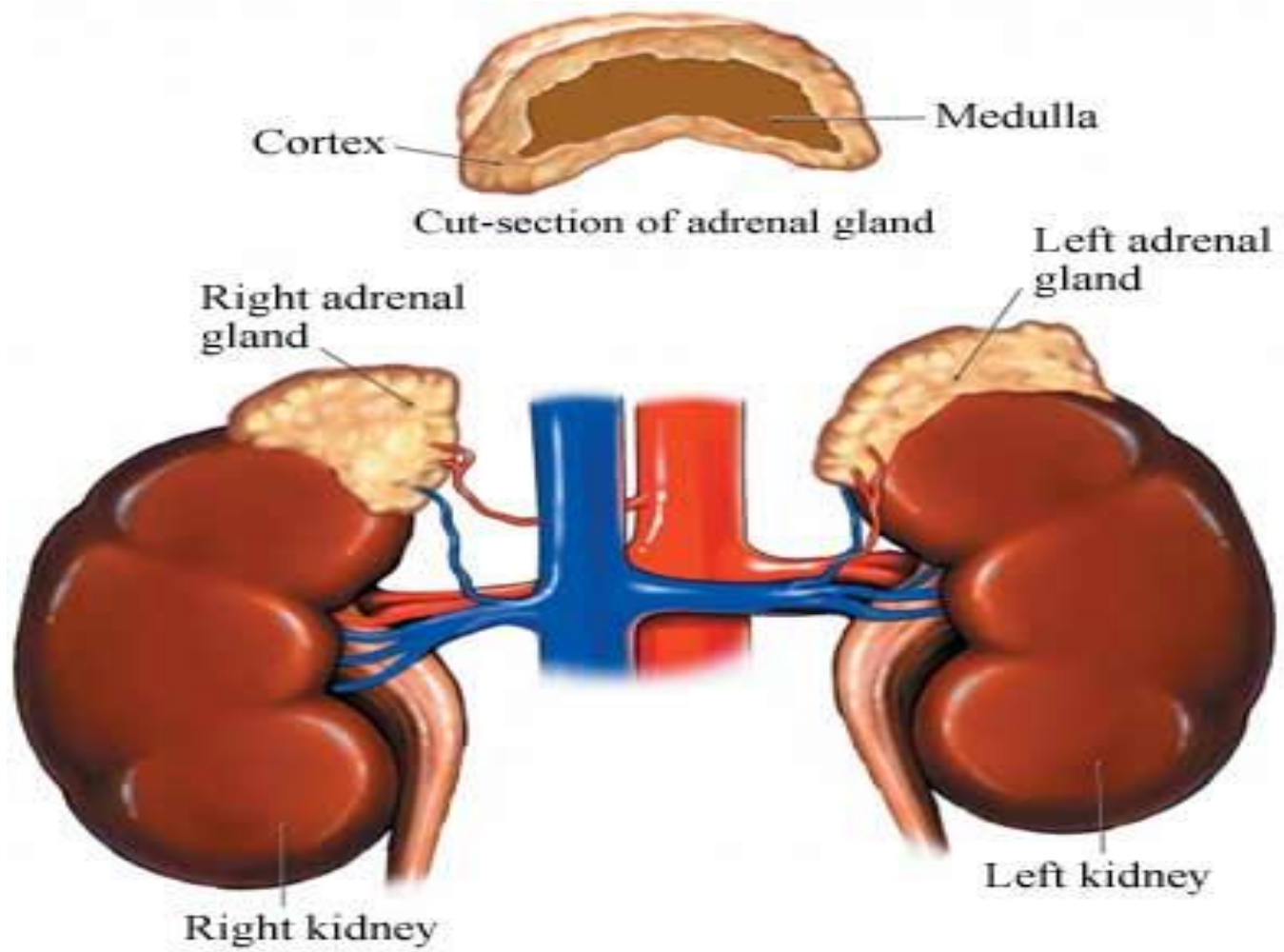


ADRENAL CORTEX

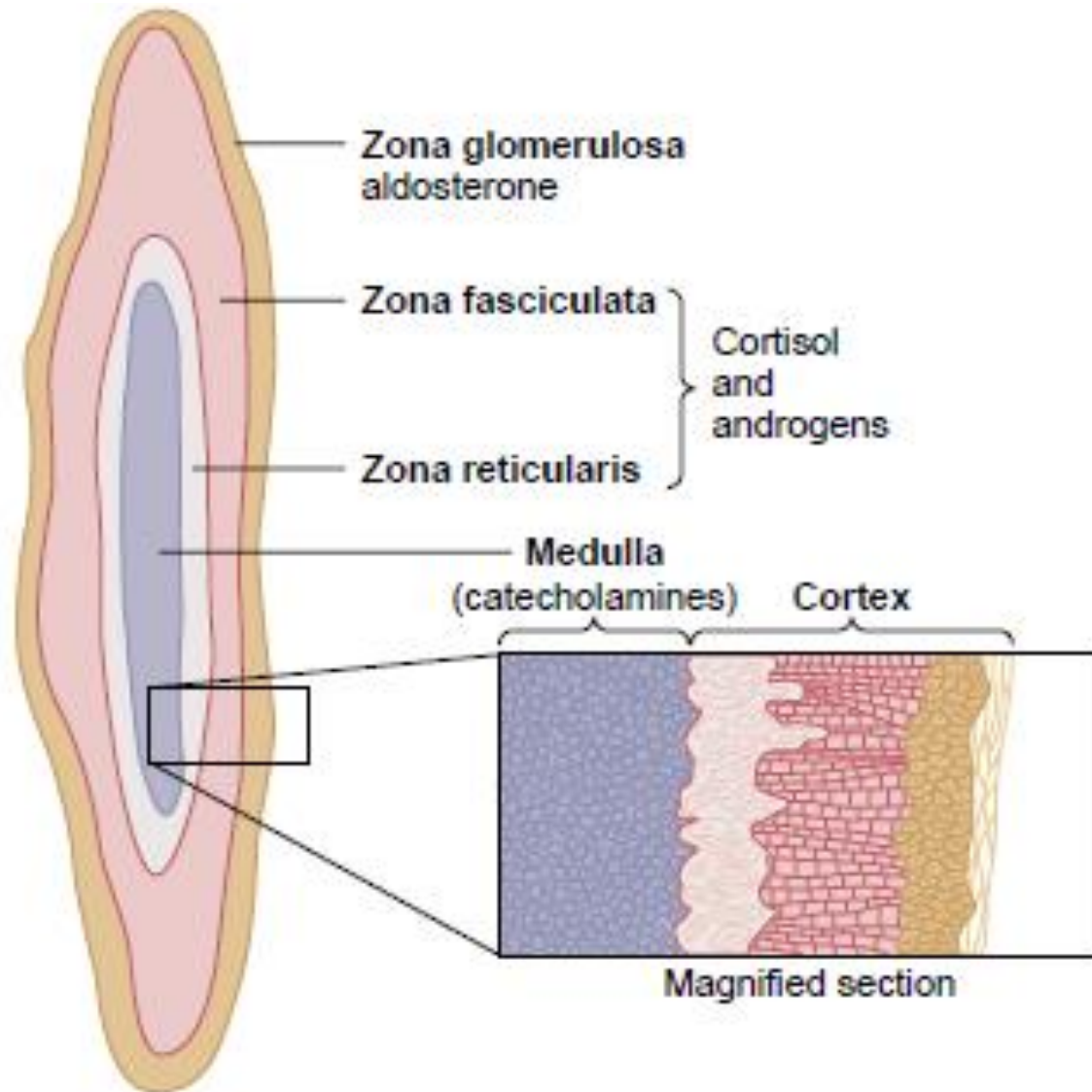
- Competency no.PY 8.2

-Dr.Swati.R.Gawali
(Dt: 09.04.2020)

- 
- The adrenals glands located on top of the kidneys.
 - Each adrenal gland is composed of two endocrine components: a **medulla** (inner part) that constitutes 20% of the gland and a **cortex** (outer part) that constitutes the remaining 80%.
 - The cortex consists of three zones
 - 1.Zona glomerulosa
 - 2.Zona fasciculata
 - 3. Zona reticularis



Adrenocortical Hormones



1. Zona glomerulosa

Aldosterone also called mineralocorticoids is secreted from this zone which is the major hormone controlling the sodium and potassium levels, and thus fluid balance

2. Zona fasciculata

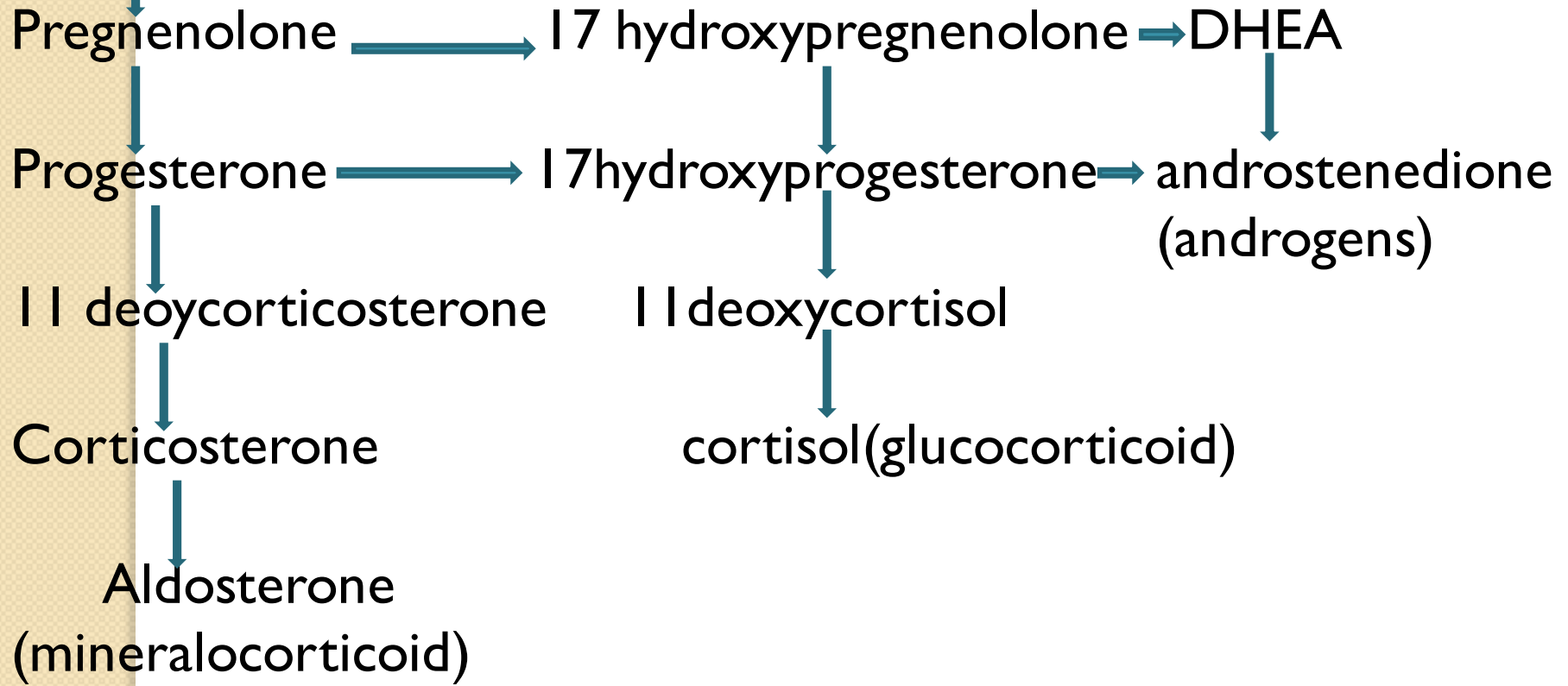
Coritsol (hydrocortisone) affects glucose, amino acid and fat metabolism, which is called glucocorticoids.

3. Zona reticularis

Dehydroepiandrosterone (DHEA)-precursor for androgen is synthesized.

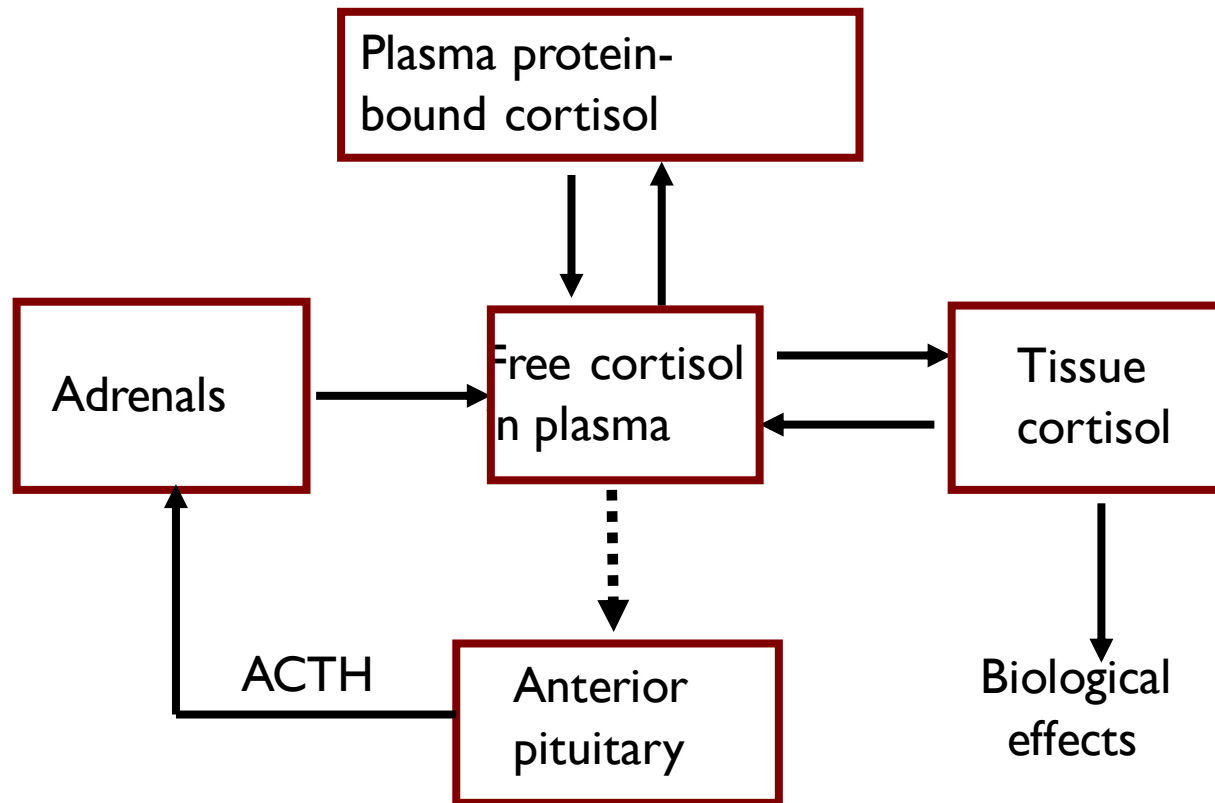
Synthesis: Derived from cholesterol

Cholesterol



- 
- Cortisol binds to plasma protein –cortisol binding globulin(transcortin) and albumin
 - Aldosterone 60 % bound 40% free
 - Adrenocortical hormones are metabolised in liver

Interrelationships Between Free & Bound Cortisol



Mineralocorticoids

- Aldosterone
 - Deoxycorticosterone
 - Corticosterone
 - Cortisol
 - Cortisone
-
- * 90 % of mineralocorticoid activity is by aldosterone

Glucocorticoids

- Cortisol
- Corticosterone
- Cortisone
- Prednisone
- Methylprednisone
- Dexamethasone
- * Major glucocorticoid is cortisol

Mineralocorticoids: ALDOSTERONE

ACUTE LIFE SAVING HORMONE

- Aldosterone - 90% mineralocorticoid activity.
- Desoxycorticosterone- 1/3 as potent as aldosterone.
- 9 α –flurocostisol – synthetic (more potent)
- 90-95% bound to plasma proteins.
- 1/2 life -20 min
- Blood . Conc- 6ng/100ml
- Secretory rate 150 ng/day

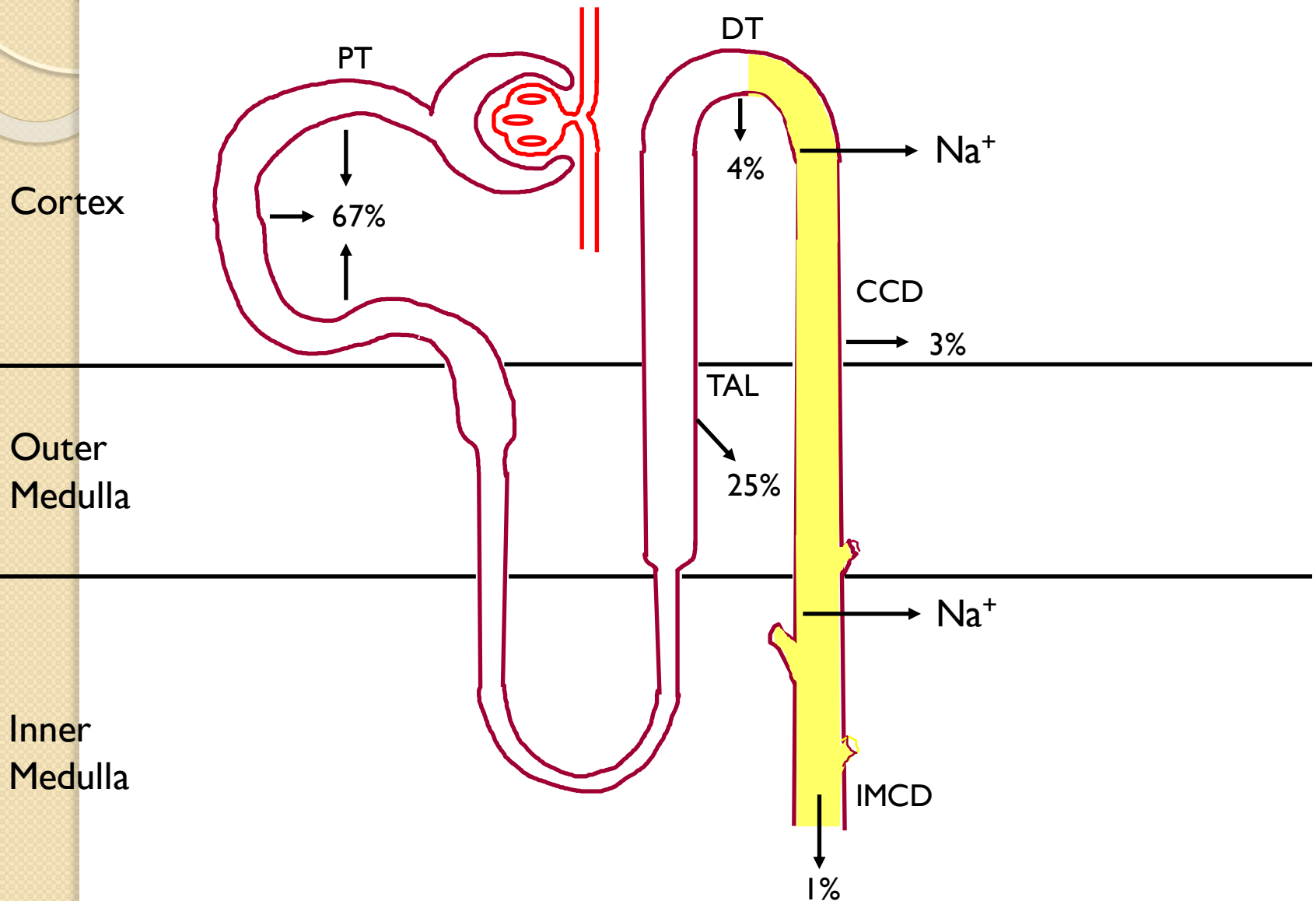
Functions of Aldosterone

- Absorption of salt and water is the main function of aldosterone
- Mineralocorticoid Deficiency Causes Severe Renal Sodium Chloride Wasting and Hyperkalemia.
- Aldosterone Is the Major Mineralocorticoid Secreted by the Adrenals.

Mineralocorticoid(ALDOSTERONE)

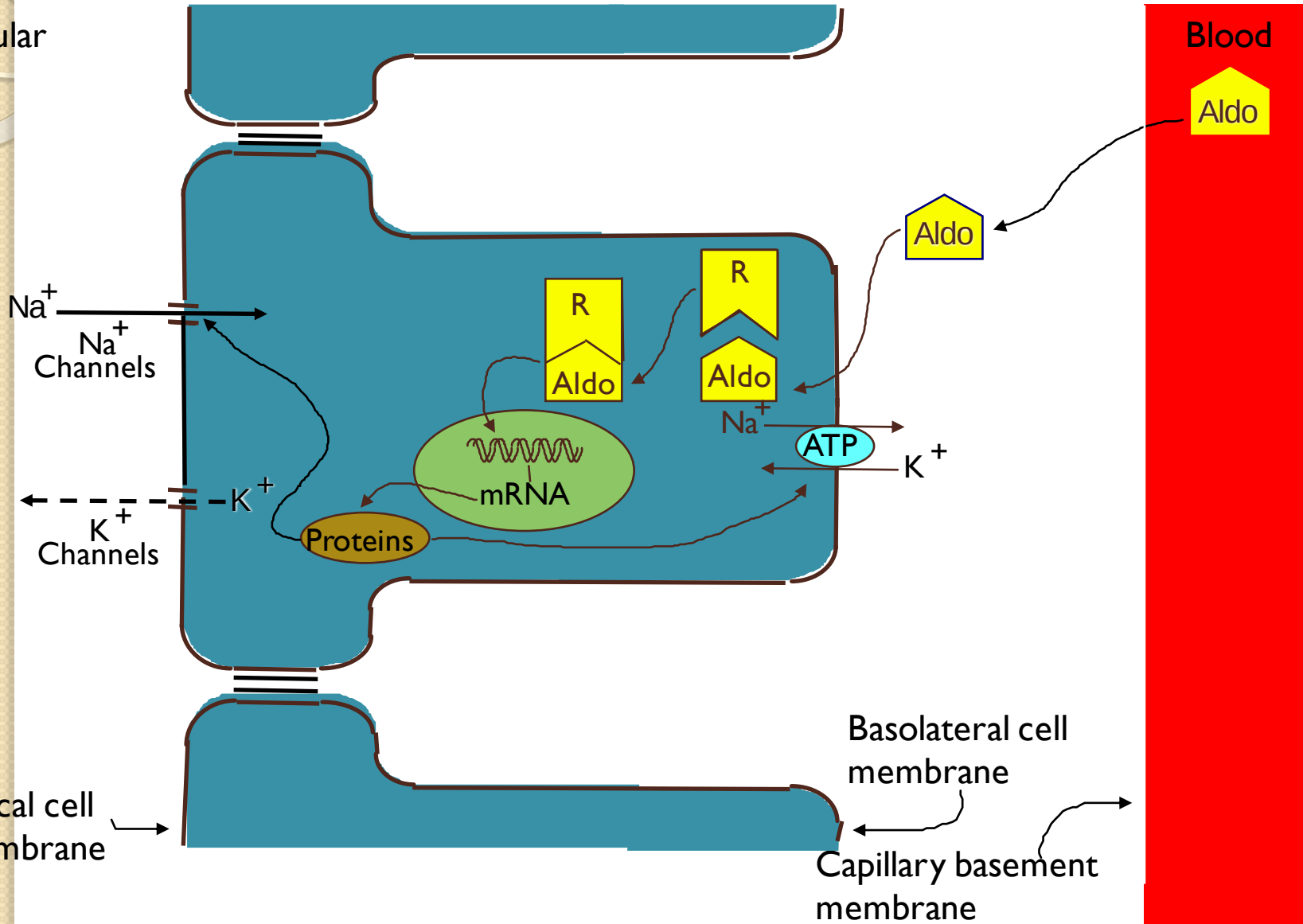
- Aldosterone acts mainly on the late distal tubule and collecting ducts to cause absorption of salt and water

Tubular Effects of Aldosterone



Cellular Actions of Aldosterone on Principal Cells of Collecting Duct

Tubular fluid

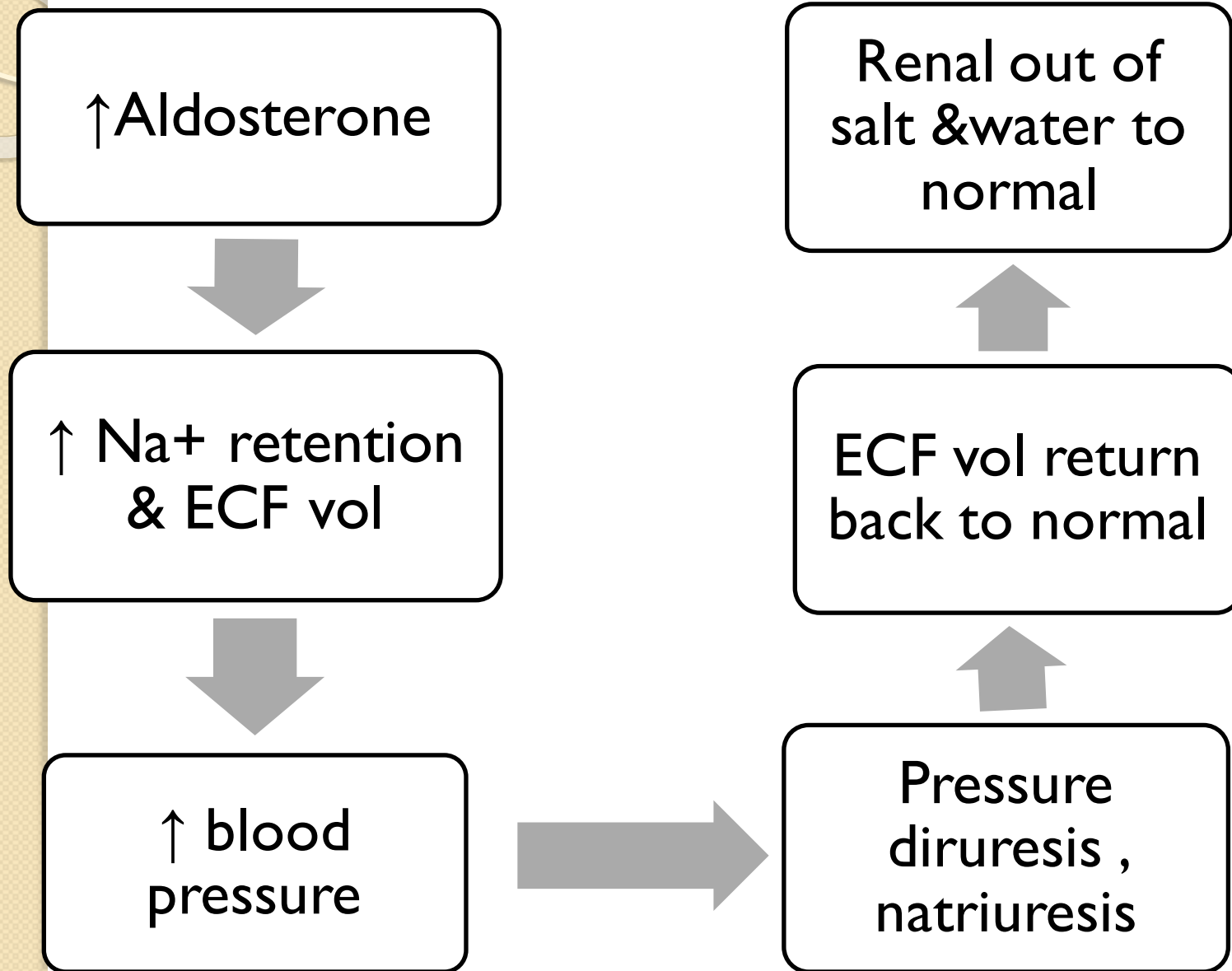


- 
1. Aldosterone in circulation
 2. Binds with receptor(R) in the principle cells
 3. Causes RNA Synthesis
 4. Protein synthesis
 5. Formation of sodium channels which causes Na^+ reabsorption & K^+ secretion

Renal and Circulatory Effects of Aldosterone

- Aldosterone Increases Renal Tubular Reabsorption of Sodium and Secretion of Potassium.
- Excess Aldosterone Increases Extracellular Fluid Volume and Arterial Pressure but Has Only a Small Effect on Plasma Sodium Concentration.
- ALDOSTERONE ESCAPE

Aldosterone Escape



- 
- Excess Aldosterone Causes Hypokalemia and Muscle Weakness as more K^+ is secreted in tubules.
 - Too Little Aldosterone Causes Hyperkalemia and Cardiac Toxicity as K^+ conc. Is increased
 - Excess Aldosterone Increases Tubular Hydrogen Ion Secretion, and Causes Mild Alkalosis.

In absence of Aldosterone, --death occurs with in 2days.

Na + is lost in the urine along with water. K⁺ increases in ECF.

Loss of ECF volume → decrease in Blood volume → decrease in CO → shock → death.

(* so it called as life saving hormone)

Regulation of Aldosterone Secretion

1. Increased **potassium ion** concentration in the extracellular fluid greatly *increases aldosterone secretion*.
2. Increased activity of the **renin-angiotensin system** (increased levels of angiotensin II) also greatly *increases aldosterone secretion*.
3. Increased **sodium ion** concentration in the extracellular fluid very *slightly decreases* aldosterone secretion.
4. **ACTH** from the anterior pituitary gland is necessary for aldosterone secretion but has little effect in controlling the rate of secretion

Glucocorticoid(CORTISOL)

- As cortisol is also a steroid hormone its main action is through the nucleus leading to DNA synthesis –RNA synthesis and ultimately protein synthesis that leads to variety of actions

Biochemical actions of Cortisol

1. Effects on glucose metabolism: They promote gluconeogenesis.

They work along with insulin from the pancreas to maintain blood glucose levels in the proper balance.

2. Effects on lipid metabolism: They increase lipolysis in adipose tissue and reduce synthesis of Triacidglycerol.

3. Effects on protein and nucleic acid metabolism: They promote transcription and protein synthesis in liver. They also cause catabolic effects in extrahepatic tissues results in enhanced degradation of protein.

4. Effects on water and electrolyte metabolism: Deficiency of them cause increased production of ADH which can decrease glomerular filtration rate causing water retention in the body.

5. Effects on immune system: Cortisol suppress the immune response directly and indirectly by affecting most cells that participate in immune reactions and inflammatory reactions. **It is powerful anti-inflammatory even when secreted at normal levels.** It also reduces the rate at which lymphocytes multiply and accelerates their programmed cell death to further protect the body from this overreaction. **This is one of the reasons why strong corticosteroids (prednisone, prednisolone, etc.) are used with all diseases involving inflammatory processes, including autoimmune diseases.**

6. Effects on cardiovascular system: Cortisol could control the contraction of the walls of the mid-sized arteries in increasing blood pressure, but this hypertensive effect is moderated by calcium and magnesium. It also directly affects the heart by regulating sodium and potassium in the heart cells and increasing the strength of contraction of the heart muscle.

7. Effects on central nervous system: The changes of behavior, mood, excitability and even the electrical activity of neurons in the brain frequently occur in cases of excess and deficient cortisol levels. Many signs and symptoms of adrenal fatigue involve moodiness, decreased tolerance, decreased clarity of thought and decreased memory. These occur because the brain is affected by both too little and too much cortisol.

Stress



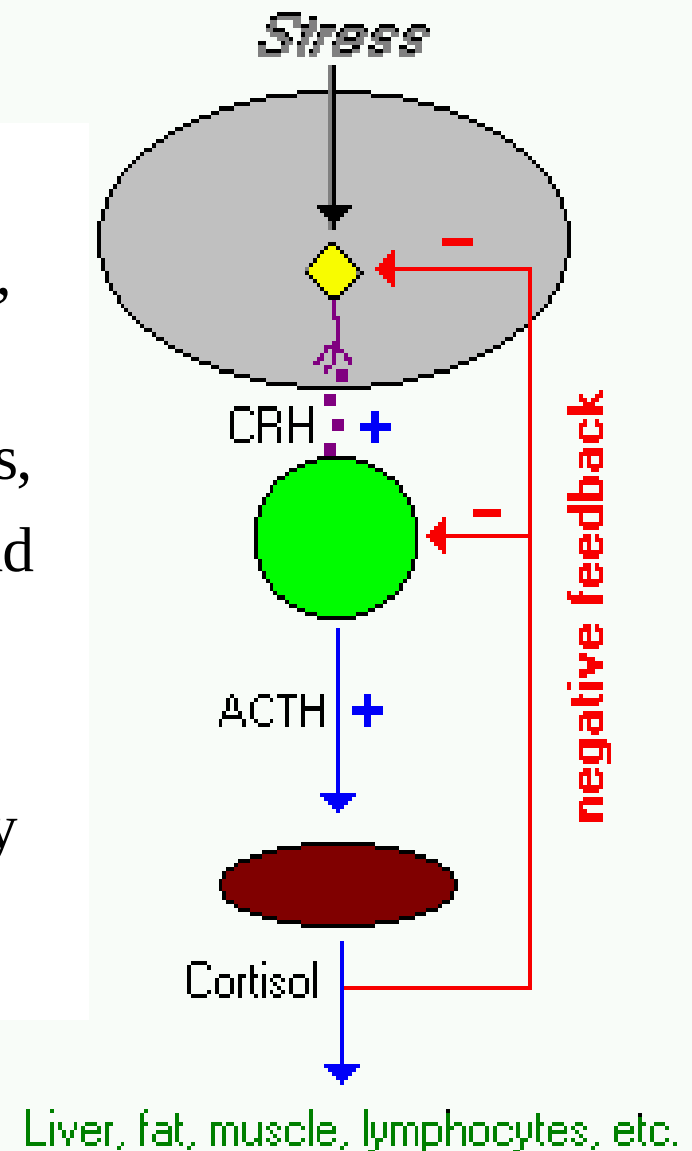
Adrenal glands are the anti-stress glands of the body.



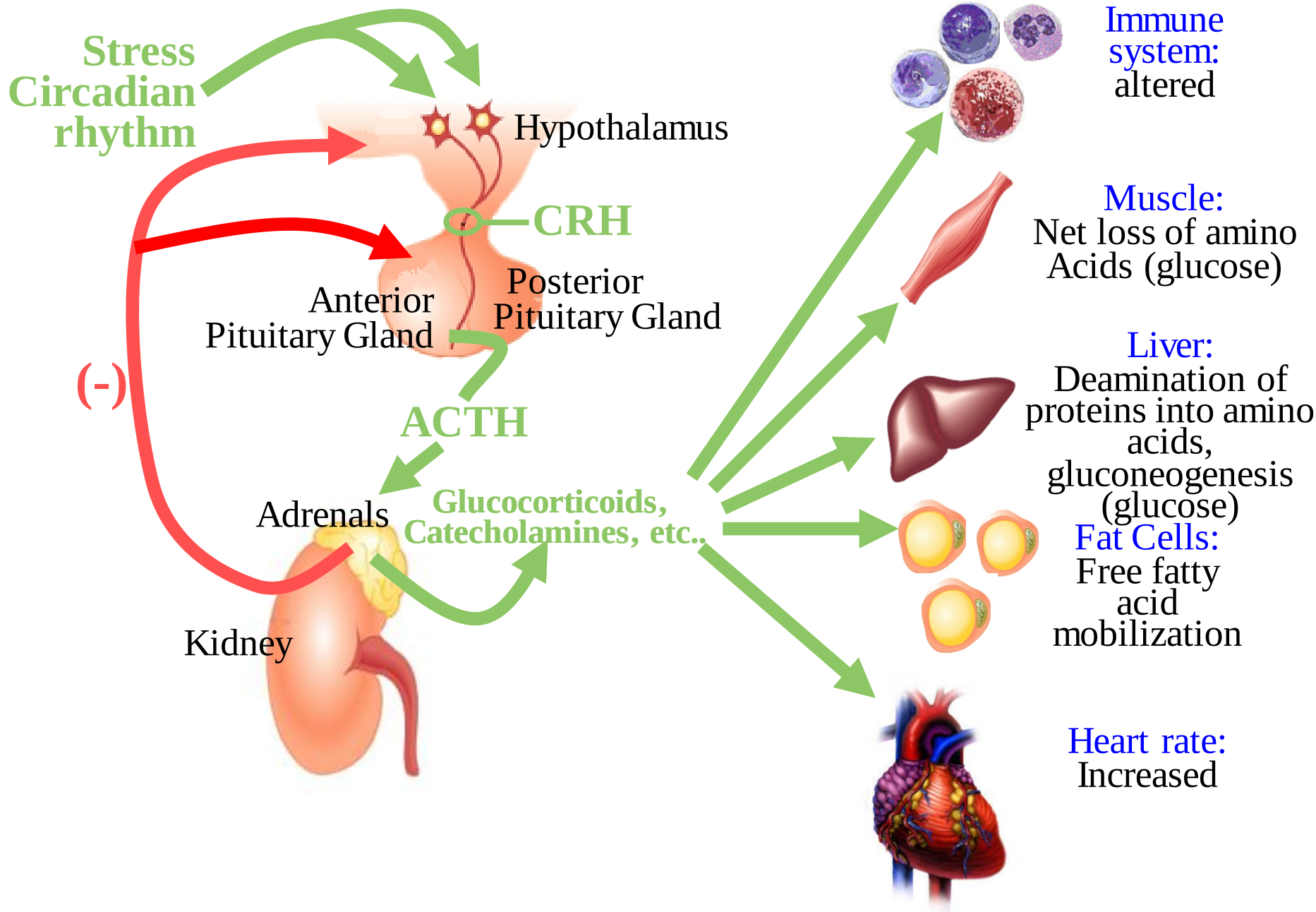
There are four major categories of stress:

- 1. Physical stress:** such as overwork, lack of sleep, athletic overtraining.
- 2. Chemical stress:** environmental pollutants, allergies to foods, diets high in refined carbohydrates, endocrine gland imbalances.
- 3. Thermal stress:** over-heating or over-chilling of the body
- 4. Emotional and mental stress**

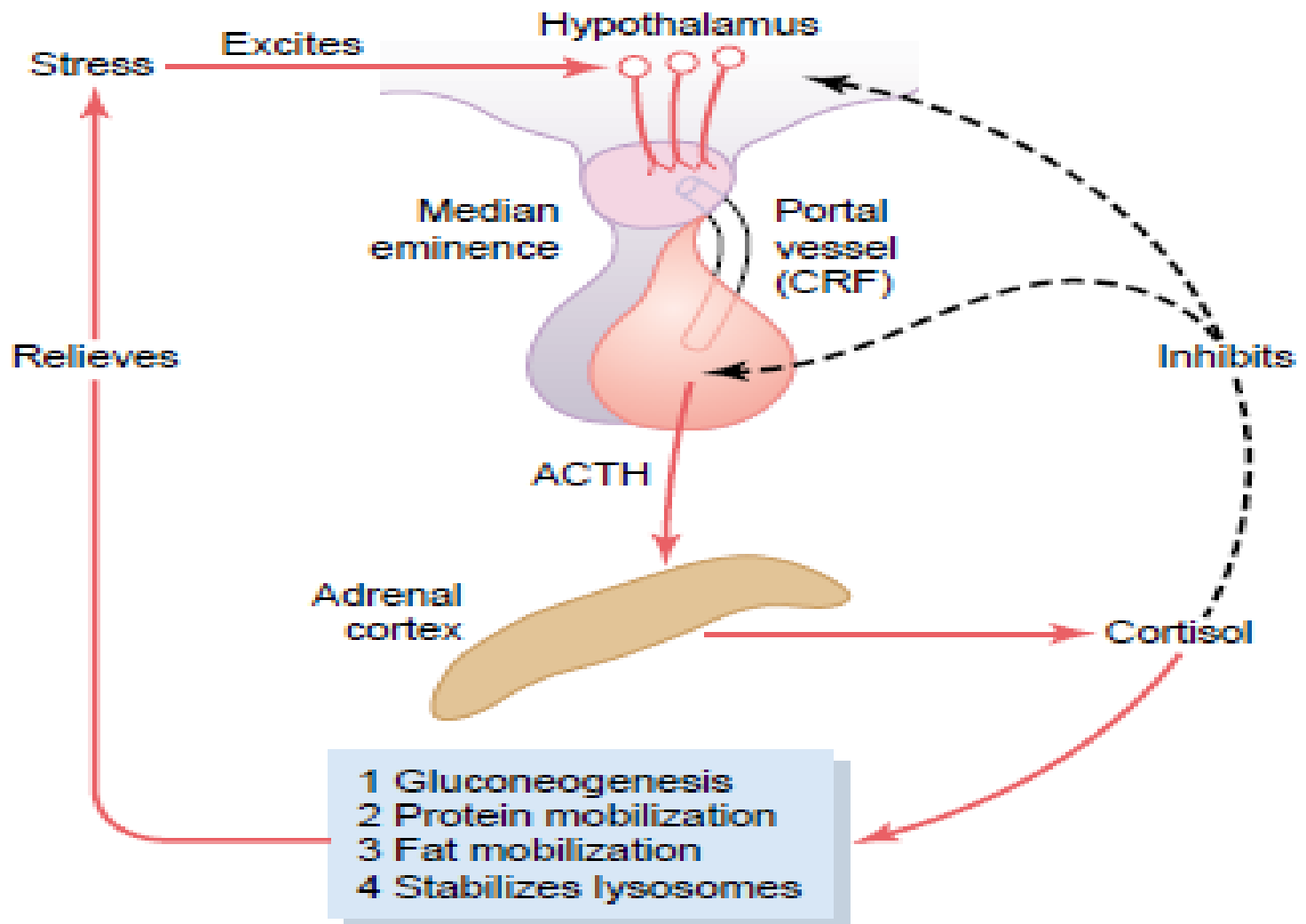
Stress: During stress cortisol must simultaneously provide more blood glucose, mobilize fats and proteins for a back-up supply of glucose, modify immune reactions, heartbeat, blood pressure, brain alertness and nervous system responsiveness. If cortisol level cannot rise in response to these needs, maintaining your body under stress is nearly impossible.



Hypothalamopituitary adrenal (HPA) axis



Regulation of cortisol secretion



Assignment

- LAQ: Enumerate corticosteroids. Describe the functions and regulation of cortisol.
- SAQ: Functions of aldosterone