

**Subject: Physiology of Coordination
(BS Zoology 6th Semester)**

Endocrine Structures

**Parathyroid, Pancreas, Gastropancreatic System, Adrenal Glands,
Gonads, and Placenta**

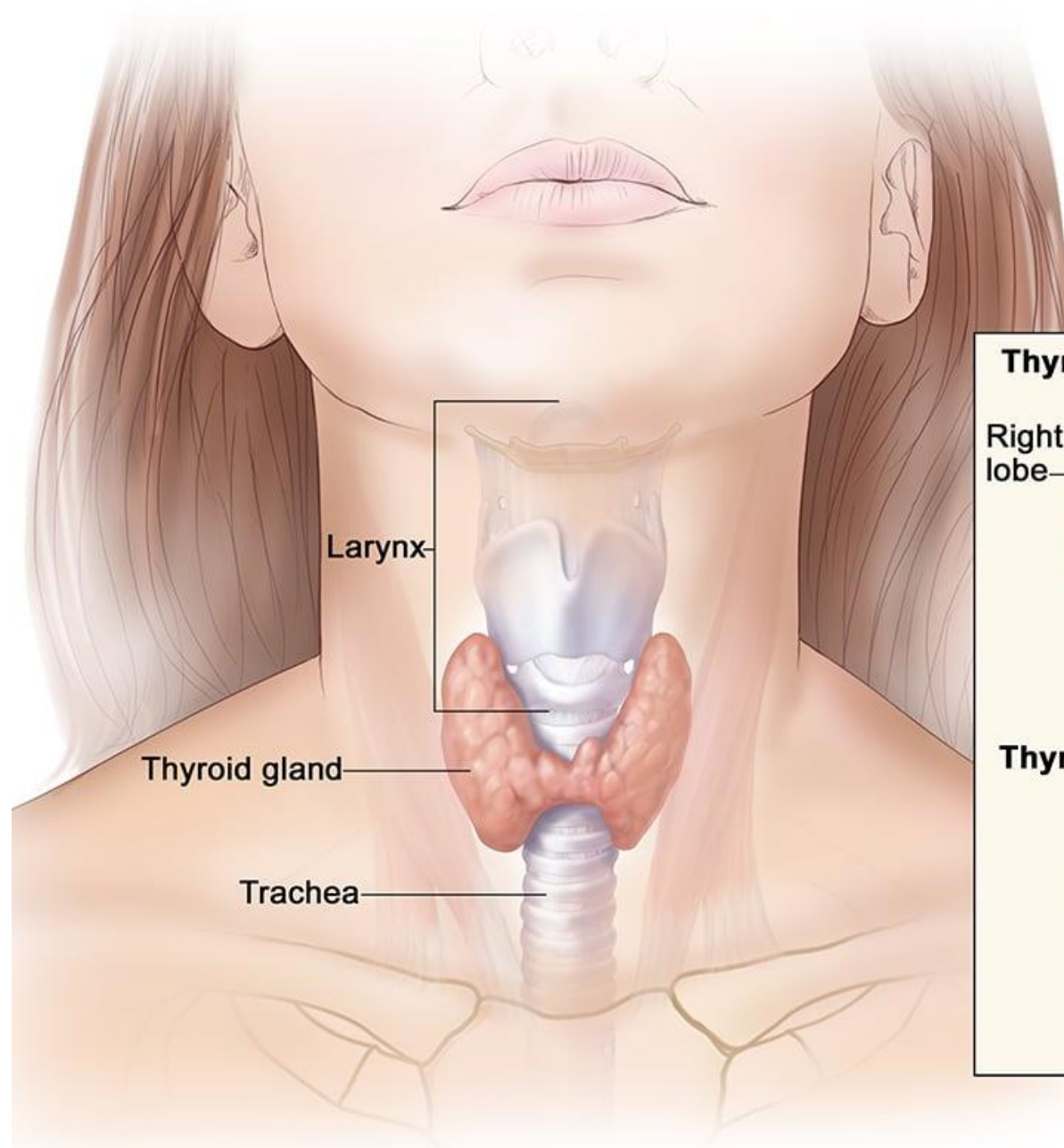
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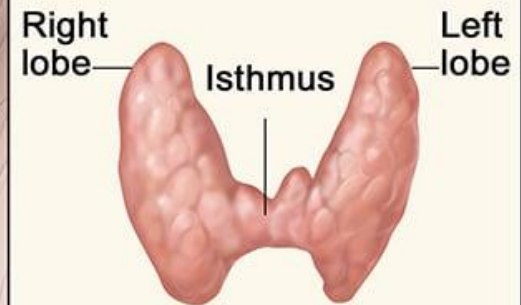
1. Parathyroid Glands and Associated Structures

- **Anatomy & Location:**
- Four small glands embedded on the posterior surface of the thyroid gland.
- Derived from endoderm (3rd & 4th pharyngeal pouches).

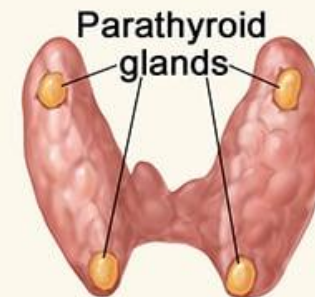
Anatomy of the Thyroid and Parathyroid Glands



Thyroid gland (front view)



Thyroid gland (back view)





Hormones & Functions: (Parathyroid Hormone (PTH))

- **Homeostasis:**

- Primary regulator of calcium (Ca^{2+}) and phosphate (PO_4^{3-}).

- **Bone:**

- Stimulates osteoclasts $\rightarrow$ bone resorption $\rightarrow$ releases Ca^{2+} .

- **Kidneys:**

- $\uparrow$ Ca^{2+} reabsorption (distal tubule).
- $\downarrow$ PO_4^{3-} reabsorption (proximal tubule).

- **Intestines:**

- Indirectly $\uparrow$ Ca^{2+} absorption via Vitamin D.

1. Parathyroid Glands and Associated Structures

- **Regulation:**

- Low serum $\text{Ca}^{2+} \rightarrow \uparrow$ PTH secretion.
- High serum $\text{Ca}^{2+} \rightarrow \downarrow$ PTH secretion (negative feedback).

- **Associated Structures:**

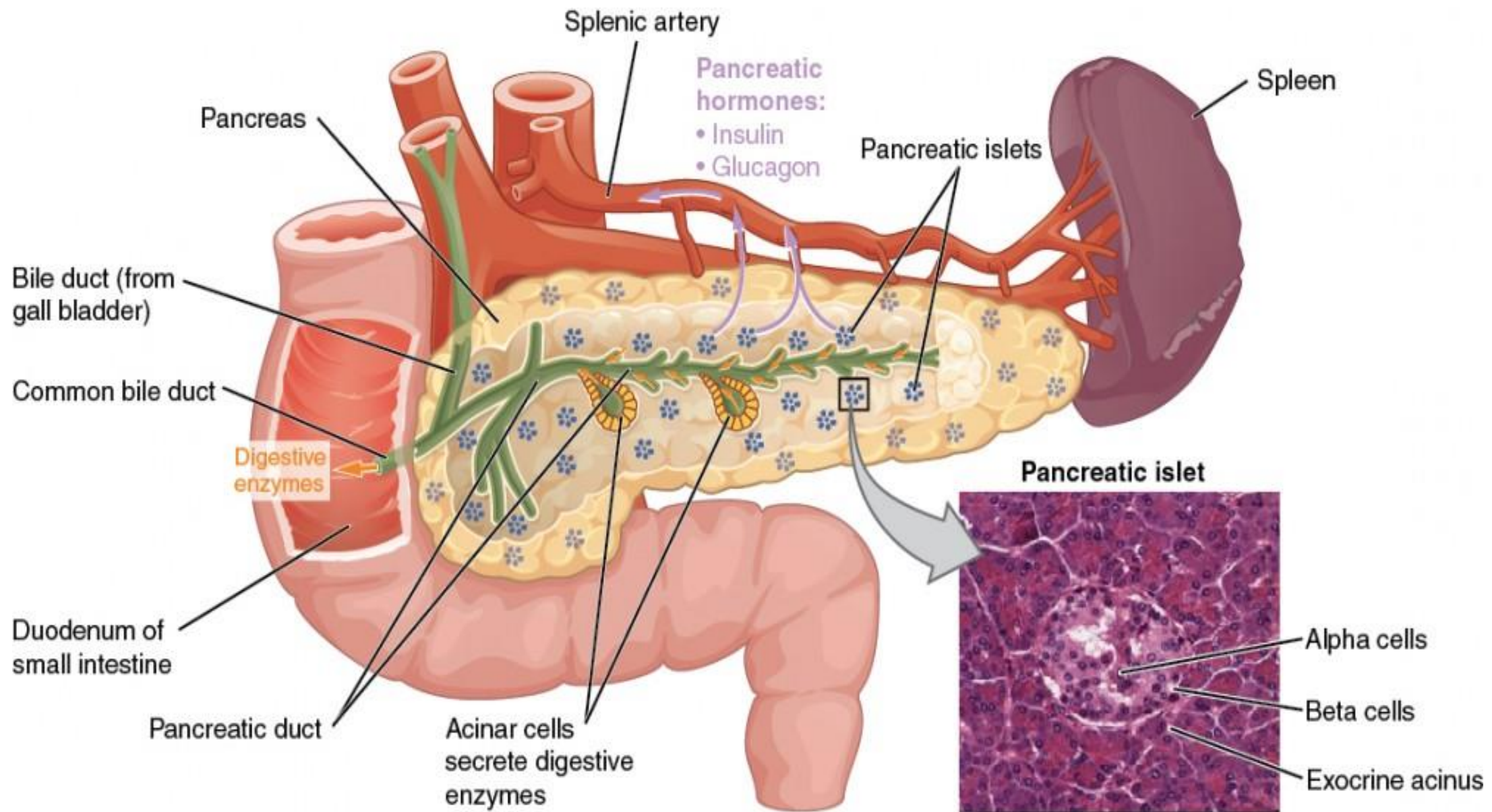
- Thyroid C-cells (Parafollicular cells):
- Secrete calcitonin (lowers Ca^{2+} , opposes PTH).

2. Endocrine Pancreas (Islets of Langerhans)

- **Regulation of Insulin & Glucagon:**
- Insulin:
- **Stimulated by:**
- High Blood Glucose Level and acetylcholine (parasympathetic).
- **Inhibited by:**
- Somatostatin and epinephrine (stress response).

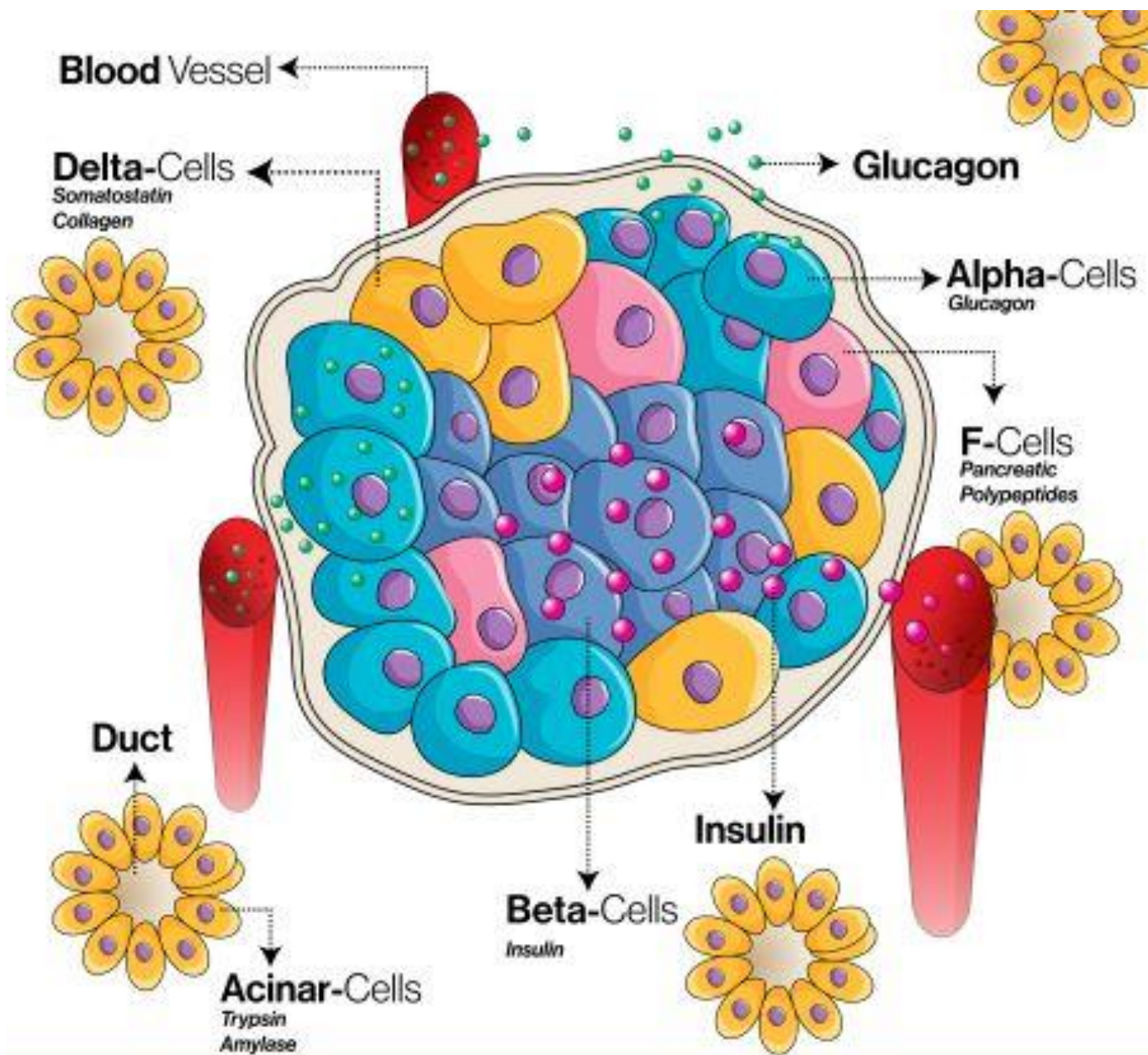
2. Endocrine Pancreas (Islets of Langerhans)

- **Glucagon:**
- **Stimulated by:**
- ↓ (Low) Blood glucose, amino acids, sympathetic activation.
- **Clinical Relevance:**
- **Diabetes Mellitus:** Dysfunction of β -cells (Type 1) or insulin resistance (Type 2).
- **Glucagonoma:**
- Excess glucagon $\rightarrow$ hyperglycemia.



Cell Types & Hormones:

Cell Type	Hormone Secreted	Primary Function
Beta (β) cells (60-70%)	Insulin	↓ Blood glucose (glycogen synthesis)
Alpha (α) cells (20%)	Glucagon	↑ Blood glucose (glycogenolysis, gluconeogenesis).
Delta (δ) cells (5-10%)	Somatostatin (GHIH)	Inhibits insulin & glucagon secretion.
PP cells (1%)	Pancreatic Polypeptide (PP)	Regulates pancreatic exocrine secretion & appetite.
Epsilon (ϵ) cells (rare)	Ghrelin	Stimulates hunger (also from stomach).



Pancreatic Endocrine Cells

3. Gastropancreatic (Enteroendocrine) System

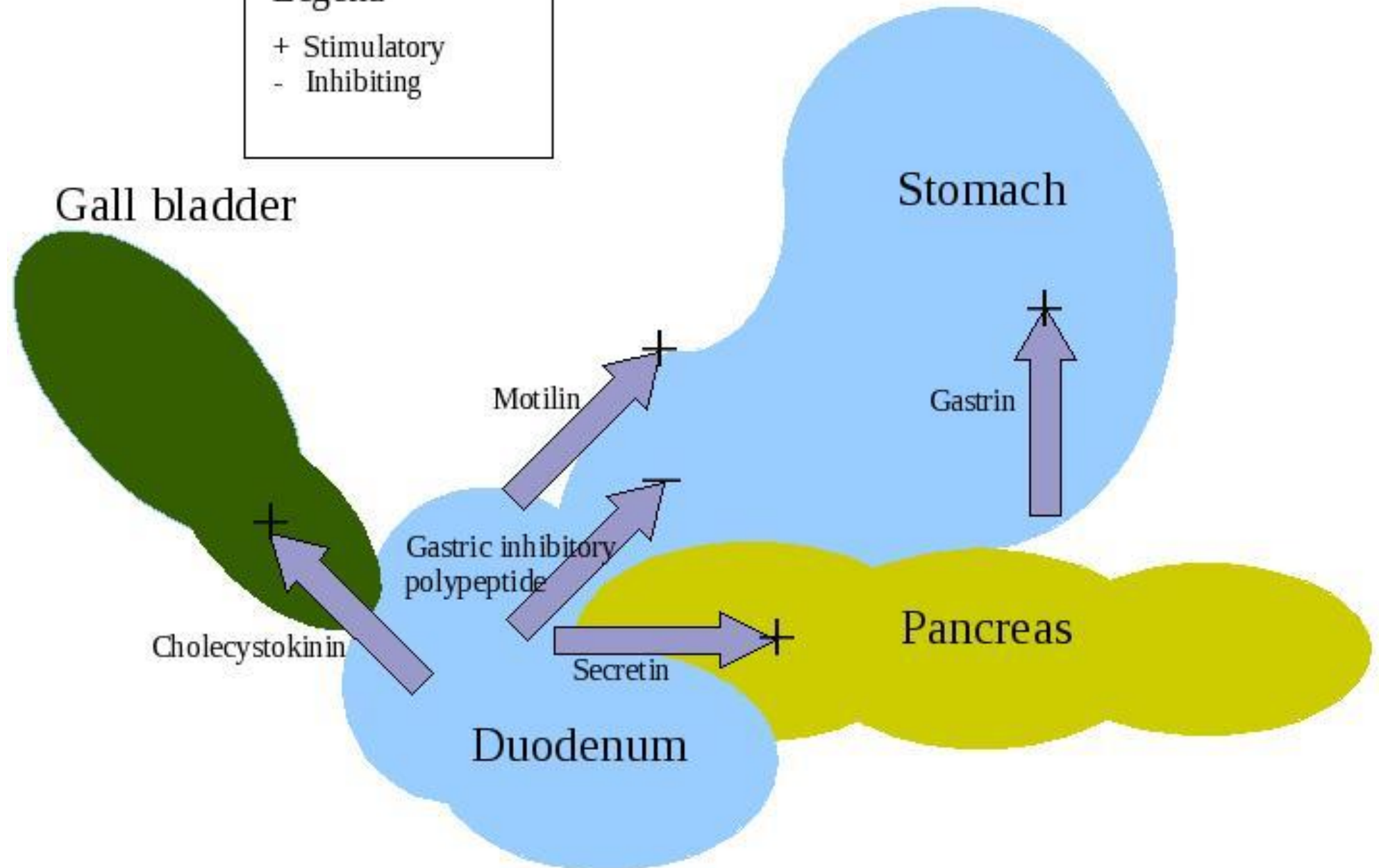
- **Role in Digestion & Metabolism:**
- **CCK (Cholecystokinin) & Secretin:**
- Coordinate bile release & pancreatic secretion.
- **GLP-1 & GIP:**
- "Incretin effect" → enhances insulin release after meals.
- GLP-1: Glucagon-like peptide-1
- GIP: Glucose-dependent insulinotropic polypeptide

Key Hormones & Sources:

Hormone	Source	Function
Gastrin	G cells (stomach antrum)	Stimulates gastric acid (HCl) secretion.
Cholecystokinin (CCK)	I cells (duodenum)	Stimulates pancreatic enzyme release & gallbladder contraction.
Secretin	S cells (duodenum)	Stimulates pancreatic HCO_3^- secretion (neutralizes acid).
GLP-1 (Glucagon-like peptide-1)	L cells (ileum, colon)	↑ Insulin, ↓ glucagon (used in diabetes drugs).
GIP (Glucose-dependent insulinotropic peptide)	K cells (duodenum)	↑ Insulin secretion after meal.

Legend

- + Stimulatory
- Inhibiting



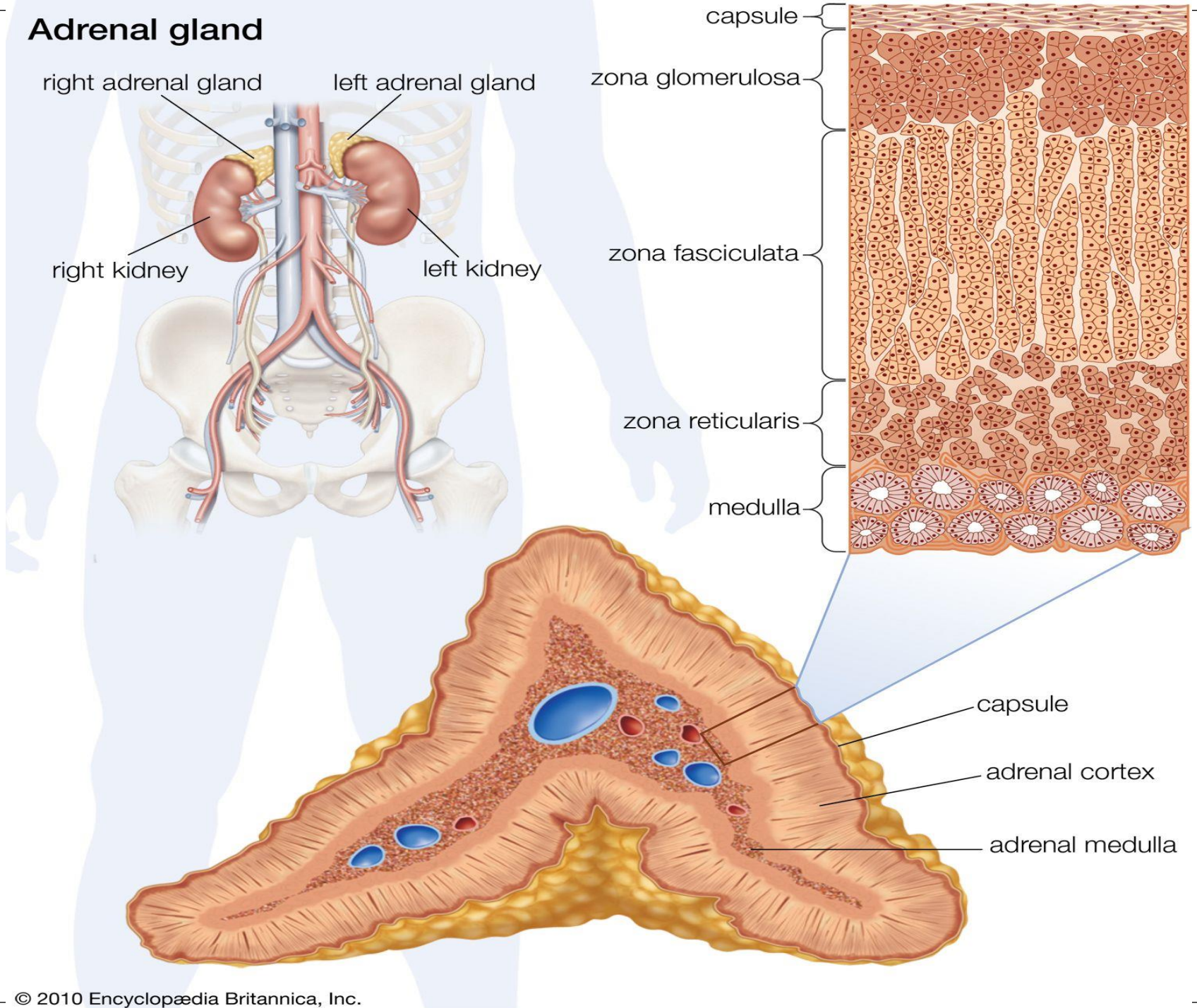
4. Adrenal Medulla (Chromaffin Tissue)

- **Structure & Function:**
- Derived from neural crest (neuroendocrine tissue).
- **Secretes catecholamines:**
- Epinephrine (80%)
- Nor-epinephrine (20%)
- Dopamine (minor)

4. Adrenal Medulla (Chromaffin Tissue)

- **Regulation:**
- Sympathetic stimulation → release of catecholamines.
- Effects (Fight-or-Flight Response):
- **Cardiovascular:** ↑ Heart Rate, BP, vasoconstriction.
- **Metabolic:** ↑ Glycogenolysis, lipolysis.
- **Respiratory:** Bronchodilation.
- **Clinical Relevance:**
- Hypertension and palpitations.

Adrenal gland



5. Adrenal Cortex

- **Regulation:**
- **Cortisol:** Controlled by ACTH (from pituitary).
- **Aldosterone:** Controlled by angiotensin II & K^+ levels.
- **Clinical Relevance:**
- Cushing's Syndrome:
 - Excess cortisol → obesity, hyperglycemia.
- Addison's Disease:
 - Adrenal insufficiency → hyponatremia, hyperkalemia.

Three Layers & Hormones:

Layer	Hormone Secreted	Function
Zona Glomerulosa	Aldosterone (Mineralocorticoid)	↑ Na ⁺ reabsorption, ↑ K ⁺ excretion
Zona Fasciculata	Cortisol (Glucocorticoid)	↑ Blood glucose, anti-inflammatory, stress response.
Zona Reticularis	Androgens	Weak androgens → converted to testosterone/estrogen peripherally.

6. Ovary

- **Hormones & Functions:**

- Estrogen (Estradiol):

- **Follicular phase:** Stimulates endometrial proliferation.

- Secondary sex characteristics.

- Progesterone:

- **Luteal phase:** Prepares endometrium for implantation.

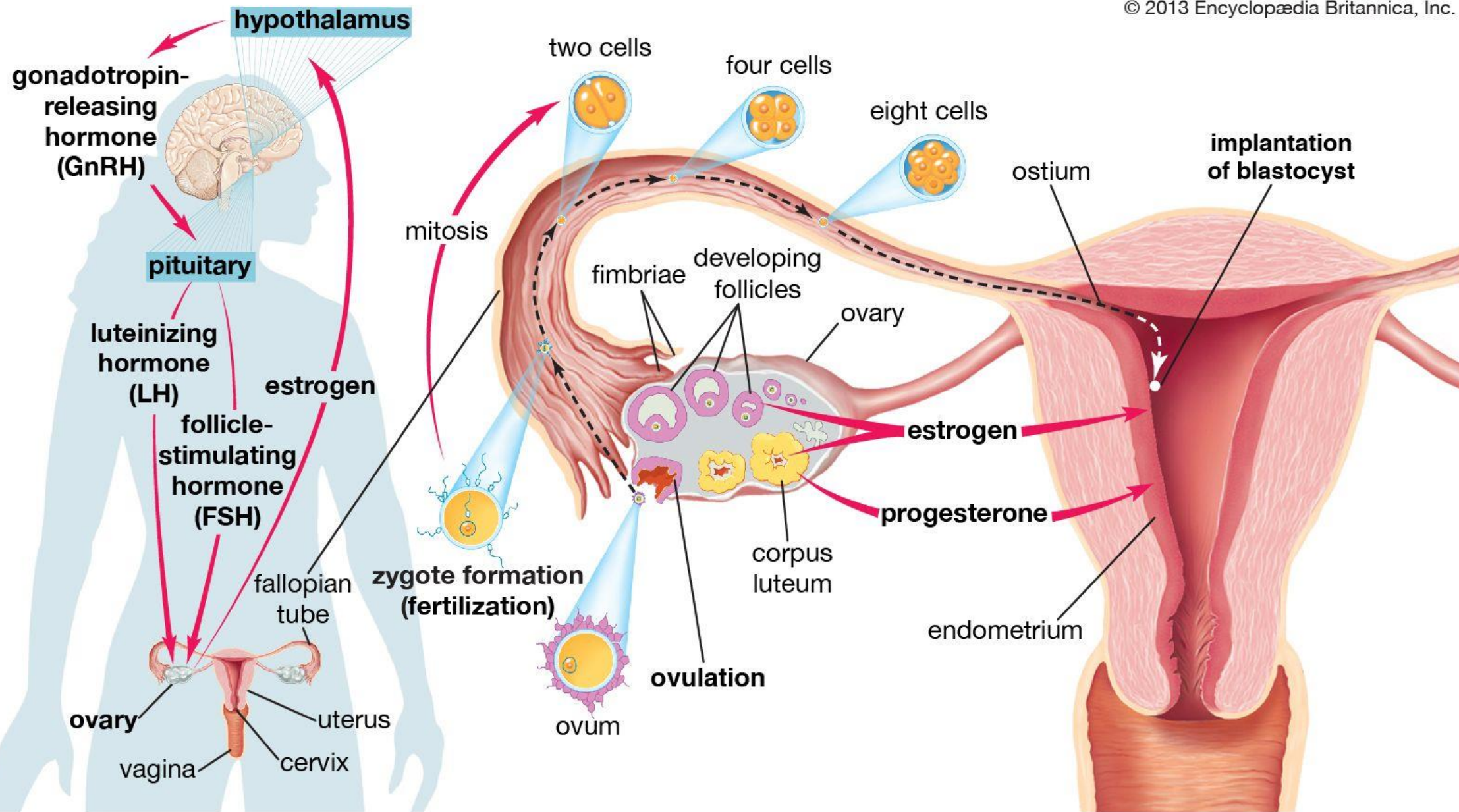
- Inhibin: Inhibits FSH.

- **Relaxin (Pregnancy):** Softens cervix, relaxes pelvic ligaments.

- Regulation:

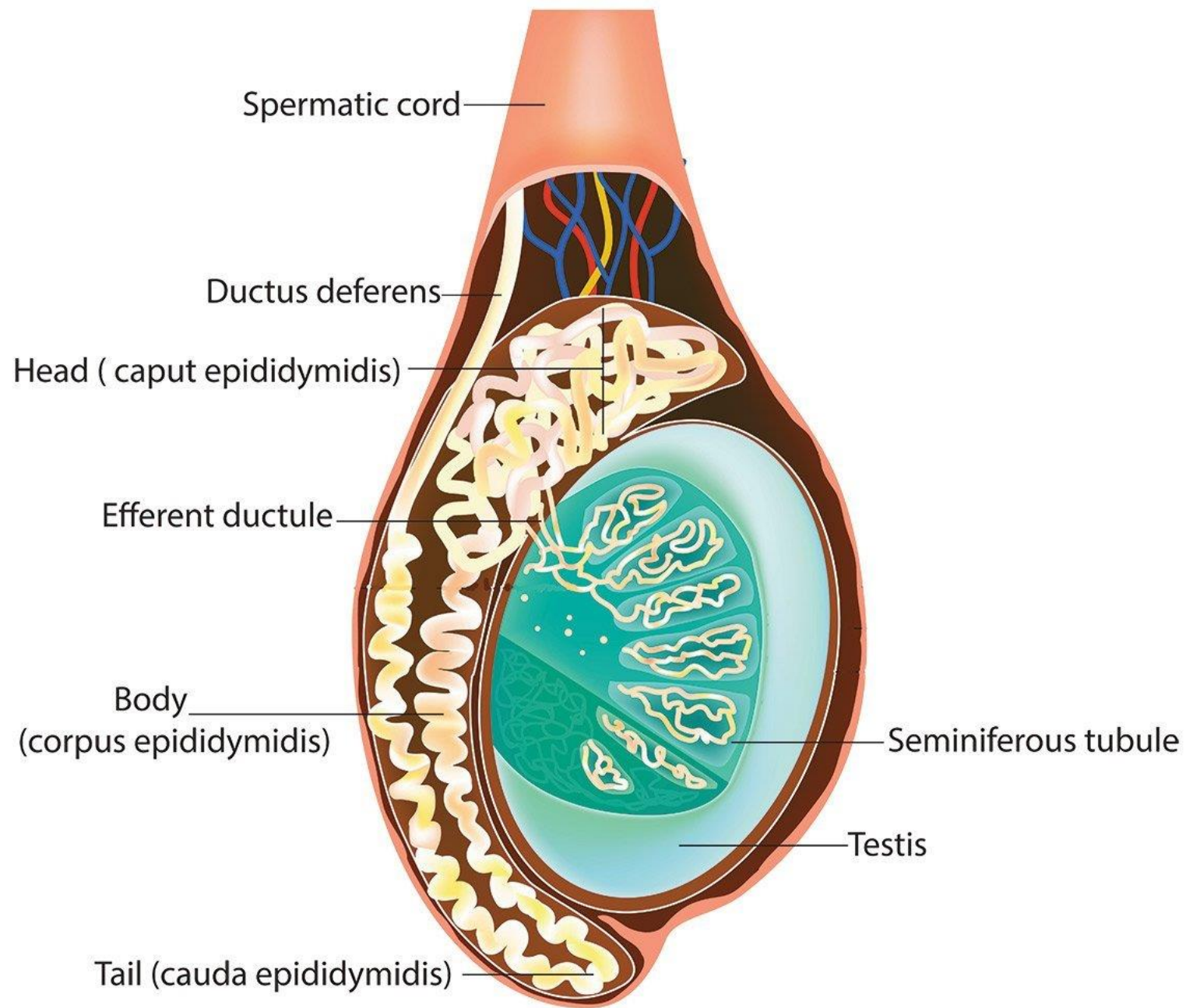
- FSH → stimulates follicular growth.

- LH → triggers ovulation & corpus luteum formation.



7. Testis

- **Hormones & Functions:**
- **Testosterone (Leydig cells):**
- Spermatogenesis, male secondary sex characteristics.
- **Inhibin (Sertoli cells):** Inhibits FSH.
- **Anti-Mullerian Hormone (AMH):**
- Prevents female duct development in males.
- **Regulation:**
- LH → stimulates testosterone.
- FSH → supports spermatogenesis.



8. Placenta

- **Hormones & Functions:**
- **hCG (Human Chorionic Gonadotropin):**
- Maintains corpus luteum (early pregnancy).
- **Progesterone & Estrogen:** Sustain pregnancy.
- **hPL (Human Placental Lactogen):**
- Induces insulin resistance (ensures fetal glucose supply).
- **Clinical Relevance:**
- Placental dysfunction → hypertension, proteinuria.



Hormones secreted by the Human Placenta

Steroid Hormones

Oestrogen



Stimulates growth of uterus in pregnancy



Stimulates breast tissue growth

Progesterone



Prevents premature uterine contractions

Human Chorionic Gonadotropin



Detected in pregnancy test



Maintains progesterone production from corpus luteum

Protein Hormones

Relaxin



Relaxes pelvic ligaments and softens cervix at labour

Kisspeptin



Important for fertility

Human Placental Lactogen



May help develop milk glands



Aids maternal metabolism

Placental Growth Hormone

Helps in placenta growth

Summary Table of Key Hormones

Endocrine Structure	Key Hormones	Primary Functions
Parathyroid	PTH	$\uparrow \text{Ca}^{2+}$, $\downarrow \text{PO}_4^{3-}$
Endocrine Pancreas	Insulin, Glucagon	Glucose homeostasis
Adrenal Medulla	Epinephrine, Norepinephrine	Fight-or-flight response
Adrenal Cortex	Cortisol, Aldosterone	Stress response, Na^+/K^+ balance
Ovary	Estrogen, Progesterone	Female reproduction
Testis	Testosterone	Male reproduction
Placenta	hCG, Progesterone	Pregnancy maintenance

THANK YOU