Adrenal Glands

There are two **adrenal glands,** one embedded above each kidney in a capsule of fat (*ad* means "next to"; *renal* means "kidney")

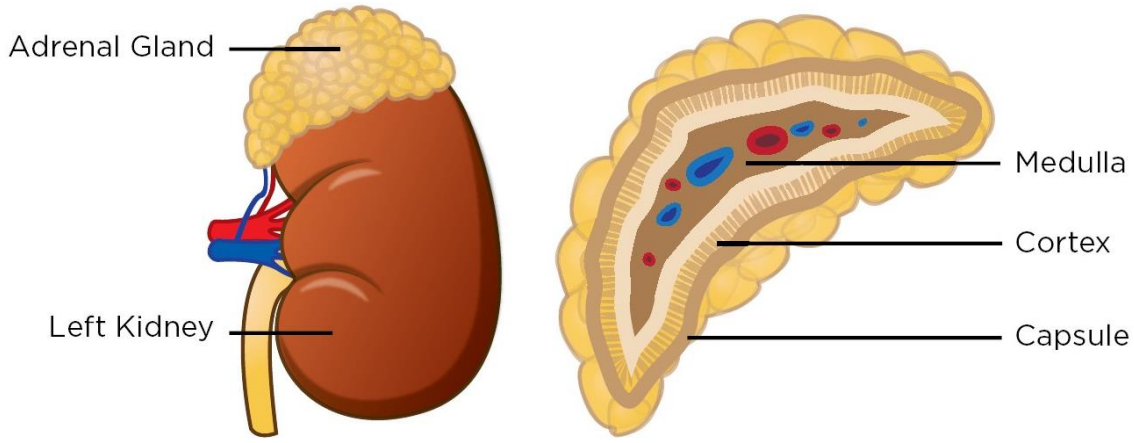


Figure : adrenal gland

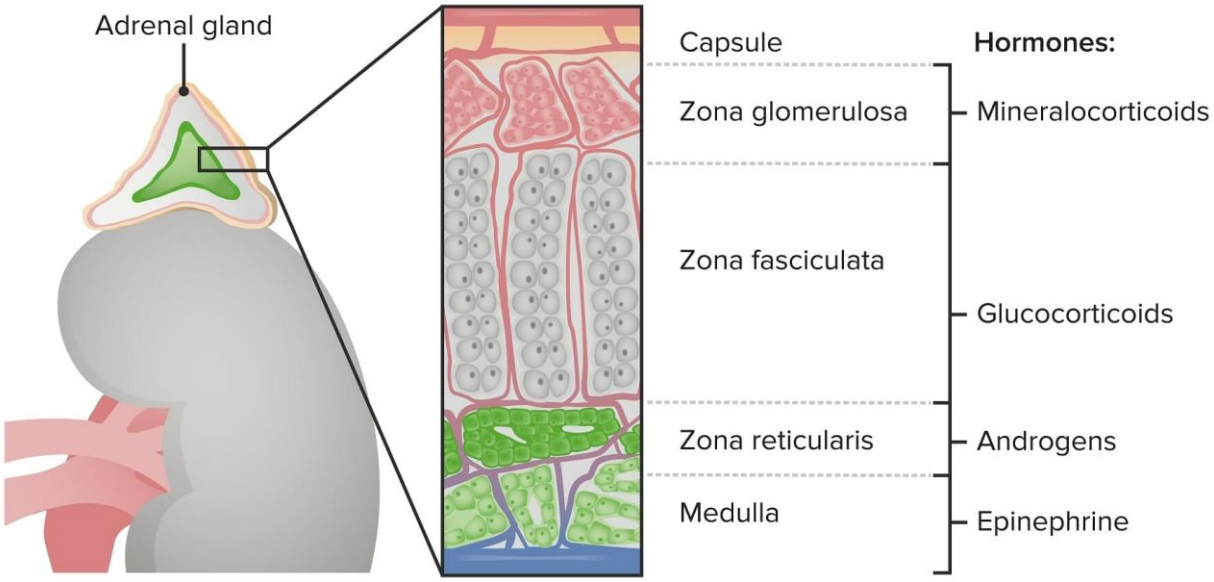
Each adrenal gland consists of a steroid secreting cortex and a catecholamine secreting medulla.

Each adrenal is composed of two endocrine glands, one surrounding the other. The outer layers composing the **adrenal cortex** secrete a variety of steroid hormones; the inner portion, the **adrenal medulla,** secretes catecholamines.

The adrenal cortex secretes mineralocorticoids, glucocorticoids, and sex hormones.

The adrenal cortex consists of three layers, or zones:

1- the **zona glomerulosa,** the outermost layer
2- the **zona fasciculata,** the middle and largest portion
3- the **zona reticularis,** the innermost zone .



adrenocortical hormones, which can be divided into three categories based on their primary actions:

1. **Mineralocorticoids,** mainly ***aldosterone***, influence mineral (electrolyte) balance, specifically Na1 and K1 balance.
2. **Glucocorticoids,** primarily *cortisol*, play a major role in glucose metabolism, as well as in protein and lipid metabolism and in adaptation to stress.
3. **Sex hormones** are identical or similar to those produced by the gonads (testes in males, ovaries in females). The most abundant and physiologically important of the adrenocortical sex hormones is *dehydroepiandrosterone*, an androgen, or "male" sex hormone.

The major effects of mineralocorticoids are on Na and K balance and blood pressure homeostasis.

The principal site of aldosterone action is on the distal and collecting tubules of the kidney, where it promotes Na1 retention and enhances K1 elimination during the formation of urine. The promotion of Na1 retention by aldosterone secondarily induces osmotic retention of H2O, expanding the ECF volume (including the plasma volume), which is important in the long-term regulation of blood pressure.

Aldosterone secretion is increased:

(1) via the complex renin–angiotensin–aldosterone system (RAAS) in response to a reduction in Na1 and a fall in blood pressure

(2) via direct stimulation of the adrenal cortex by a rise in plasma K1 concentration .

Adrenocorticotropic hormone (ACTH) from the anterior pituitary promotes secretion of cortisol, not aldosterone.

Thus, regulation of aldosterone secretion is independent of anterior pituitary control.

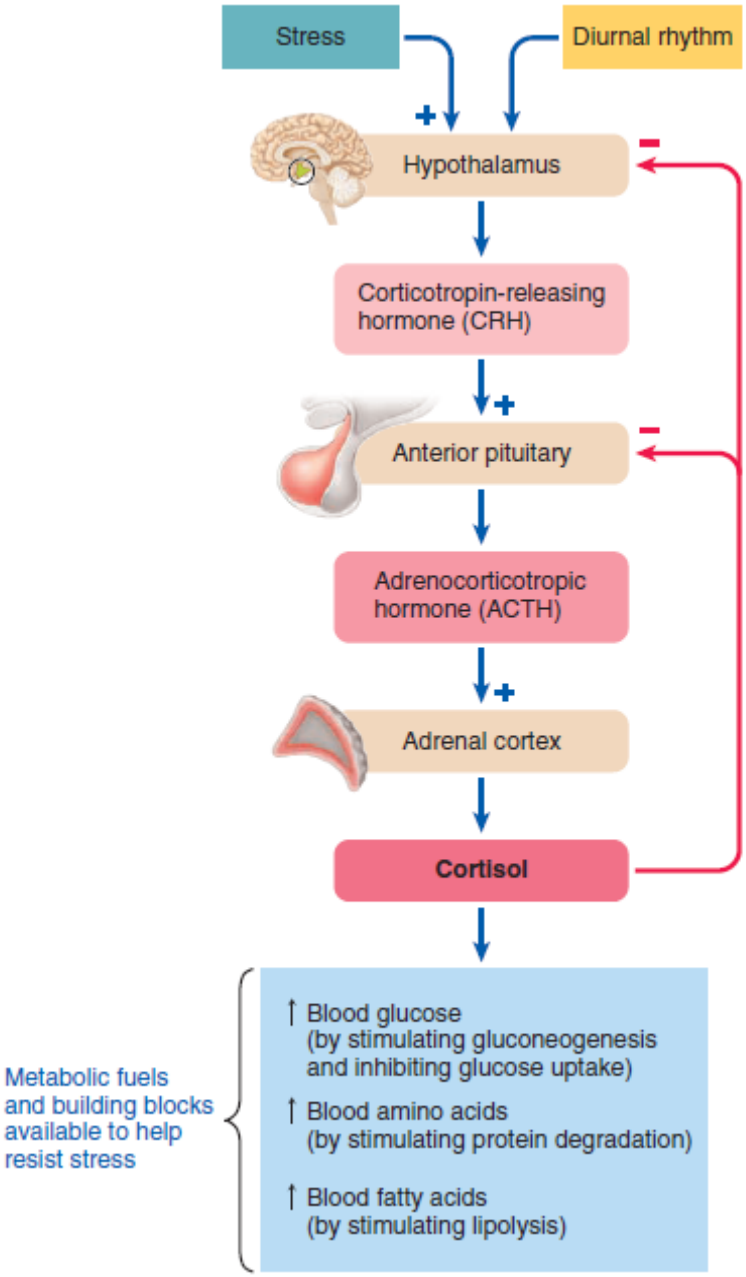
Glucocorticoids exert metabolic effects and play a key role in adaptation to stress.

Cortisol, the primary glucocorticoid, plays an important role in carbohydrate, protein, and fat metabolism; executes significant permissive actions for other hormonal activities; and helps people resist stress.

Metabolic Effects The overall effect of cortisol's metabolic actions is to increase the concentration of blood glucose at the expense of protein and fat stores.

Cortisol secretion is regulated by the hypothalamus–pituitary–adrenal cortex axis.

Cortisol secretion by the adrenal cortex is regulated by a negative-feedback system involving the hypothalamus and anterior pituitary



The adrenal cortex secretes both male and female sex hormones in both sexes.

In both sexes, the adrenal cortex produces both *androgens*, or "male" sex hormones, and *estrogens*, or "female" sex hormones.

The adrenal medulla

The adrenal medulla is actually a modified part of the sympathetic nervous system.

The adrenal medulla consists of modified postganglionic sympathetic neurons called **chromaffin cells**. Like sympathetic fibers, the adrenal medulla does release norepinephrine, but its most abundant secretory output is a similar chemical messenger known as **epinephrine**.

Epinephrine reinforces the sympathetic nervous system and exerts metabolic effects.

Adrenomedullary hormones are not essential for life, but virtually all organs in the body are affected by these catecholamines. They play important roles in mounting stress responses, regulating arterial blood pressure, and controlling fuel metabolism.