

Endocrine 4

Adrenal gland
And
Pancreas

Adrenal gland

▶ Structure

▶ Cortex

○ Glucocorticoids

- Effects
- Control of secretion

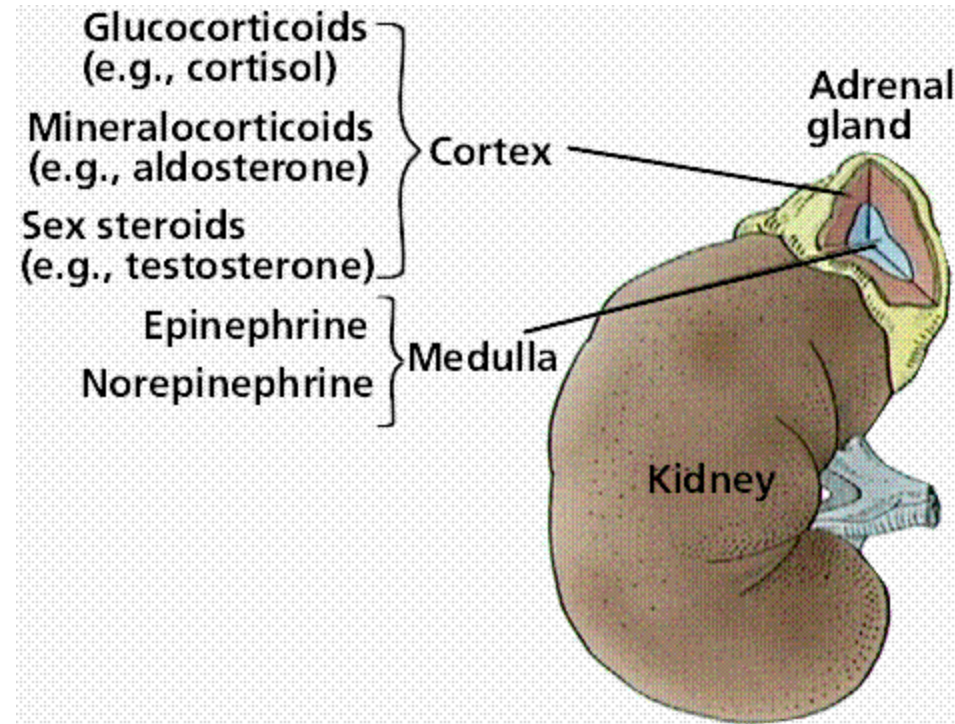
○ Mineralocorticoids

- Effects
- Control of secretion

○ Sex steroids

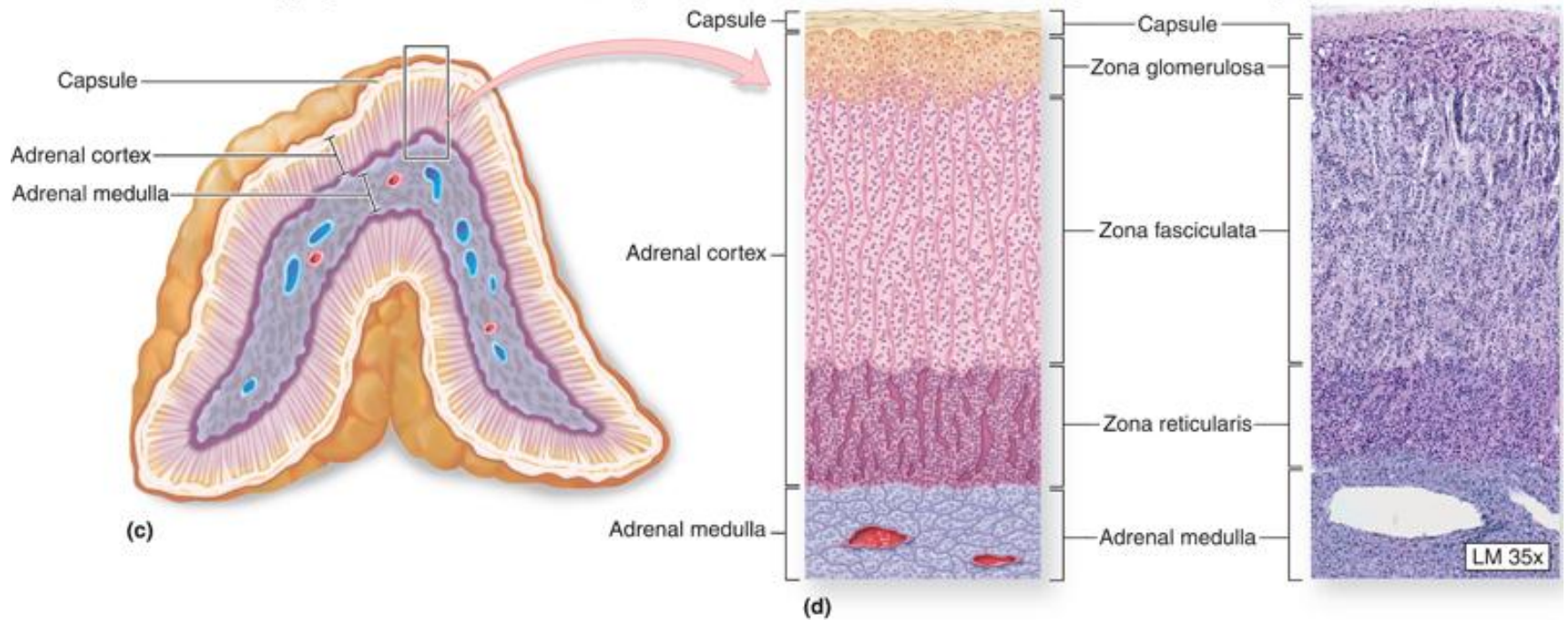
▶ Medulla

○ Catecholamines



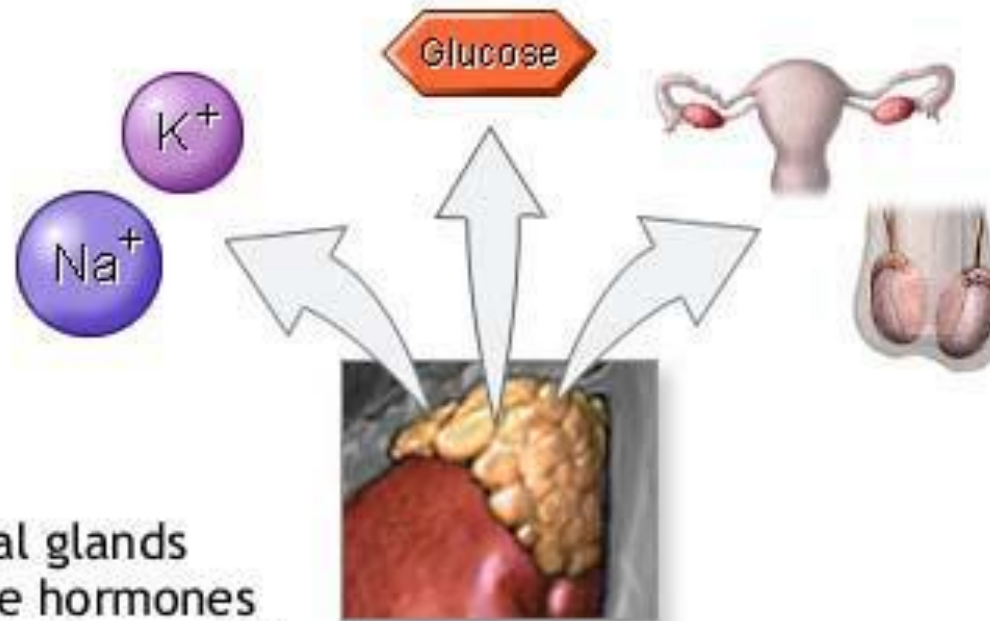
Adrenal gland Structure

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Adrenal cortex

- ▶ Adrenal cortex
 - 80% of an adrenal gland's total weight
 - Zona glomerulosa
 - Mineralocorticoids
 - Zona fasciculata
 - Glucocorticoids
 - Small amount of androgens+estrogens
 - Zona reticularis
 - Androgens (DHEA)
 - Small amount of estrogens and glucocorticoids



Adrenal glands secrete hormones which help regulate chemical balance, regulate metabolism and supplement other glands

Adrenal cortex

▶ **Cortex**

- Activity stimulated by ACTH

▶ **Cortical hormones**

- Mineralcorticoids
 - Aldosterone → regulate salt and water balance
- Glucocorticoids
 - Cortisol → regulate glucose metabolism and the immune system.
- Gonadocorticoids
 - Androgens
 - Estrogens

Adrenal cortex

- **Glucocorticoid hormones**
 - Most potent naturally occurring glucocorticoid is **cortisol**
 - Direct effects on carbohydrate metabolism
 - Anti-inflammatory and growth-suppressing effects

Effects of cortisol

▶ On carbohydrates

- Stimulates gluconeogenesis in the liver
- Increases glycogen storage in liver cells
- Decreases glucose utilization by the cells

▶ On protein

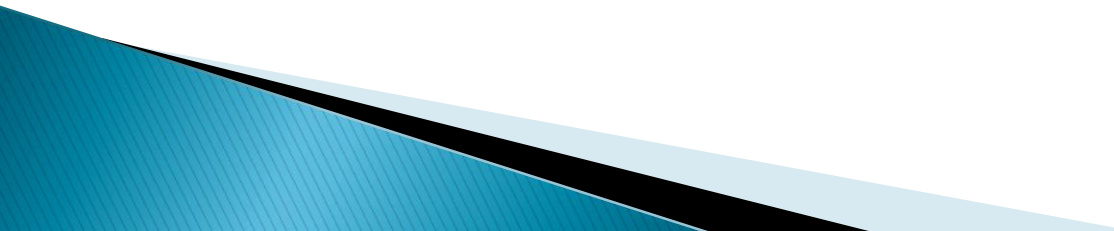
- Proteokatabolic effect in all body cells except the liver
- Mobilization of amino acids from muscles
- Decreases protein synthesis

▶ On fat

- Mobilization of fatty acids from adipose tissue

Effects of cortisol

▶ **Anti-inflammatory**

- Stabilizes lysosomal membrane
 - Reduces degree of vasodilatation
 - Decreases permeability of capillaries
 - Decreases migration of white blood cells
 - Suppresses immune system
 - Resolution of inflammation
- 

Adrenal cortex

- **Mineralocorticoid hormones**
 - Most potent naturally occurring mineralocorticoid is **aldosterone**
 - Affect ion transport by epithelial cells
 - Increase the activity of the sodium pump of the epithelial cells
 - Cause sodium retention and potassium and hydrogen loss
 - Regulated by the renin–angiotensin system

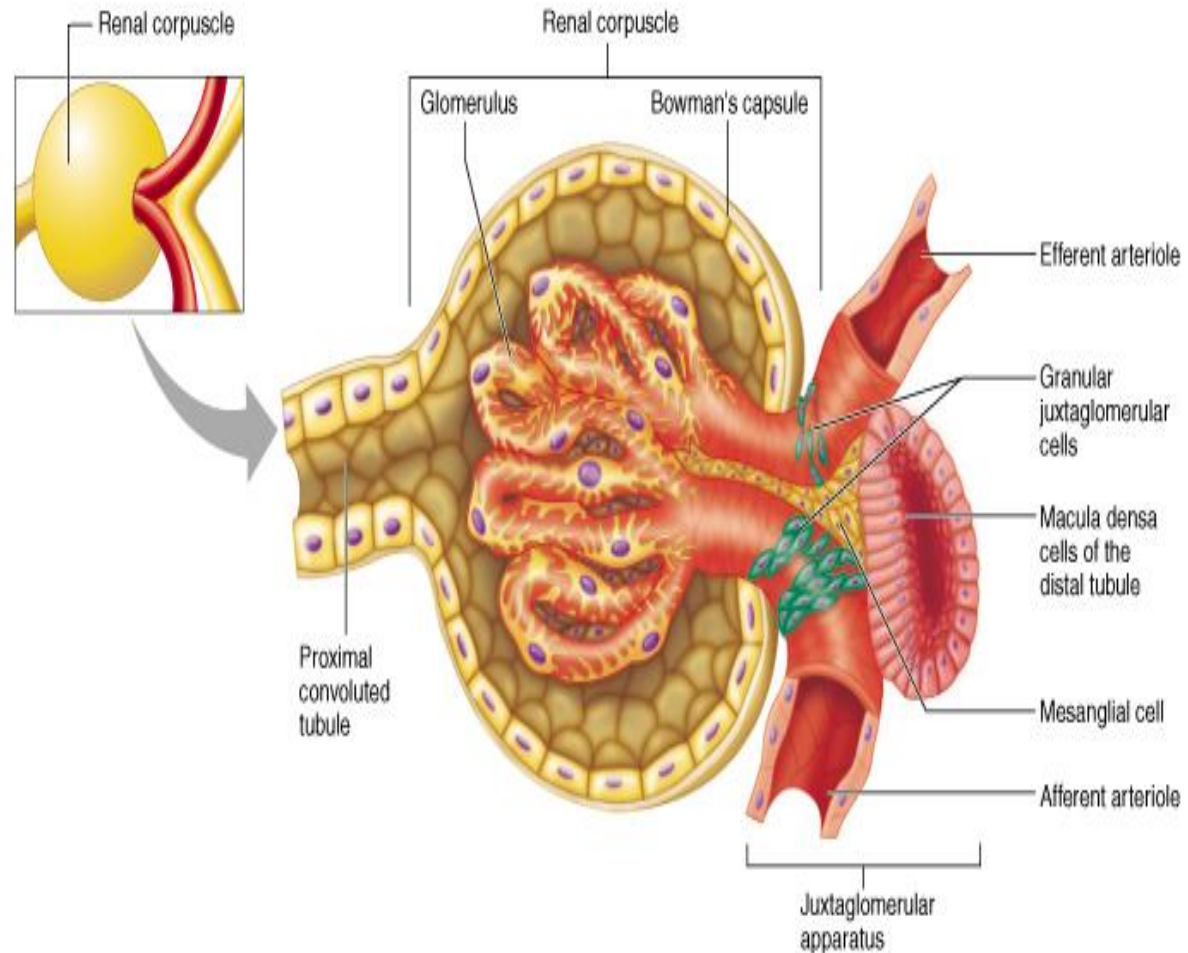
juxtaglomerular apparatus (JGA)

JGA

A specialized collection of cells located at the junction of the afferent and efferent arterioles with a portion of the distal convoluted tubule of the nephron in the kidney

two types of cells :

- macula densa cells
- juxtaglomerular cells



JGA

▶ **Macula densa cells –**

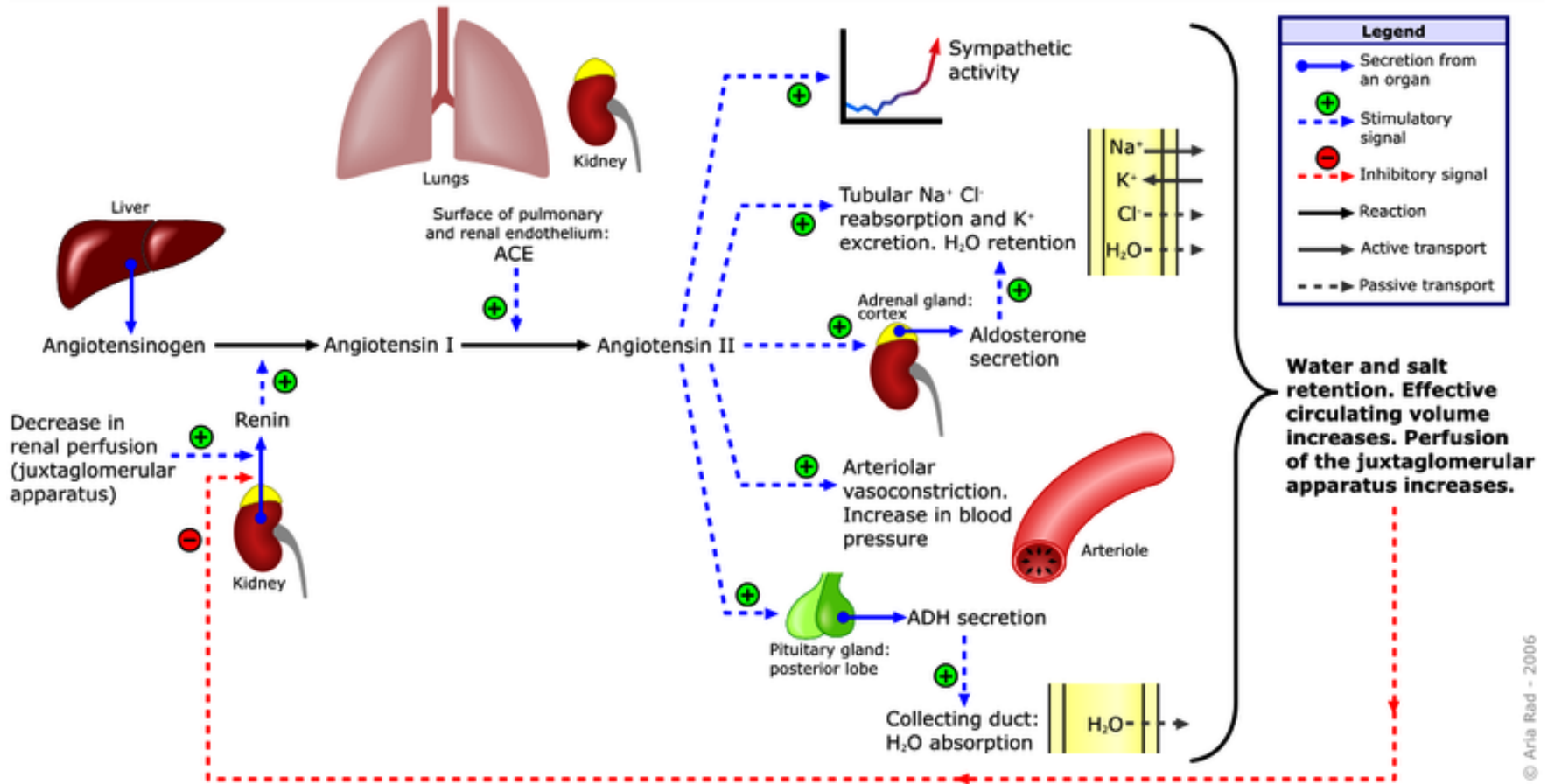
- Specialized chemoreceptor cells in the wall of the distal convoluted tubule
- respond to changes in solute concentration (especially ↓sodium levels) in the urine
- sensory information is conveyed to the juxtaglomerular cells which will adjust their output of renin accordingly.

▶ **juxtaglomerular cells**

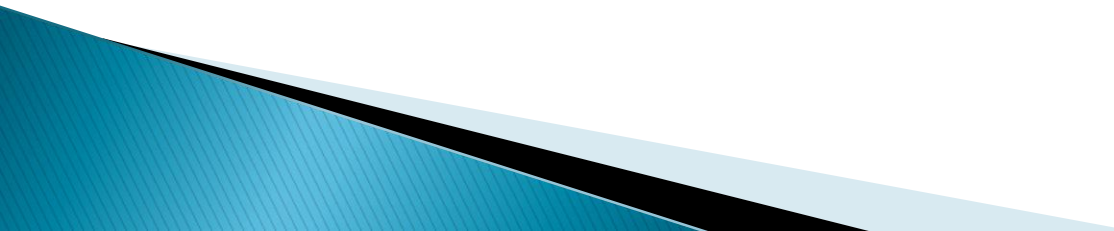
- Specialized smooth muscle cells which act as mechanoreceptors which stretch in response to increase in the blood pressure of the afferent arteriole
- synthesize and secrete the enzyme renin

Control of Aldosterone secretion

Renin-angiotensin-aldosterone system



Role of Angiotensin

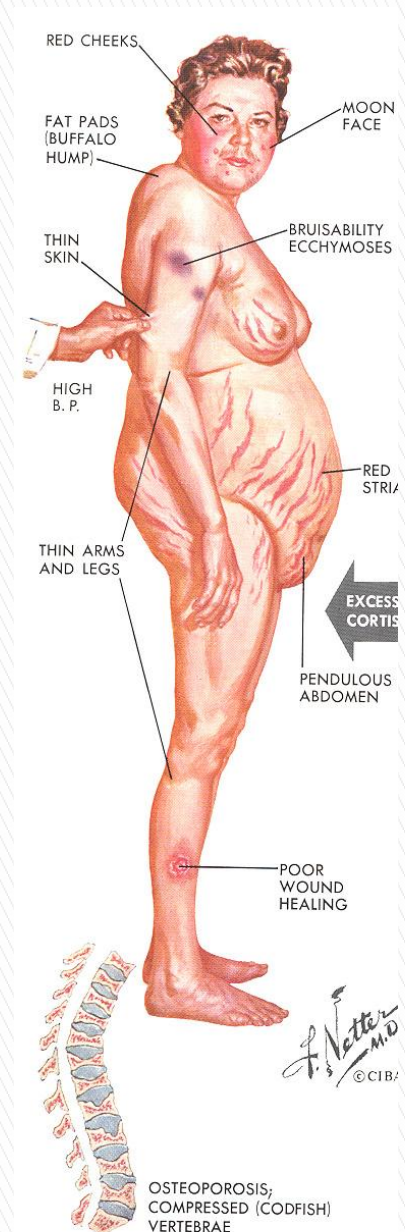
- ▶ Angiotensin **constricts the efferent renal arterioles**, which elevates blood pressure in the glomerular capillaries.
 - ▶ Angiotensin **constricts peripheral blood vessels** all over the body—an action that elevates central blood pressure.
 - ▶ Angiotensin **stimulates aldosterone** release from the adrenal cortex
 - ▶ Angiotensin acts on the brain to **stimulate thirst**. Increased water intake in response to thirst increases blood volume and blood pressure
- 

Abnormal adrenocortical secretion

▶ Hyperadrenalism (Cushing's syndrome)

○ causes

- pituitary adenoma
75–90%
- pharmacologic
- adrenal adenoma,
carcinoma
- ectopic ACTH

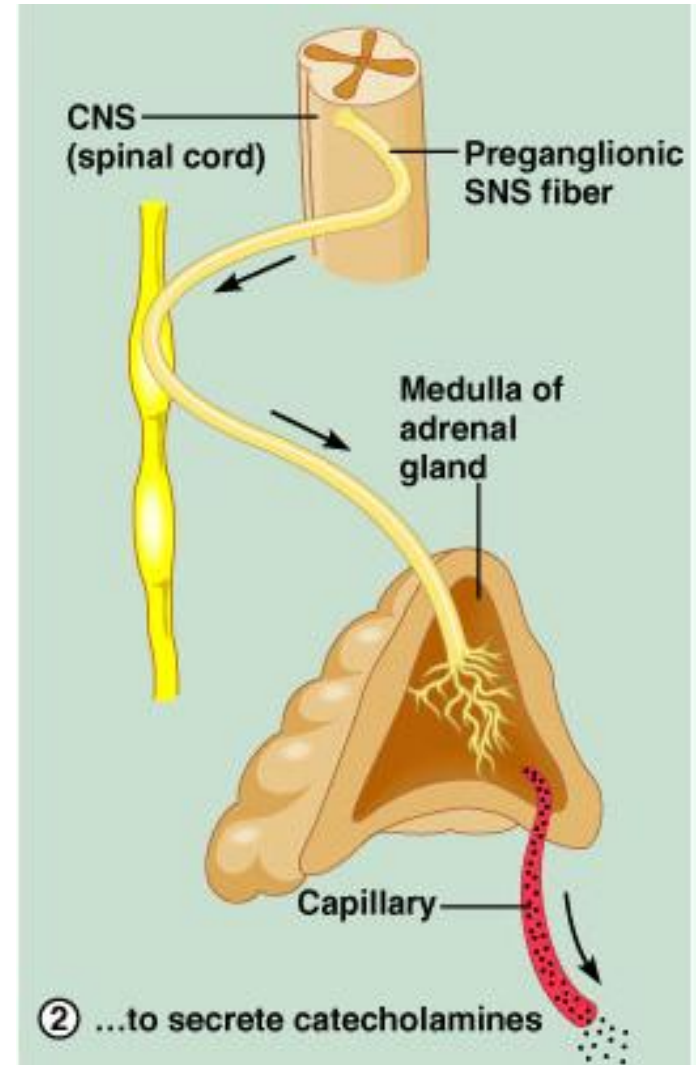


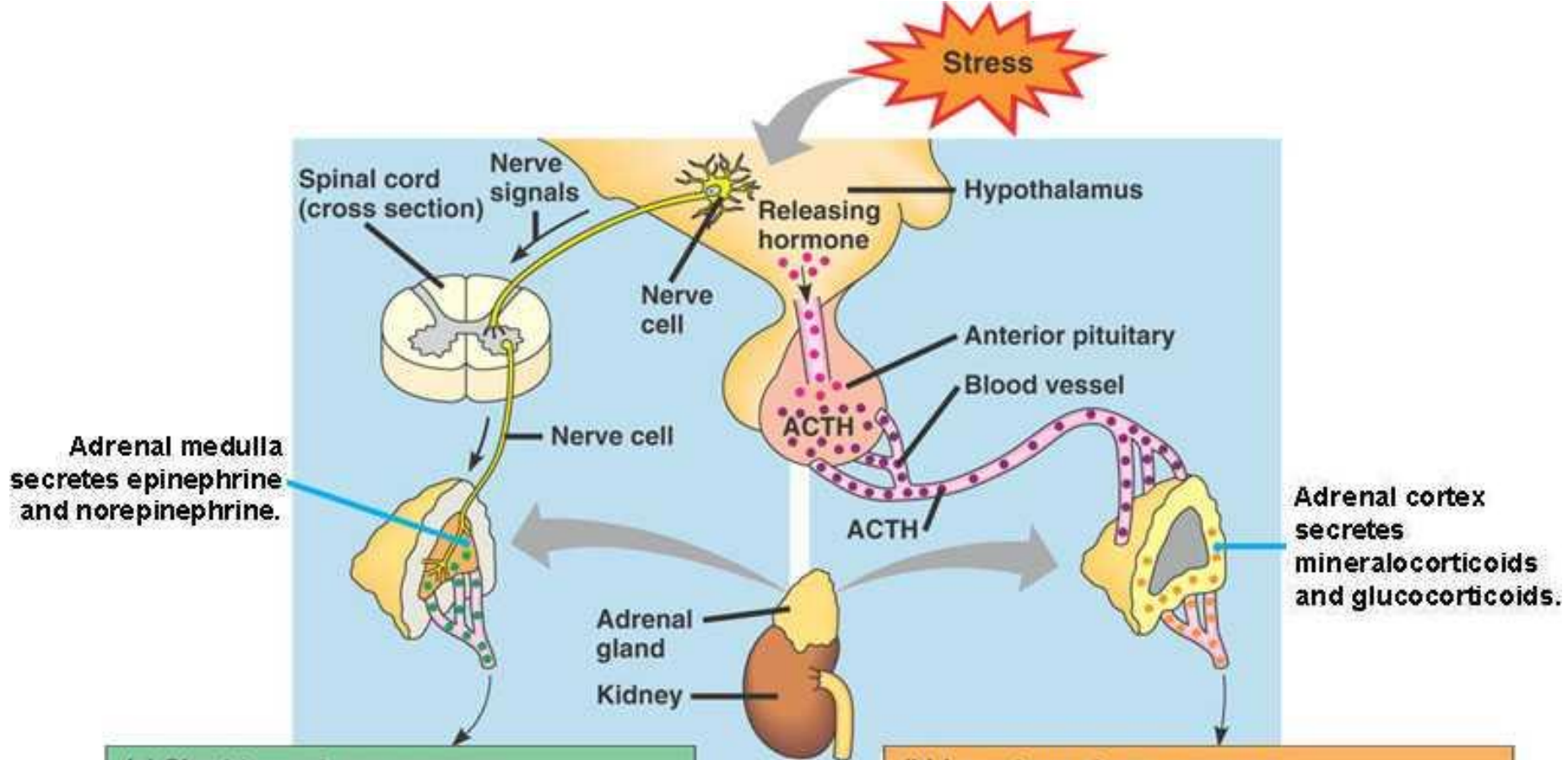
Abnormal adrenocortical secretion

- ▶ Hypoadrenalism (Addison's disease)
 - causes
 - Primary (adrenal) atrophy
 - 80% autoimmune
 - Tuberculosis or malignant invasion
 - Secondary (pituitary)
 - Very low ACTH

Adrenal medulla

- Adrenal medulla
 - Innervated by the sympathetic nervous system
 - Releases epinephrine and norepinephrine





(a) Short-term stress response

Effects of epinephrine and norepinephrine:

1. Glycogen broken down to glucose; increased blood glucose
2. Increased blood pressure
3. Increased breathing rate
4. Increased metabolic rate
5. Change in blood flow patterns, leading to increased alertness and decreased digestive and kidney activity

(b) Long-term stress response

Effects of mineralocorticoids:

1. Retention of sodium ions and water by kidneys
2. Increased blood volume and blood pressure

Effects of glucocorticoids:

1. Proteins and fats broken down and converted to glucose, leading to increased blood glucose
2. Immune system may be suppressed

Endocrine function of pancreas

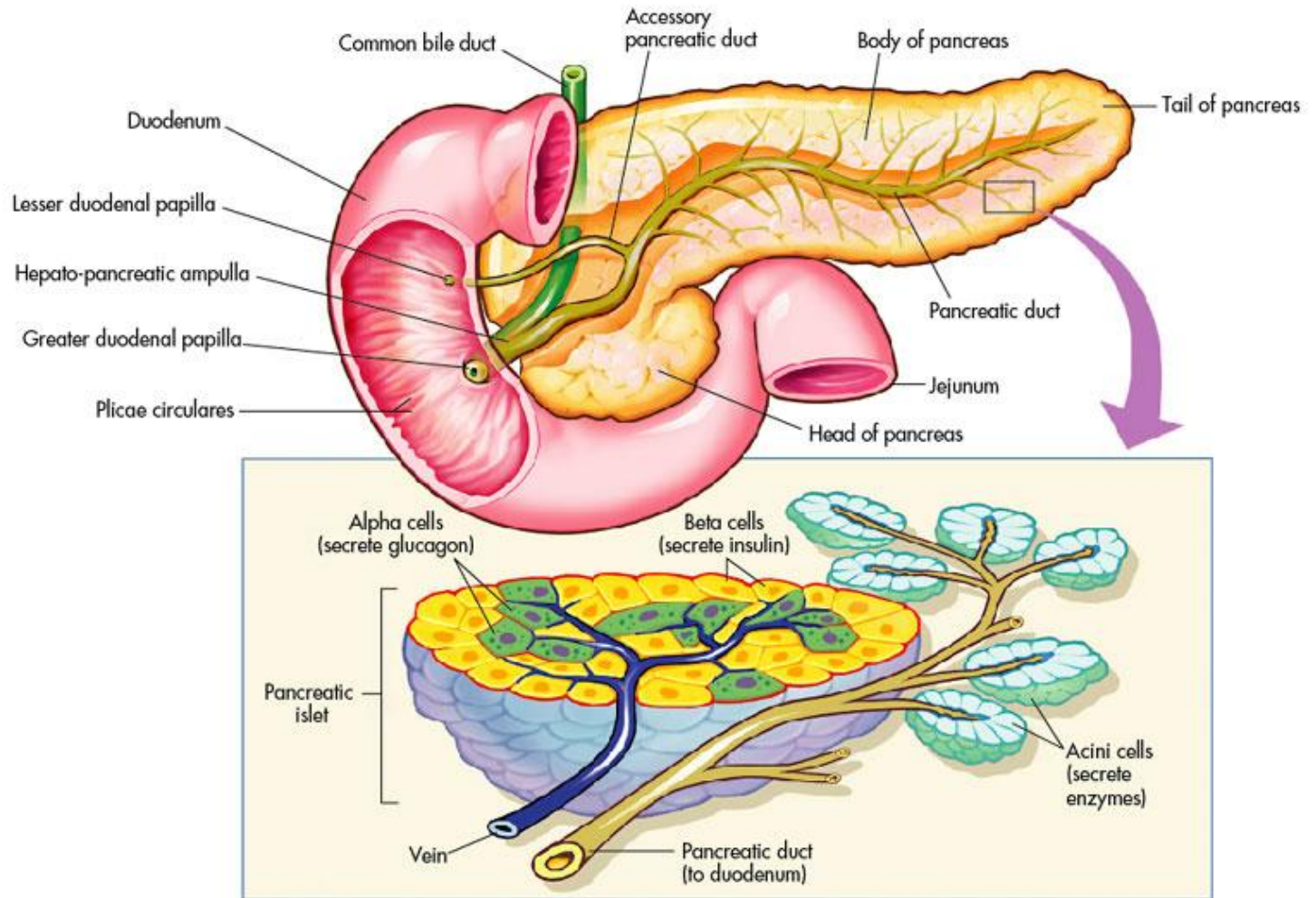
Pancreas

Endocrine

Exocrine

Islets of Langerhans
Clusters of cells scattered
between the acini
4 types of cells

Pancreas



(From Thibodeau GA, Patton K: *Anatomy & physiology*, ed 5, St Louis, 2003, Mosby.)

Major cell types of the Islets of Langerhans and the Hormones they produce

Name	Hormone produced	Percentage of total Islet*
Alpha cell	Glucagon	25
Beta cell	Insulin	60
Delta cell	Somatostatin	10
F cell	Pancreatic polypeptide	1

***The remaining 4% consists of connective tissue and blood vessels.**

Pancreas

▶ Insulin

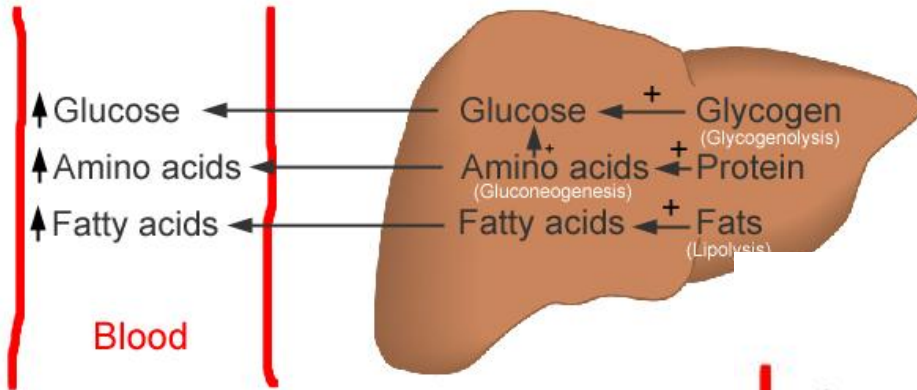
- Synthesized from proinsulin (Polypeptide: 51 a.a.)
- Secretion is promoted by increased blood glucose levels
- Facilitates the rate of glucose uptake into the cells of the body
- Anabolic hormone
 - Synthesis of proteins, lipids, and nucleic acids

Endocrine Pancreas

- ▶ Glucagon
 - Secretion is promoted by decreased blood glucose levels
 - Stimulates glycogenolysis, gluconeogenesis, and lipolysis
- ▶ Somatostatin
 - Possible involvement in regulating alpha and beta cell secretions

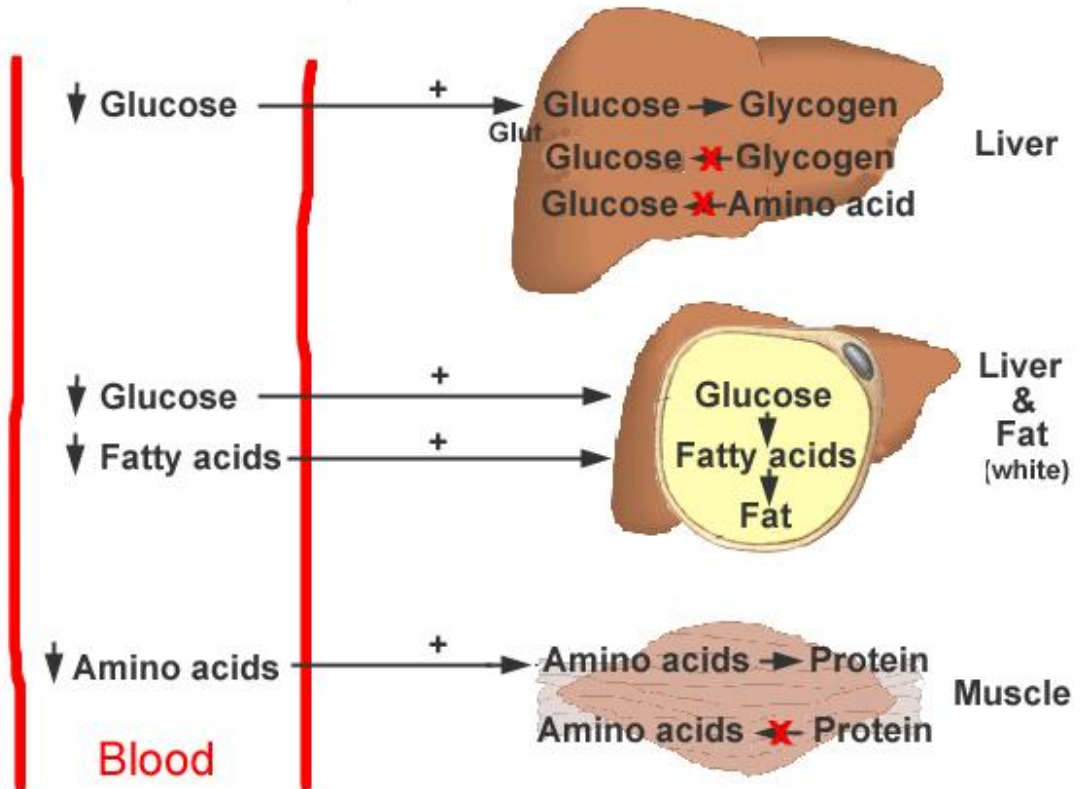
Glucagon

Glucagon catabolizes food stores

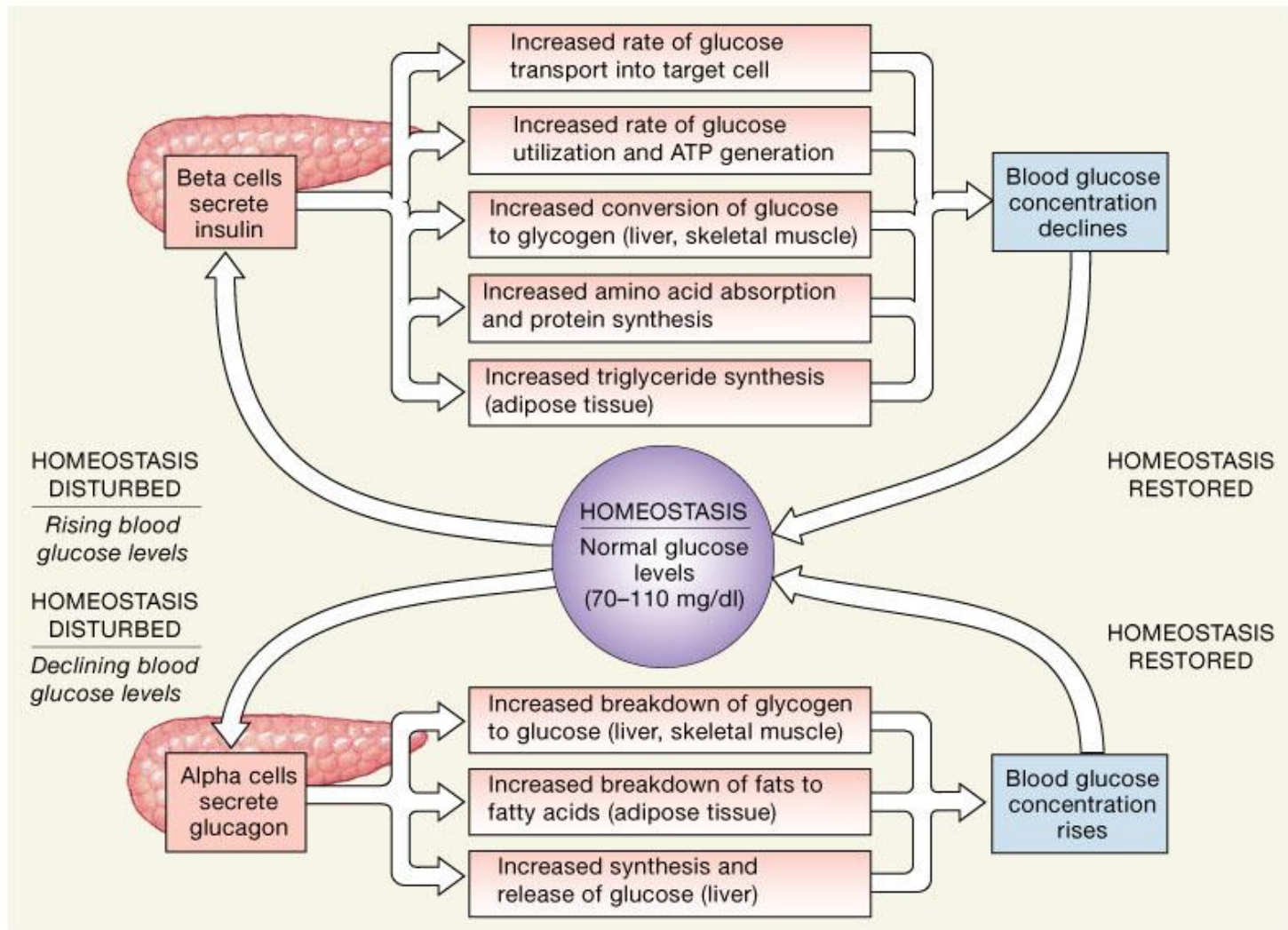


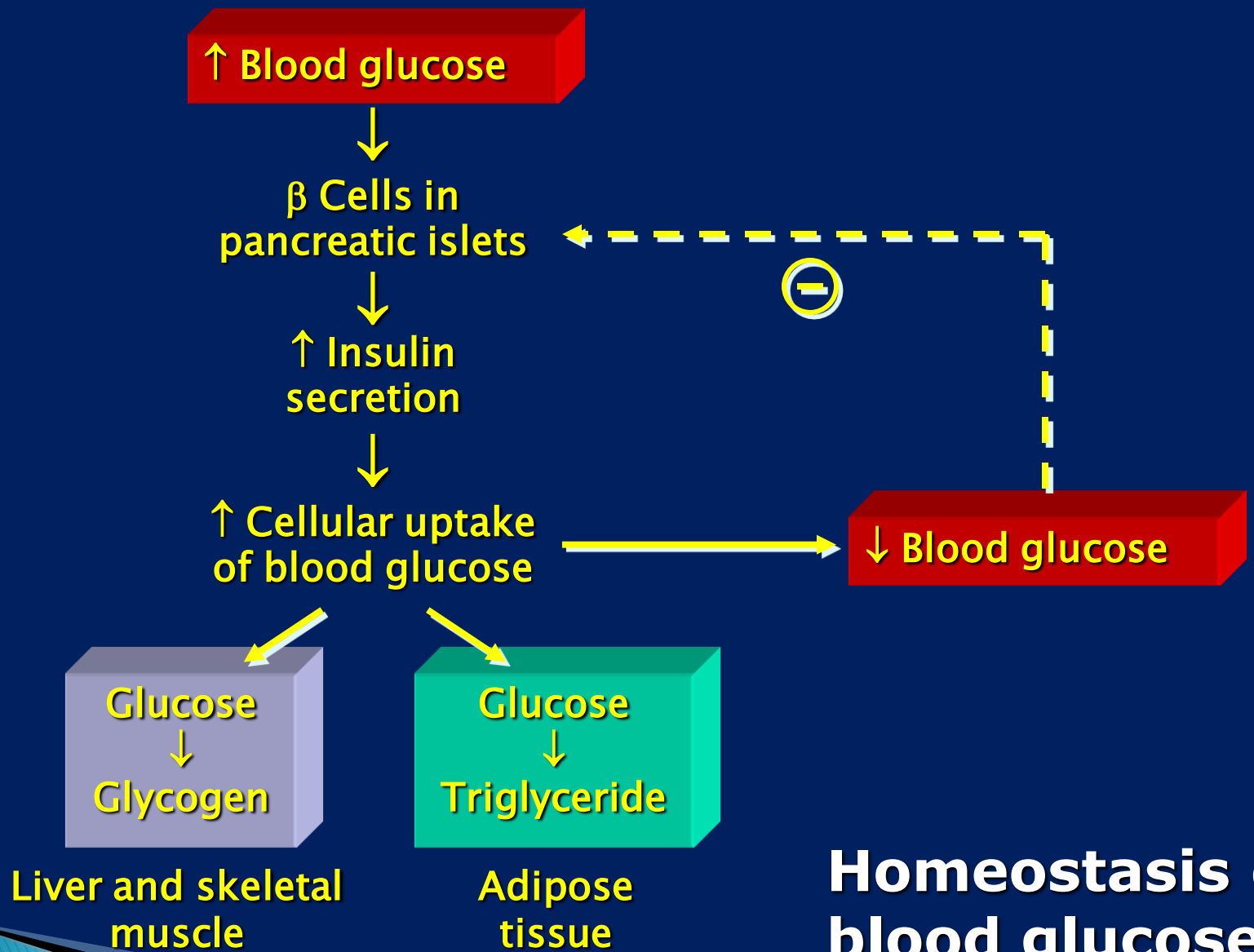
Insulin

Insulin promotes food stores

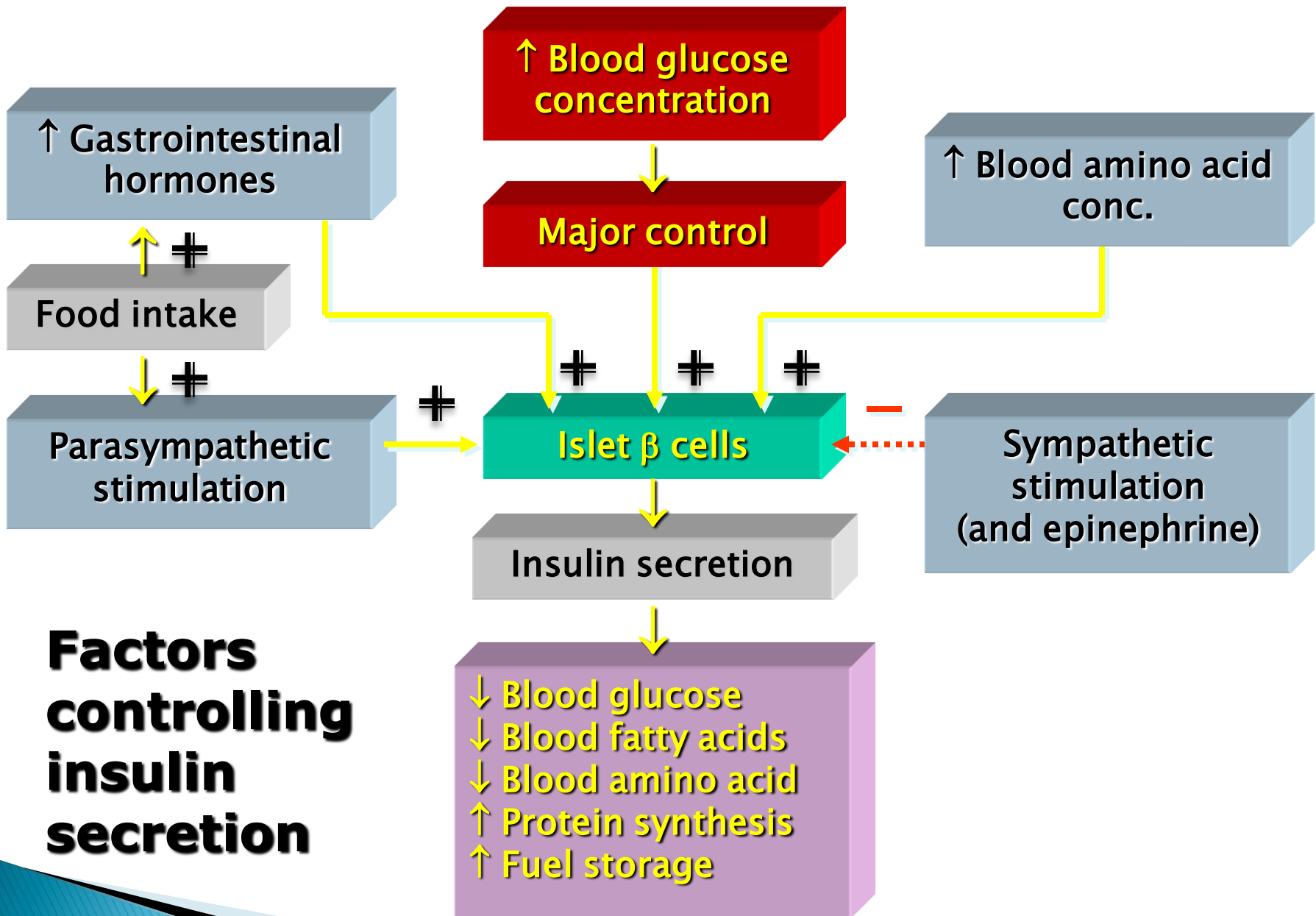


Glucose homeostasis



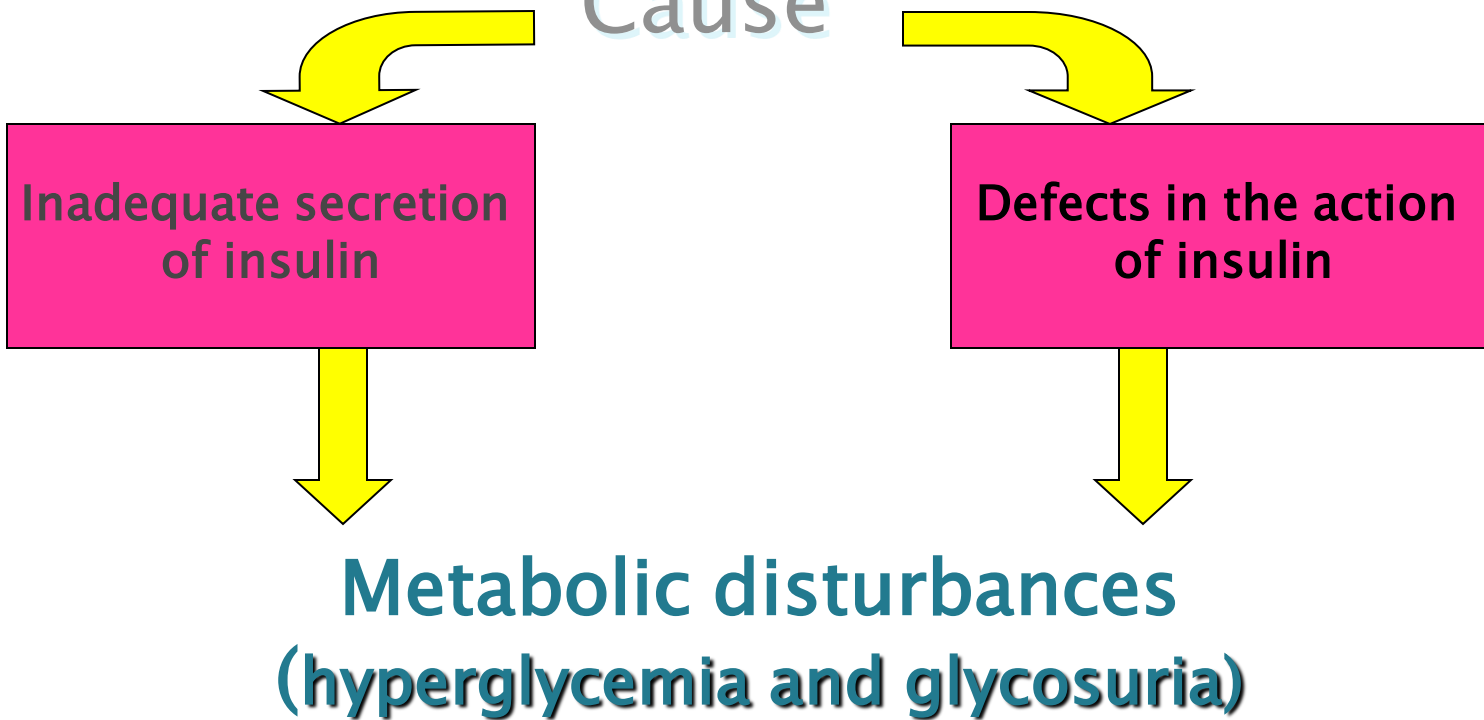


Homeostasis of blood glucose



Diabetes Mellitus

Cause



Types of Diabetes

Type 1 Diabetes

Affects children

Cause: inadequate insulin secretion

Treatment :
insulin injection

Type 2 diabetes

Affects adults

Cause defect in insulin action

Treatment :
diet or OHA

Thank you