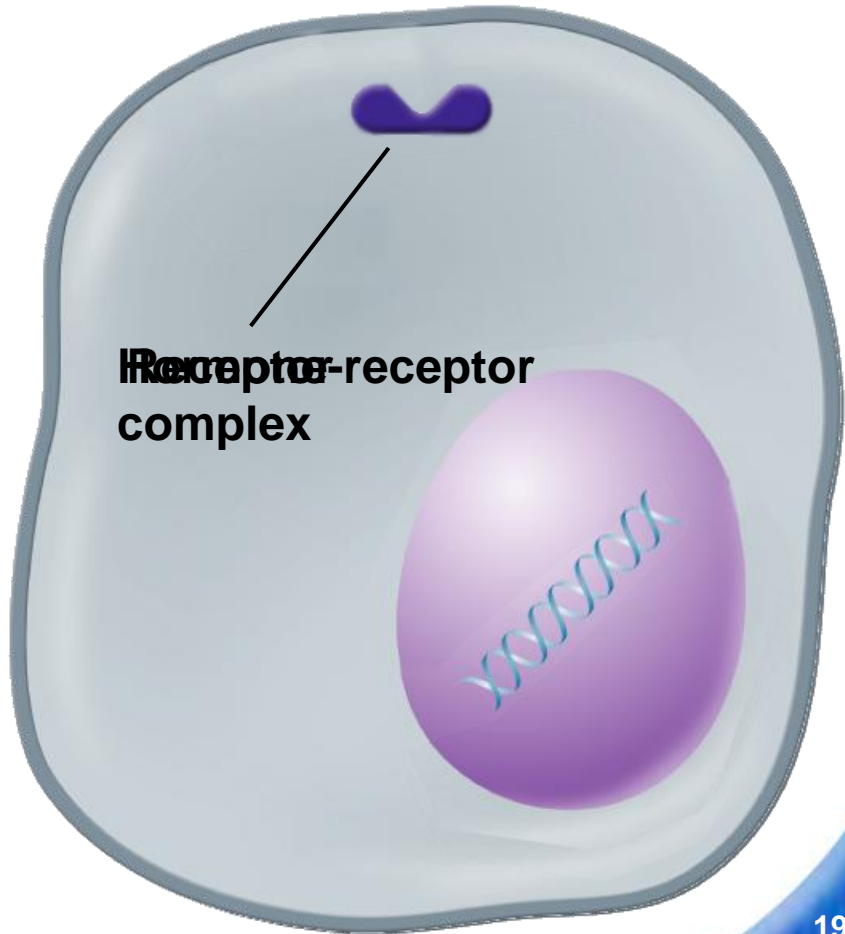
Steroid Hormone Action



A steroid hormone enters a cell directly across its membrane.

It binds to a receptor to form a hormone-receptor complex.

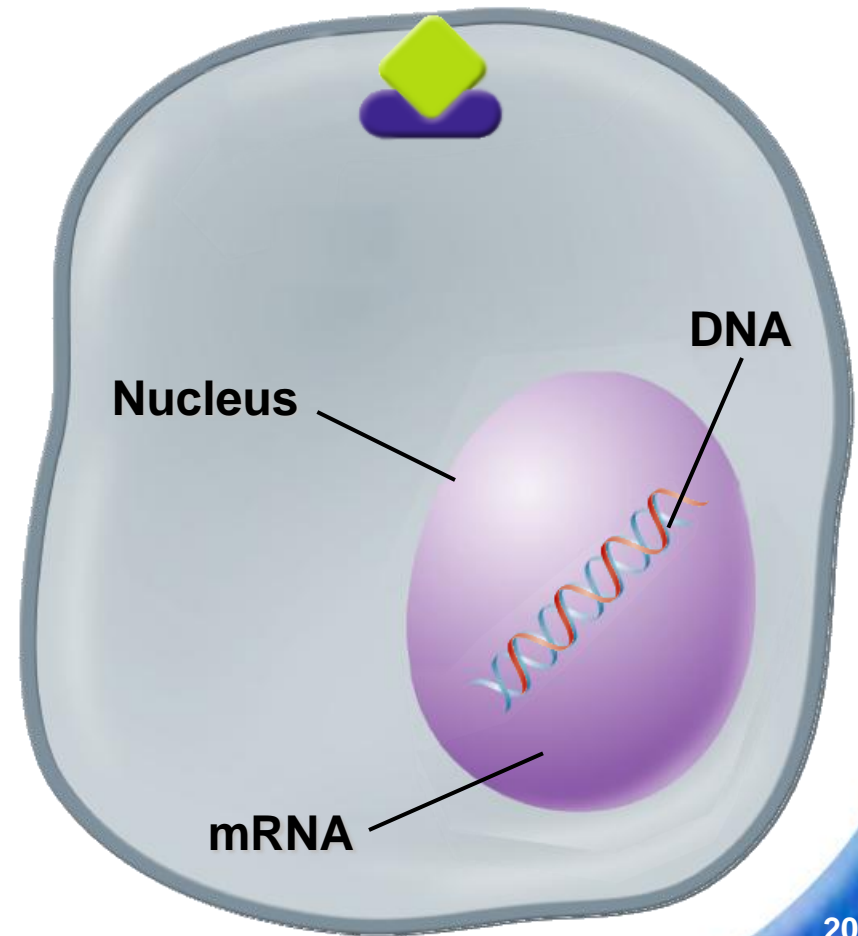
Steroid hormone



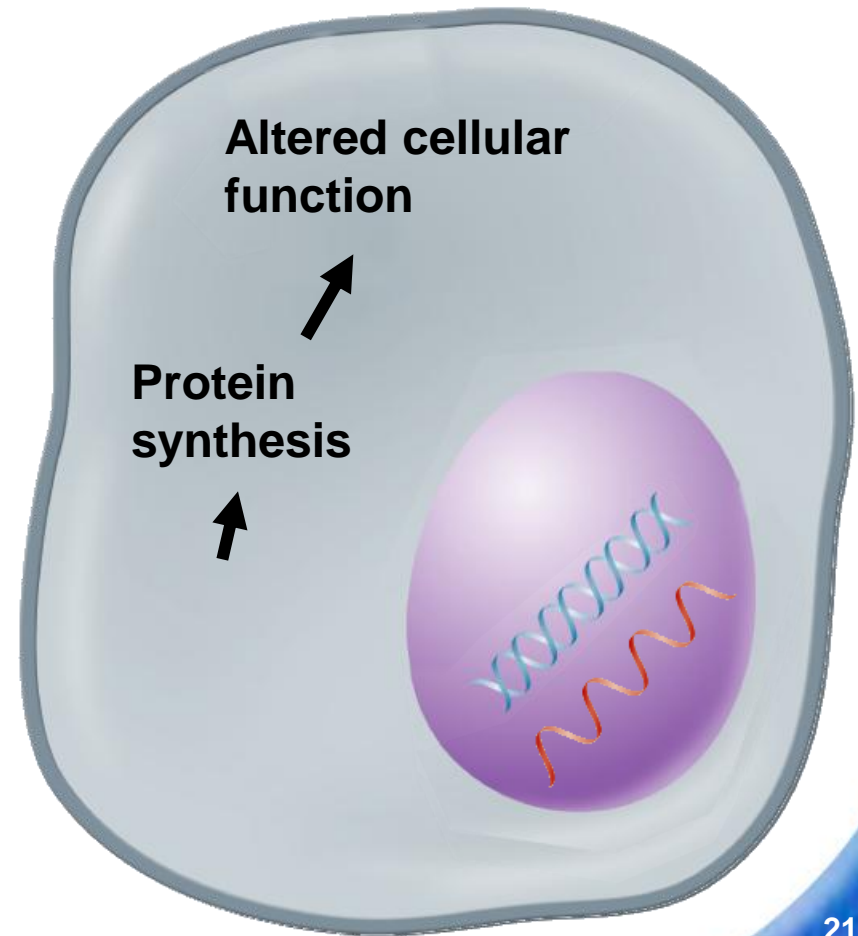
Receptor-receptor complex

The hormone-receptor complex enters the nucleus, where it binds to a DNA control sequence.

Binding initiates transcription of genes to mRNA.



mRNA moves into the cytoplasm to direct protein synthesis.



Hormone-receptor complexes regulate gene expression.

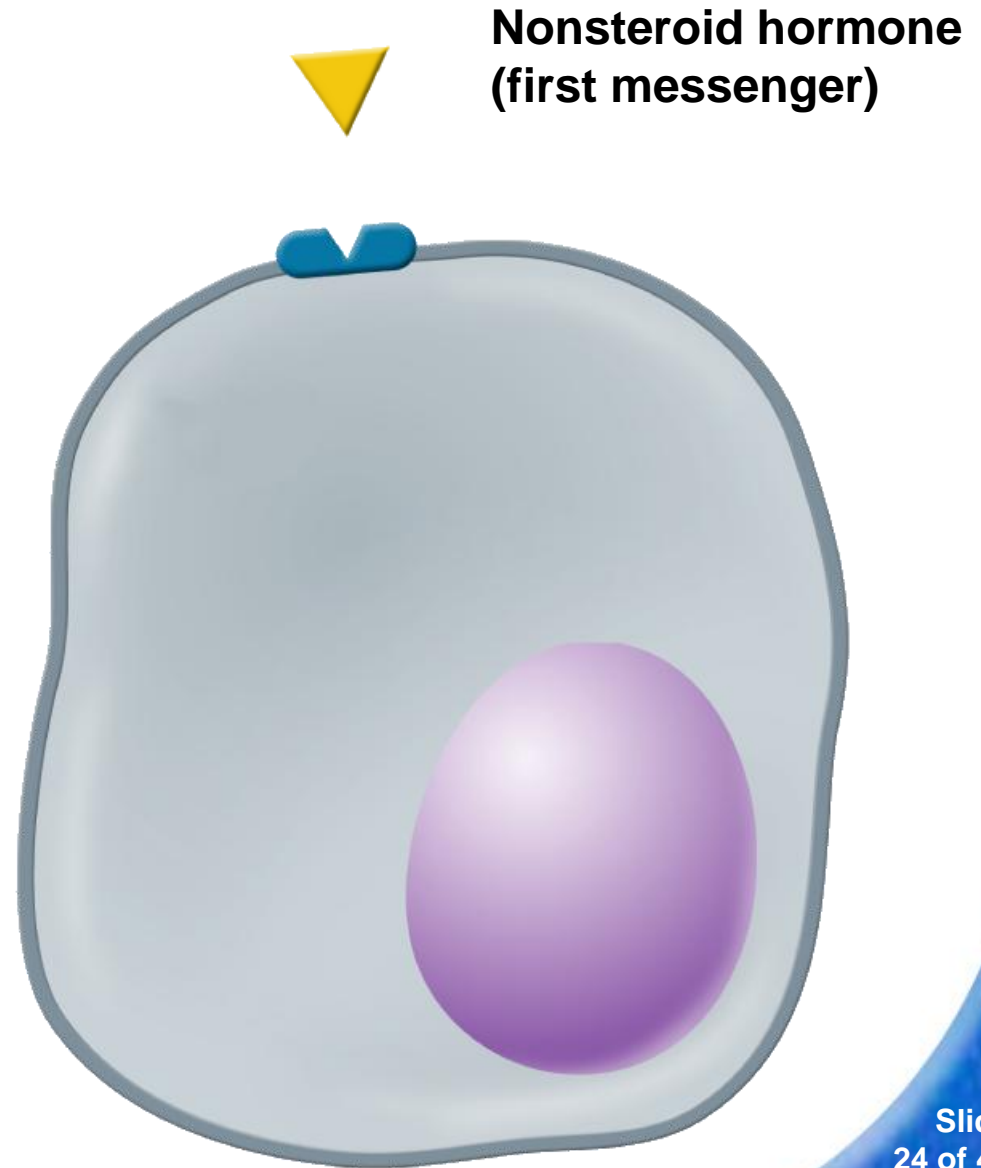
Because steroid hormones affect gene expression directly, they can produce dramatic changes in cell and organism activity.

Nonsteroid Hormones

Nonsteroid hormones cannot pass through the cell membrane.

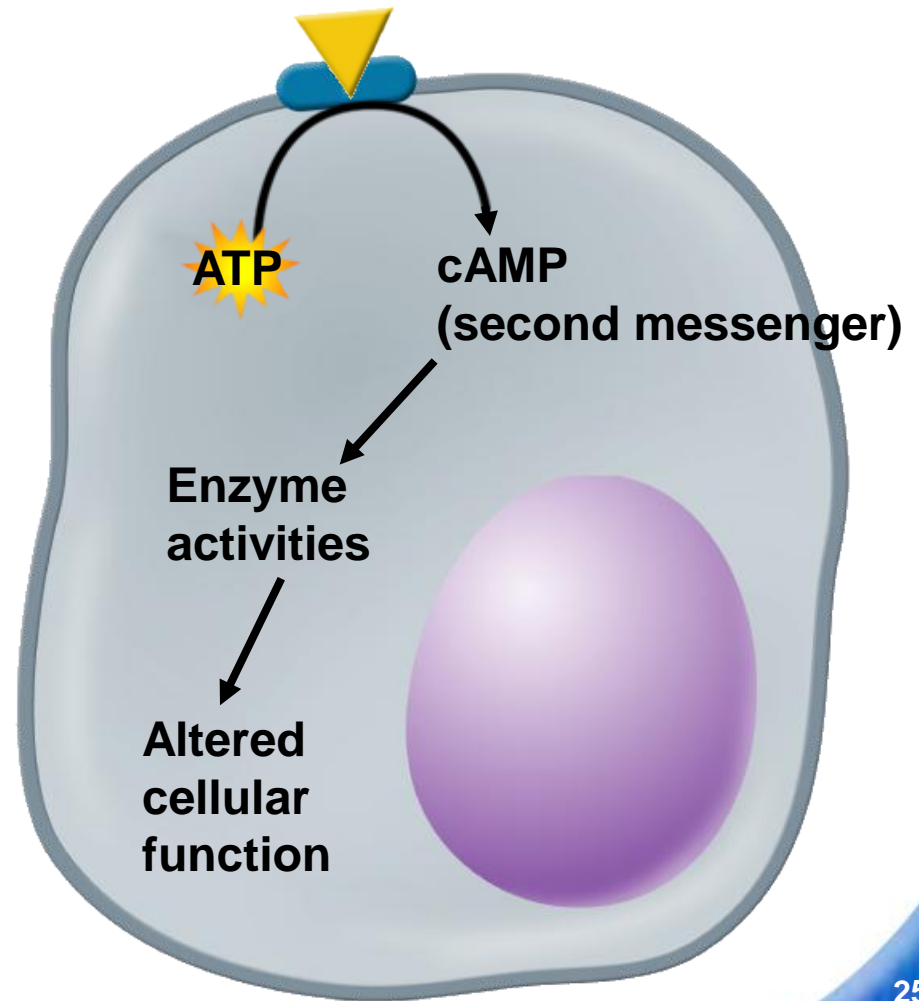
A nonsteroid hormone binds to receptors on the cell membrane.

This activates an enzyme on the inside of the membrane.



This enzyme activates secondary messengers that carry the message of the hormone inside the cell.

These messengers activate and inhibit many cell activities.



Prostaglandins

All cells (except red blood cells) produce small amounts of hormonelike substances called **prostaglandins**.

Prostaglandins are modified fatty acids.

They affect nearby cells and tissues, and are known as “local hormones.”

Control of the Endocrine System



How does the endocrine system maintain homeostasis?



The endocrine system is regulated by feedback mechanisms that function to maintain homeostasis.

Example: Controlling Metabolism

Thyroxine, a hormone of the thyroid gland, affects the activity of cells throughout the body, increasing their rate of metabolism.

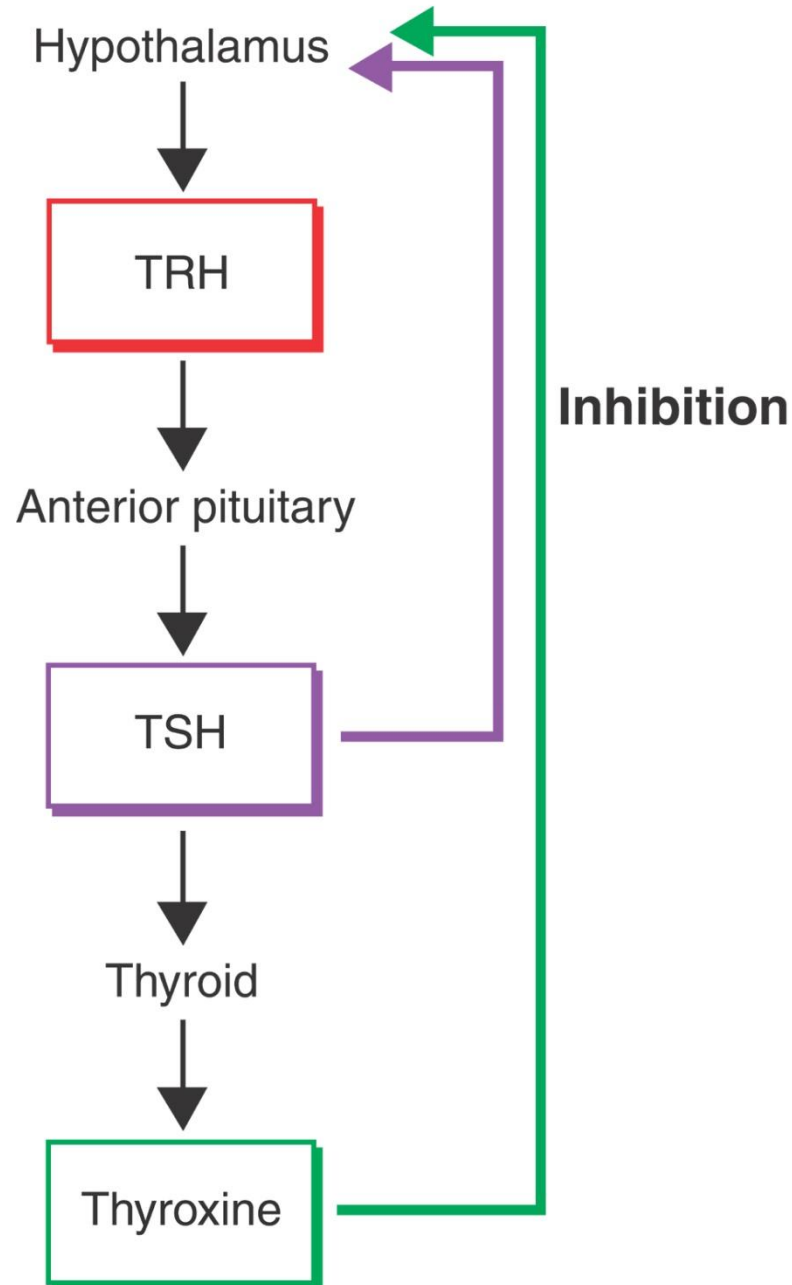
A drop in thyroxine decreases the metabolic activity of cells.

If thyroxine is low, the hypothalamus secretes thyrotropin-releasing hormone (TRH), which stimulates the anterior pituitary to secrete thyroid-stimulating hormone (TSH).

TSH stimulates the release of thyroxine.

High levels of thyroxine in the blood inhibit secretion of TRH and TSH, which stops the release of additional thyroxine.

Controlling Metabolism



The hypothalamus is also sensitive to temperature.

If body temperature drops, it produces extra TRH.

TSH is released, which causes the release of more thyroxine.

Thyroxine increases oxygen consumption and cellular metabolism.

Increased metabolic activity maintains a core temperature.

Complementary Hormone Action

Sometimes two hormones with opposite effects act to regulate part of the body's internal environment.

Such a complementary system regulates the level of calcium ions in the bloodstream.

Two hormones that regulate calcium concentration are calcitonin and parathyroid hormone (PTH).

Calcitonin decreases the level of calcium in the blood, while PTH increases it.

If calcium levels are too high, the thyroid secretes calcitonin.

Calcitonin signals the kidneys to reabsorb less calcium.

Calcitonin also reduces the amount of calcium absorbed in the intestines and stimulates calcium deposition in the bones.

If calcium levels drop too low, PTH is released by the parathyroids.

PTH, with vitamin D, stimulates the intestine to absorb more calcium from food.

PTH also causes the kidneys to retain calcium, and it stimulates bone cells to release calcium stored in bone tissue into the bloodstream.

39-1 Section QUIZ

Continue to:

Section QUIZ

- or -

Click to Launch:



39-1 Section QUIZ

1 Cells that have receptors for a particular hormone are called

a. nerve cells.

A b. target cells.

c. exocrine cells.

d. endocrine cells.

2 Chemicals that travel through the bloodstream and affect the activities of other cells are known as

- A**
- a. hormones.
 - b. receptors.
 - c. enzymes.
 - d. messengers.

39-1 Section QUIZ

3 Melatonin, which is involved in rhythmic activities such as sleep-wake cycles, is released by the

a. gonads.

A b. pineal gland.

c. prostate gland.

d. thyroid gland.

39-1 Section QUIZ

4 Which group of hormones act on target cells by binding directly to DNA in the nucleus?

A a. steroids

b. nonsteroids

c. proteins

d. second messengers

5 Metabolism is maintained by feedback loops involving the

a. hypothalamus, gonads, and adrenal glands.

A b. hypothalamus, anterior pituitary, and thyroid gland.

c. anterior pituitary, pancreas, and thyroid gland.

d. thyroid gland, parathyroid gland, and pancreas.

END OF SECTION