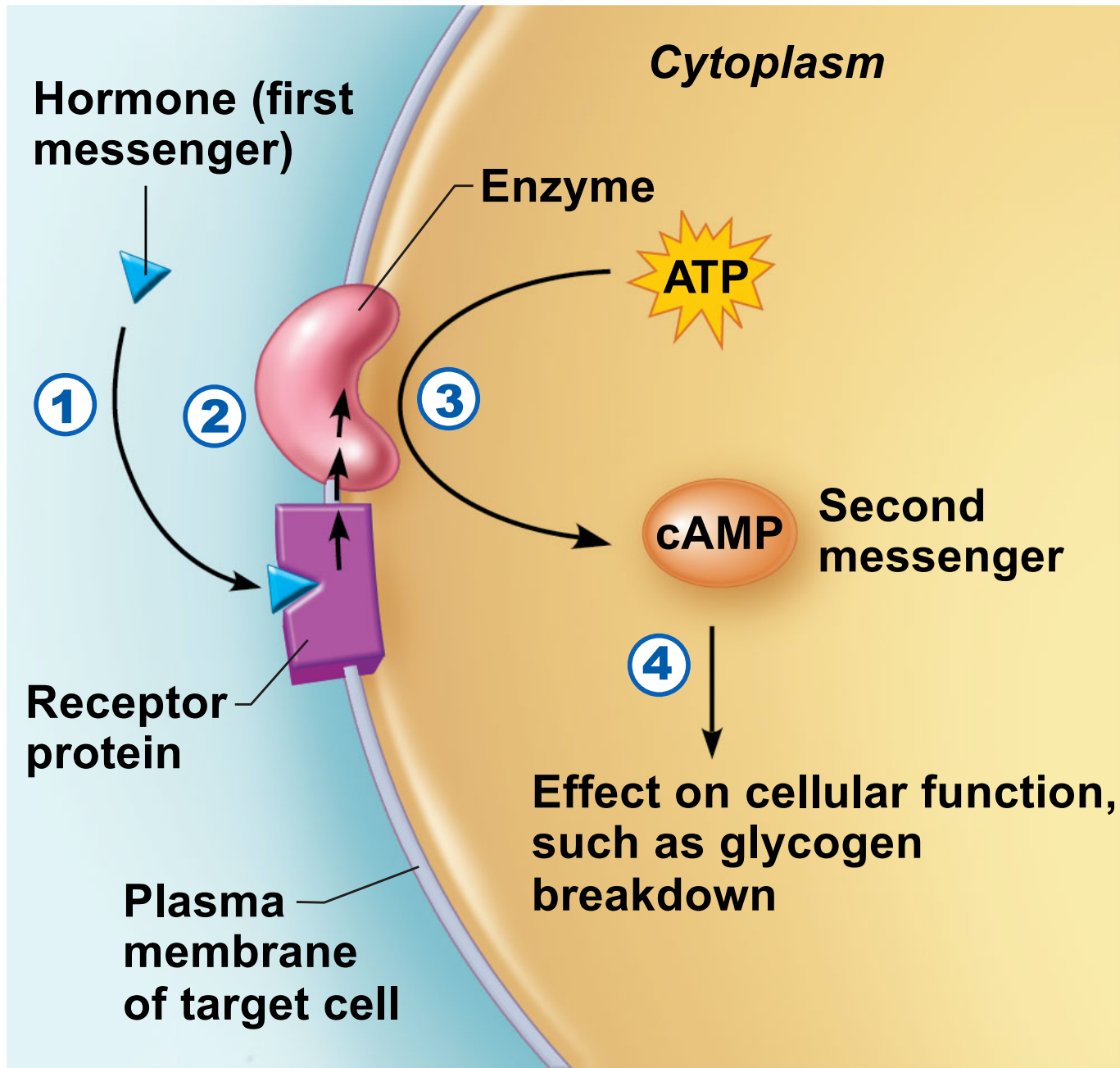


**(a) Direct gene activation**

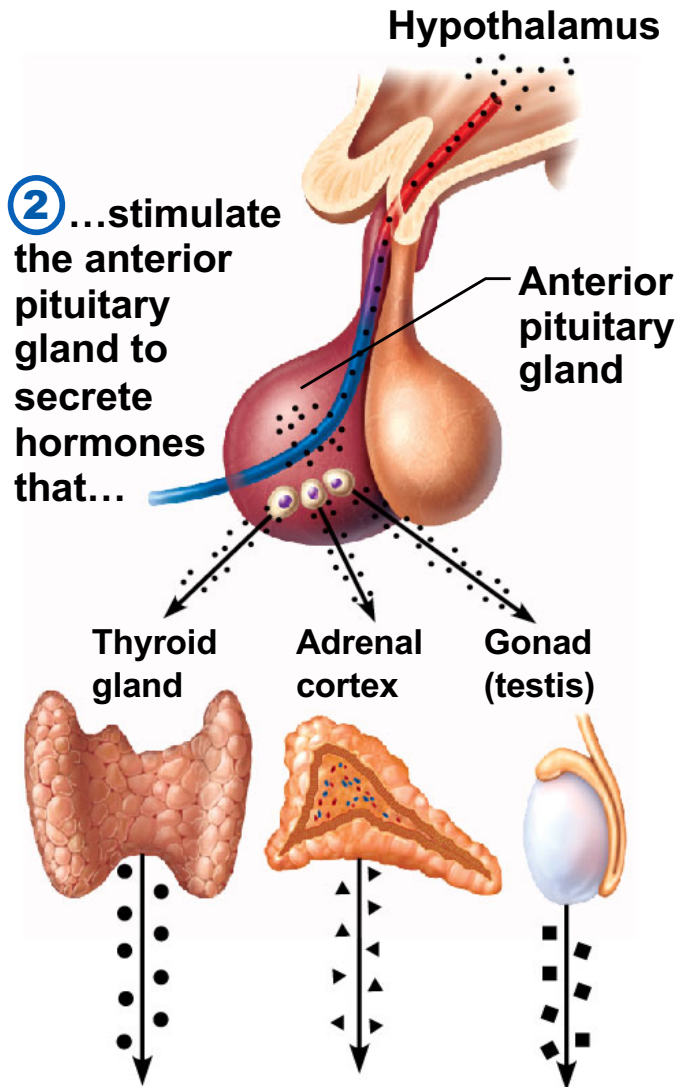


**(b) Second-messenger system**

## (a) Hormonal stimulus

① The hypothalamus secretes hormones that...

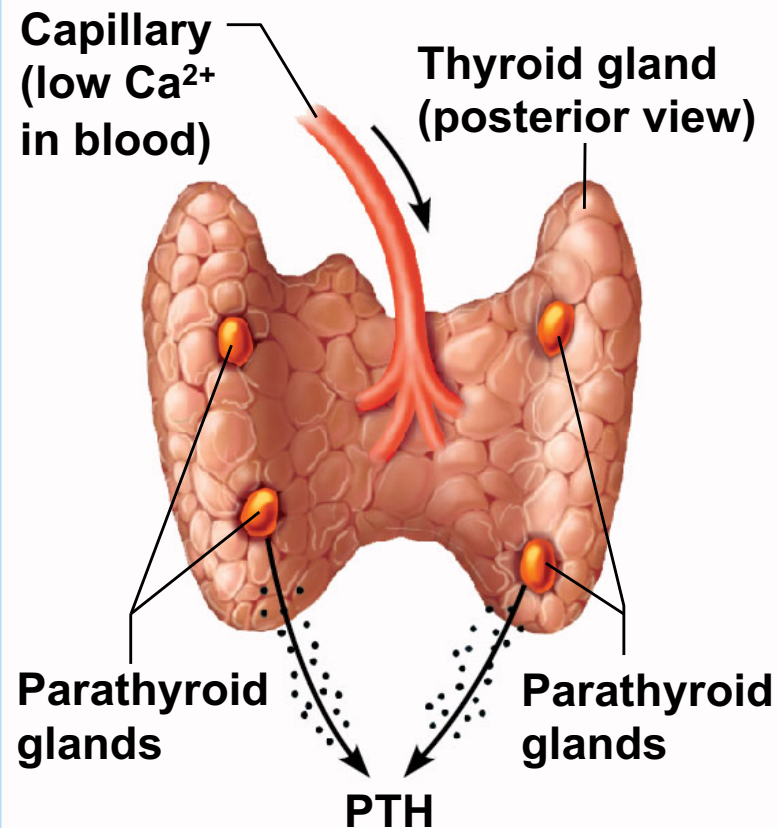
② ...stimulate the anterior pituitary gland to secrete hormones that...



③ ...stimulate other endocrine glands to secrete hormones

## (b) Humoral stimulus

- ① Capillary blood contains low concentration of  $\text{Ca}^{2+}$ , which stimulates...

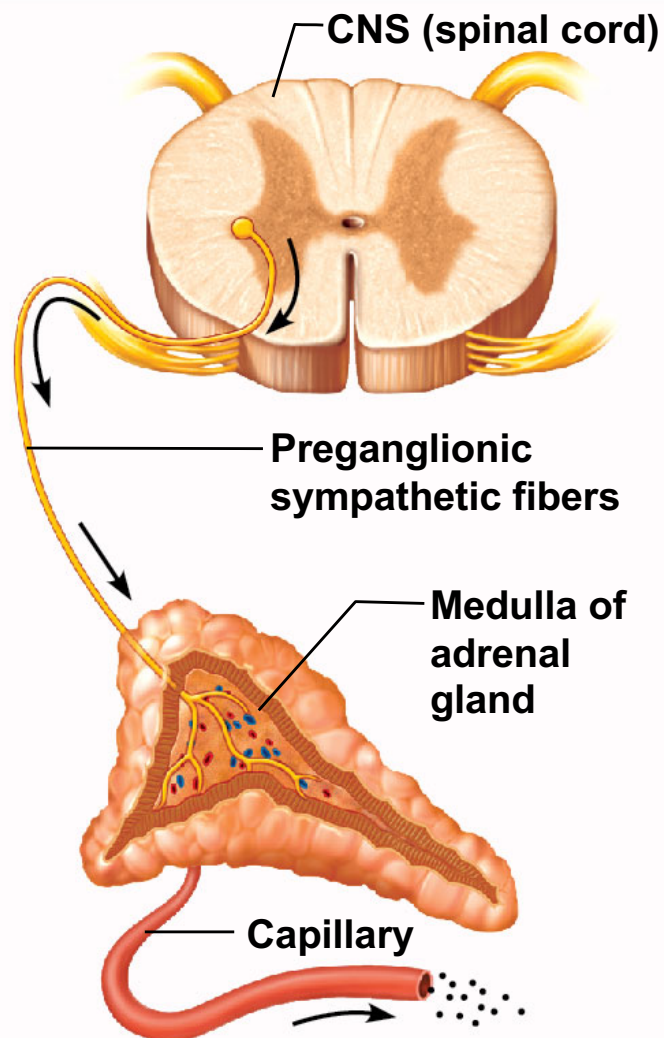


- ② ...secretion of parathyroid hormone (PTH) by parathyroid glands

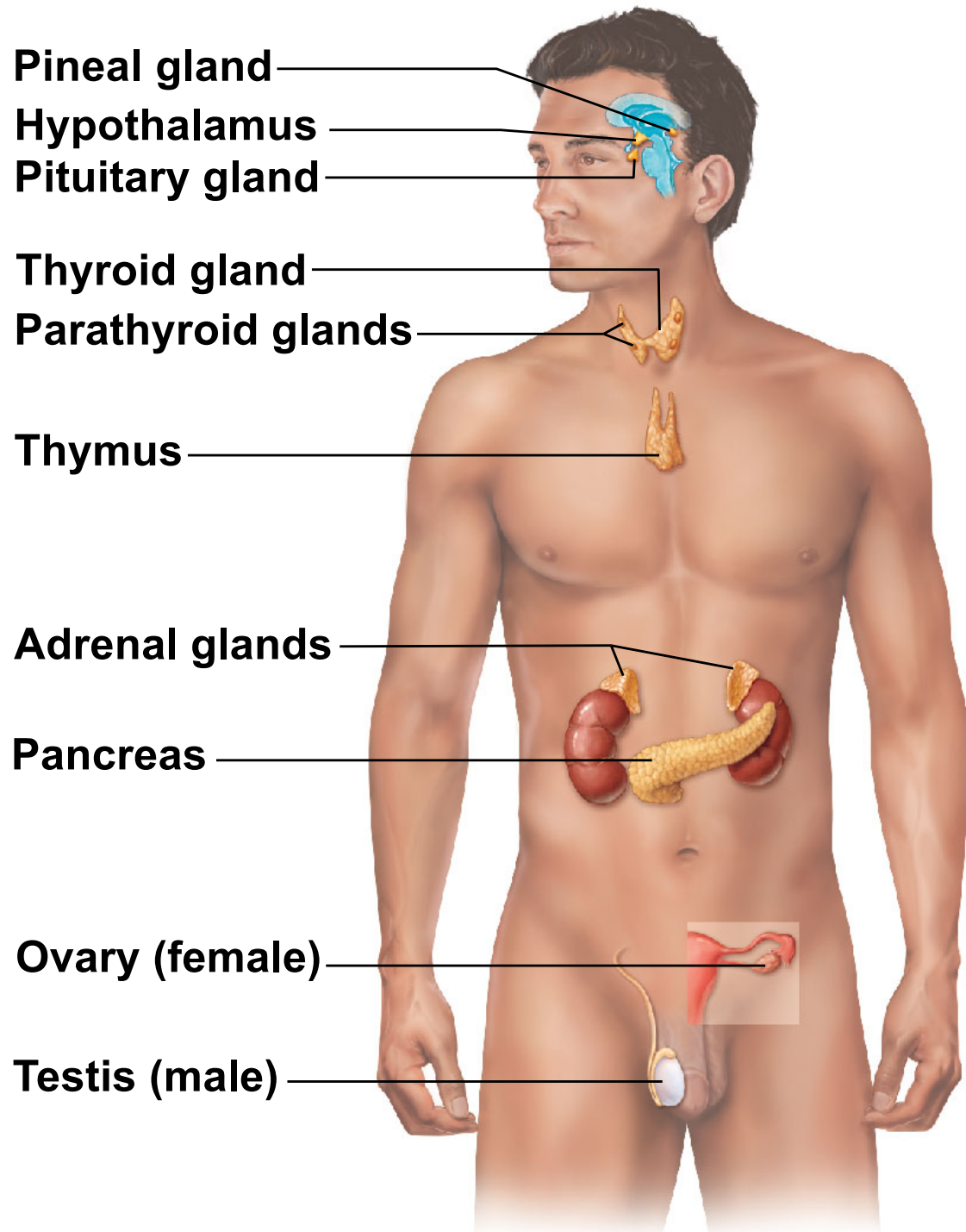


## (c) Neural stimulus

- ① Preganglionic sympathetic fiber stimulates adrenal medulla cells...



- ② ...to secrete catecholamines (epinephrine and norepinephrine)



**Pineal gland**

**Hypothalamus**

**Pituitary gland**

**Thyroid gland**

**Parathyroid glands**

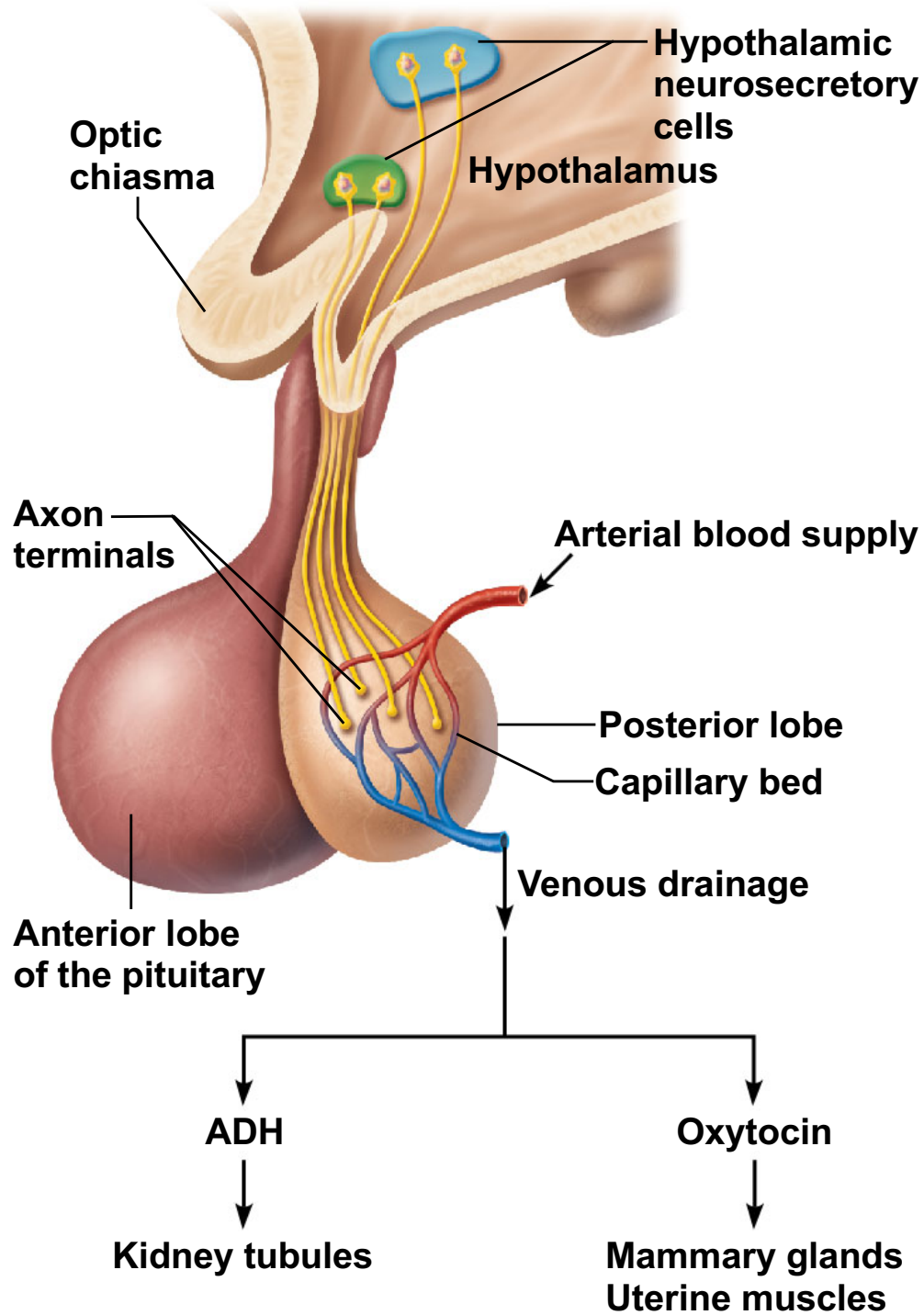
**Thymus**

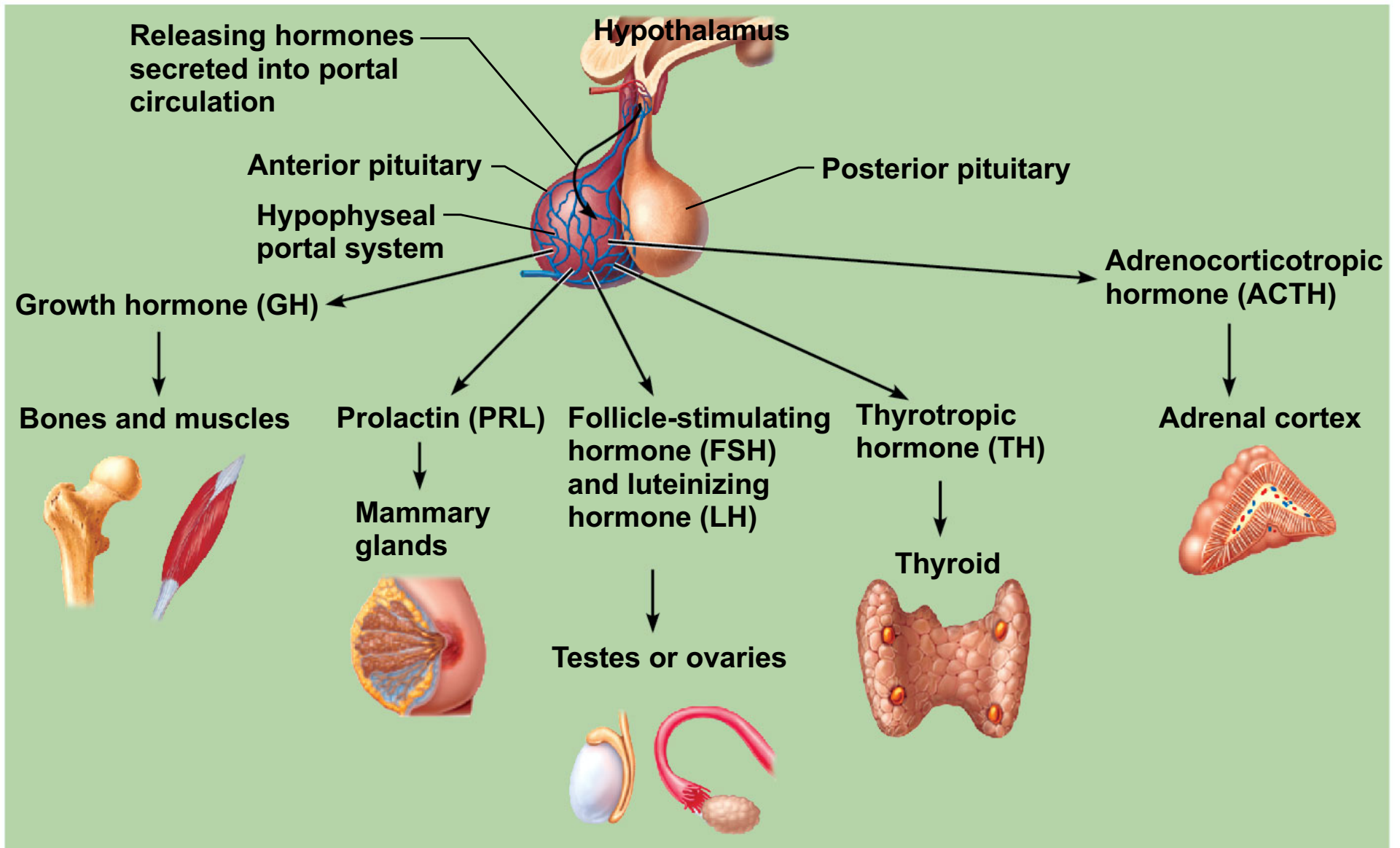
**Adrenal glands**

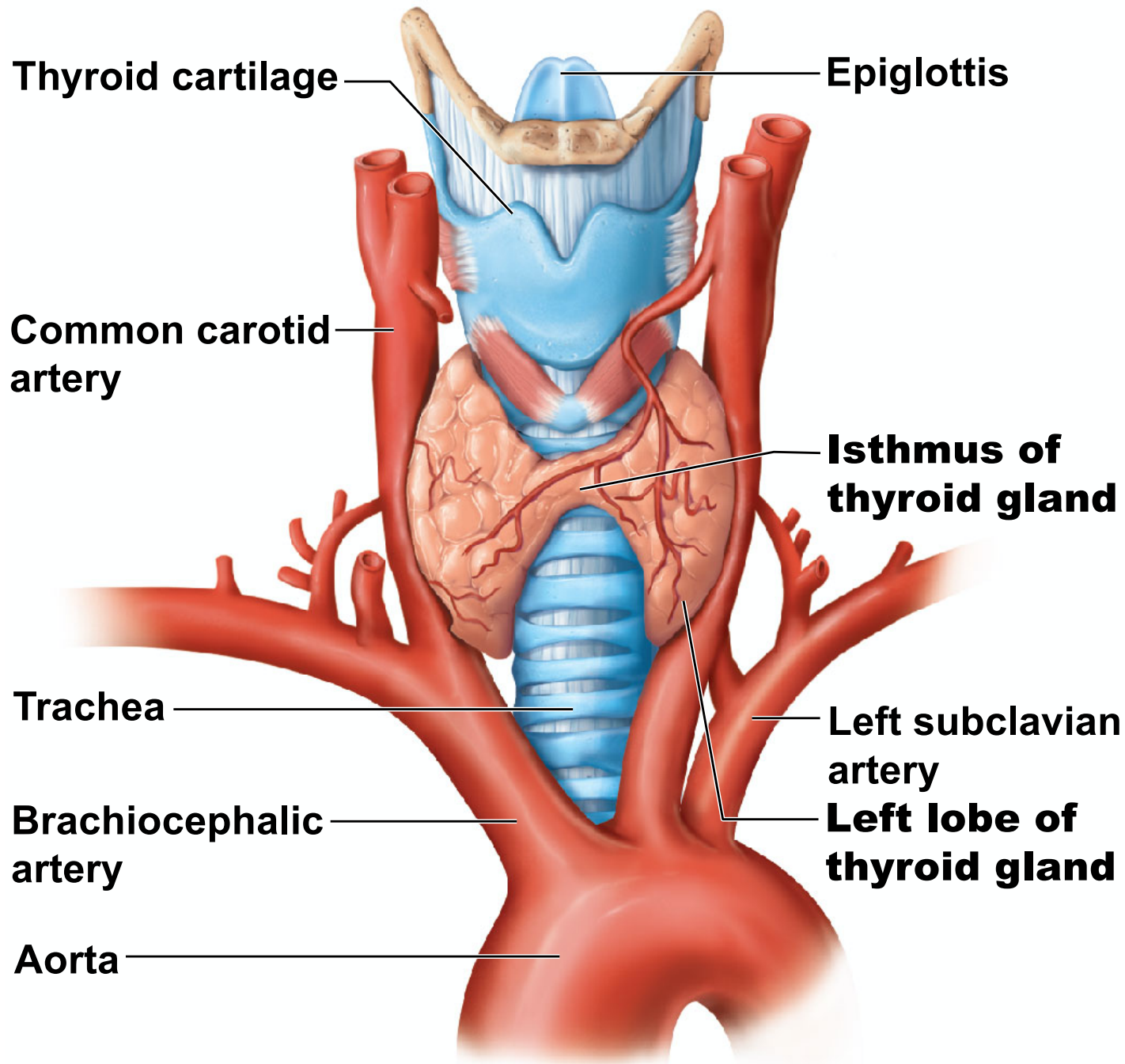
**Pancreas**

**Ovary (female)**

**Testis (male)**





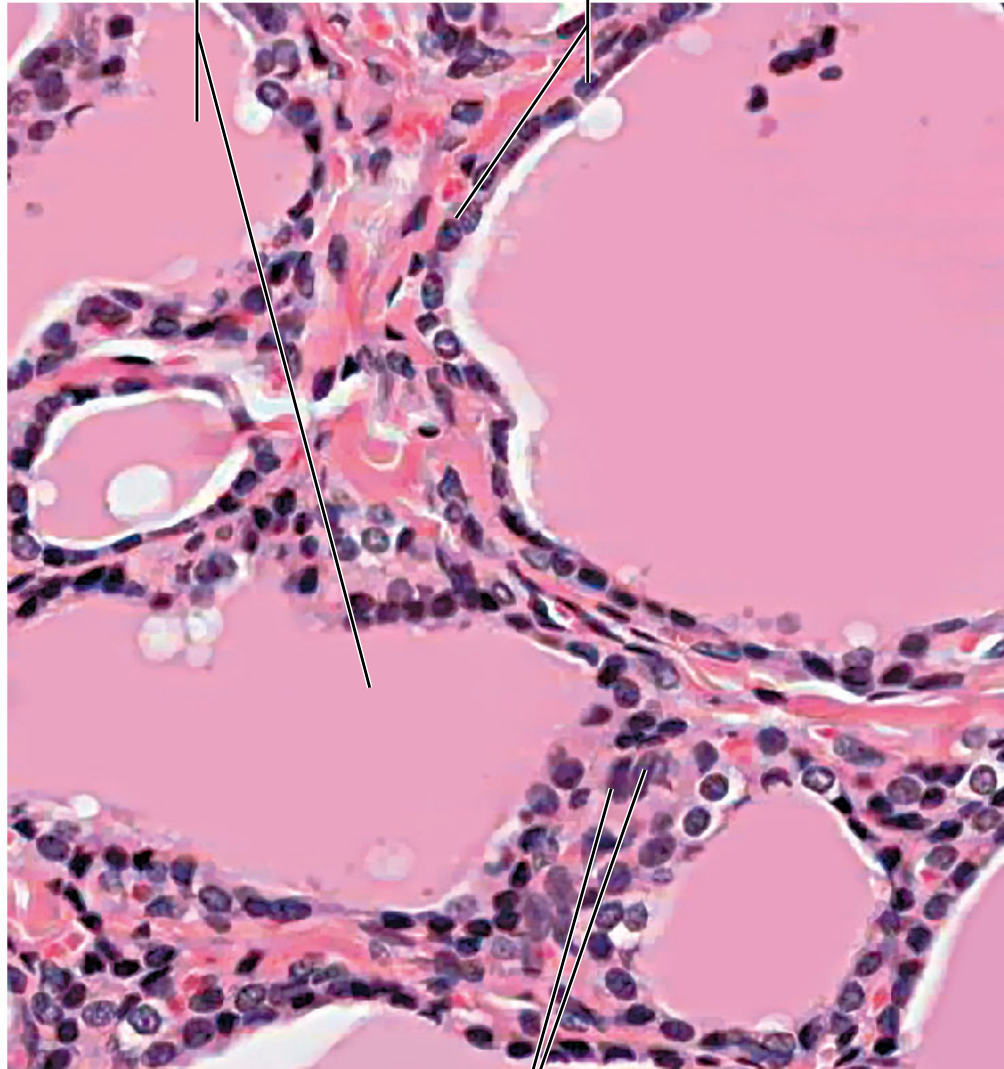


**(a) Gross anatomy of the thyroid gland, anterior view**



**Colloid-filled  
follicles**

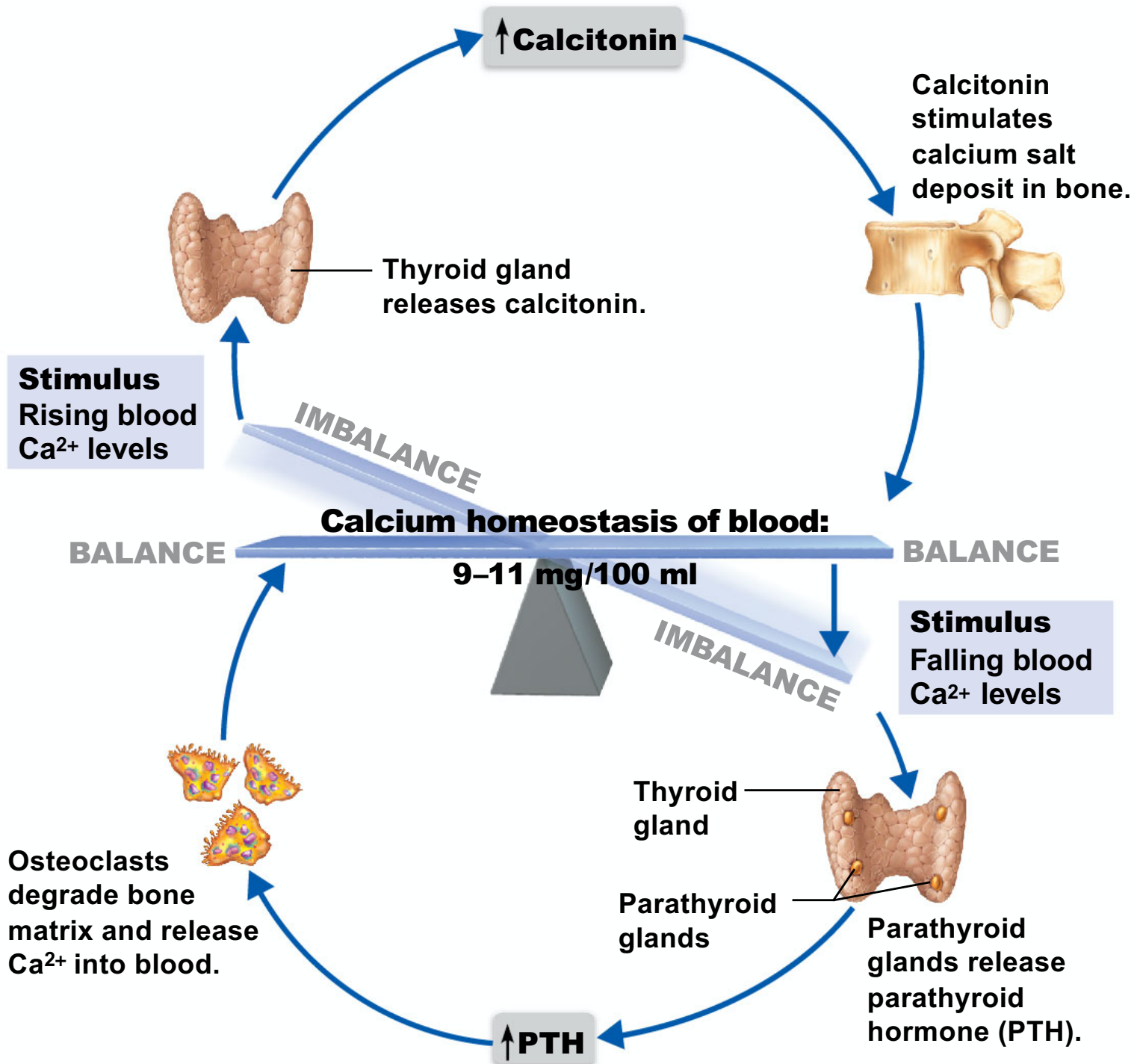
**Follicle cells**

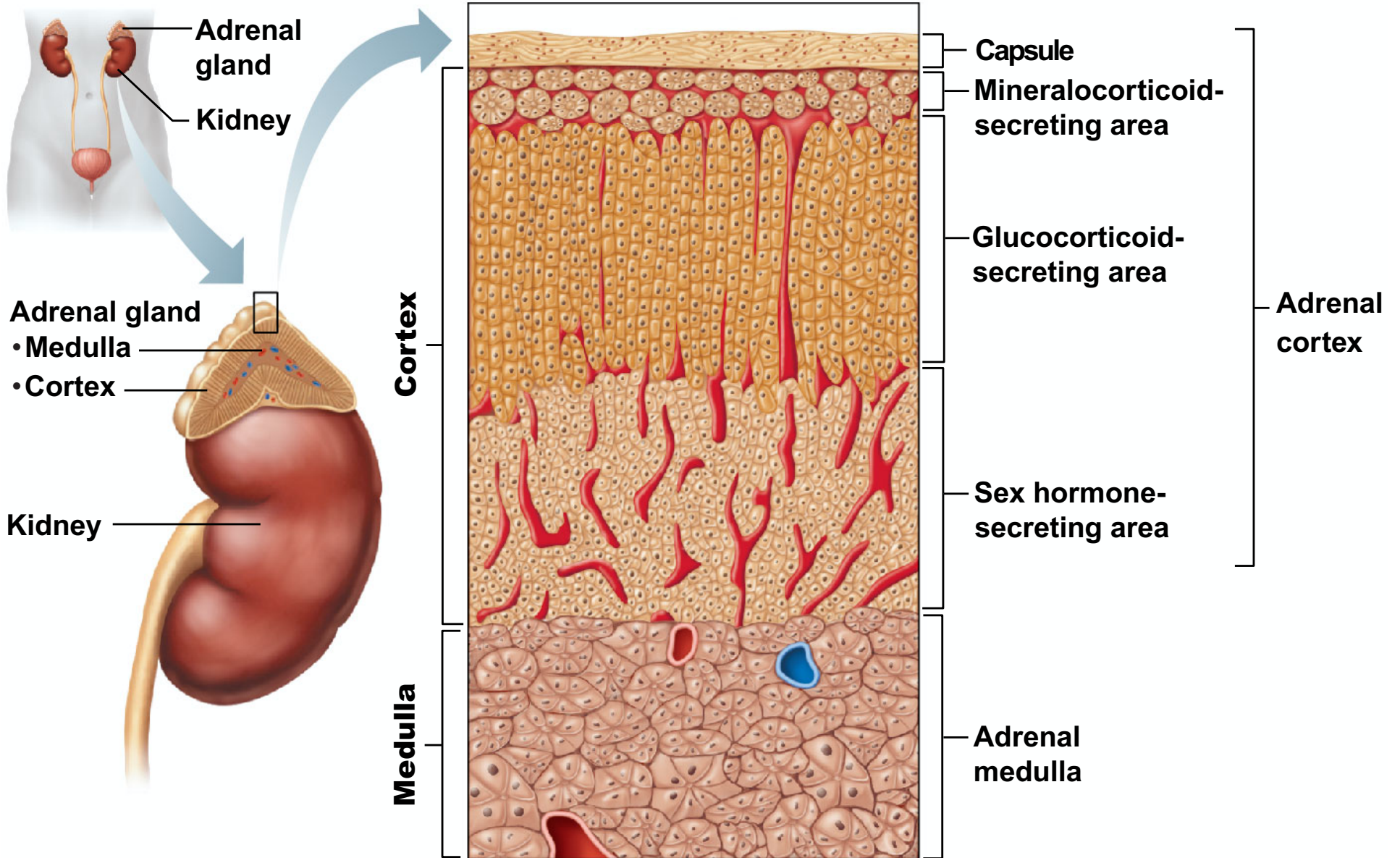


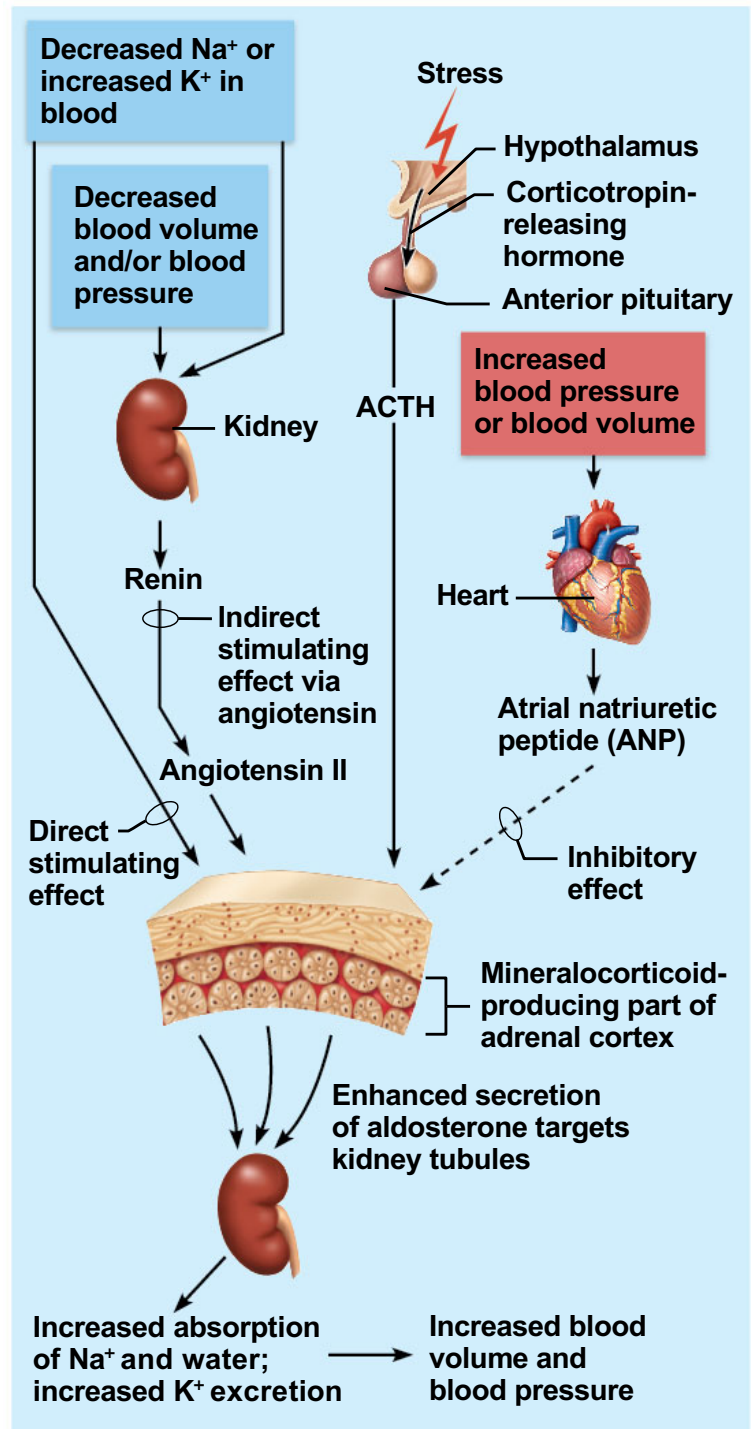
**Parafollicular cells**

**(b) Photomicrograph of thyroid gland  
follicles (380x)**



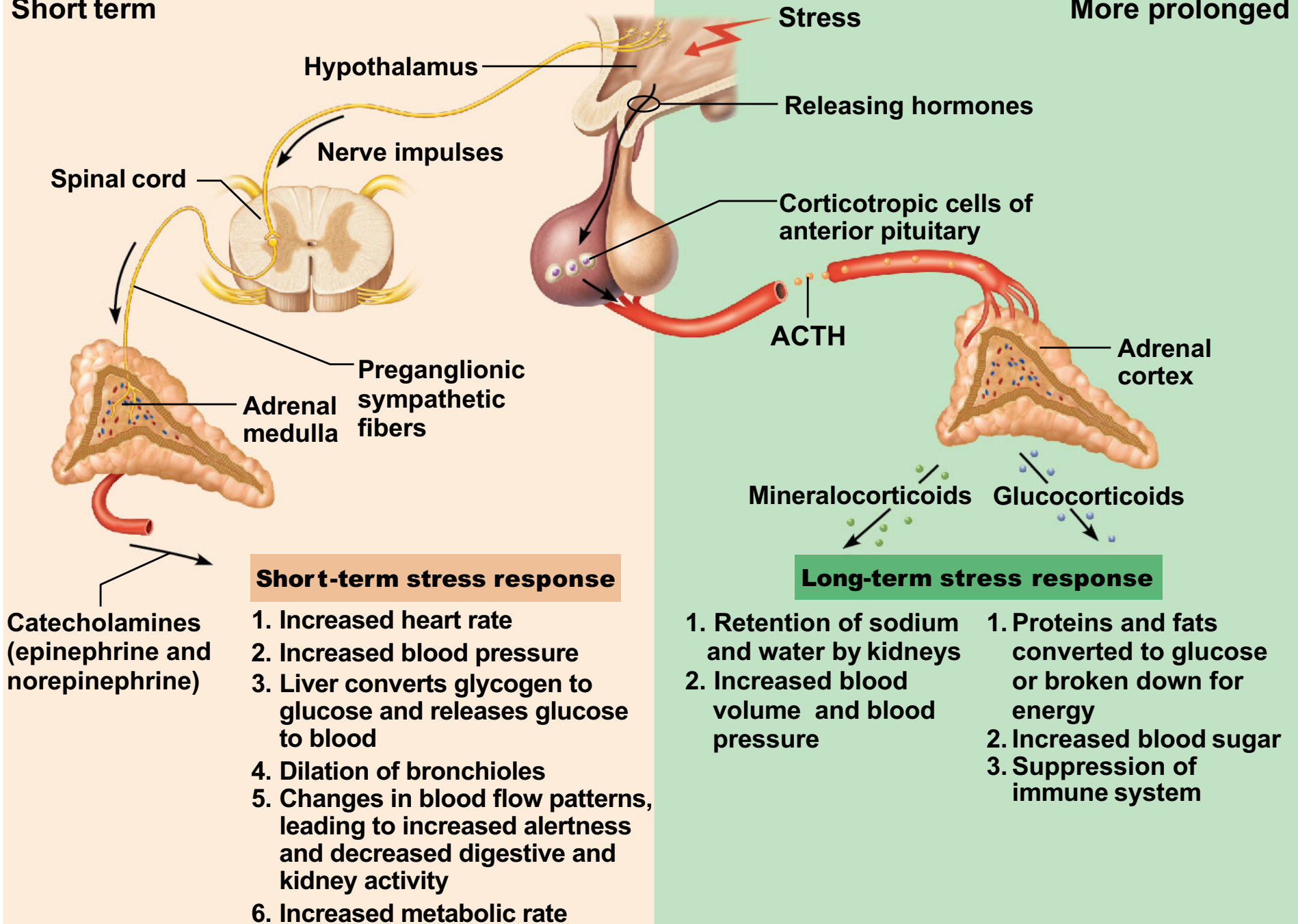


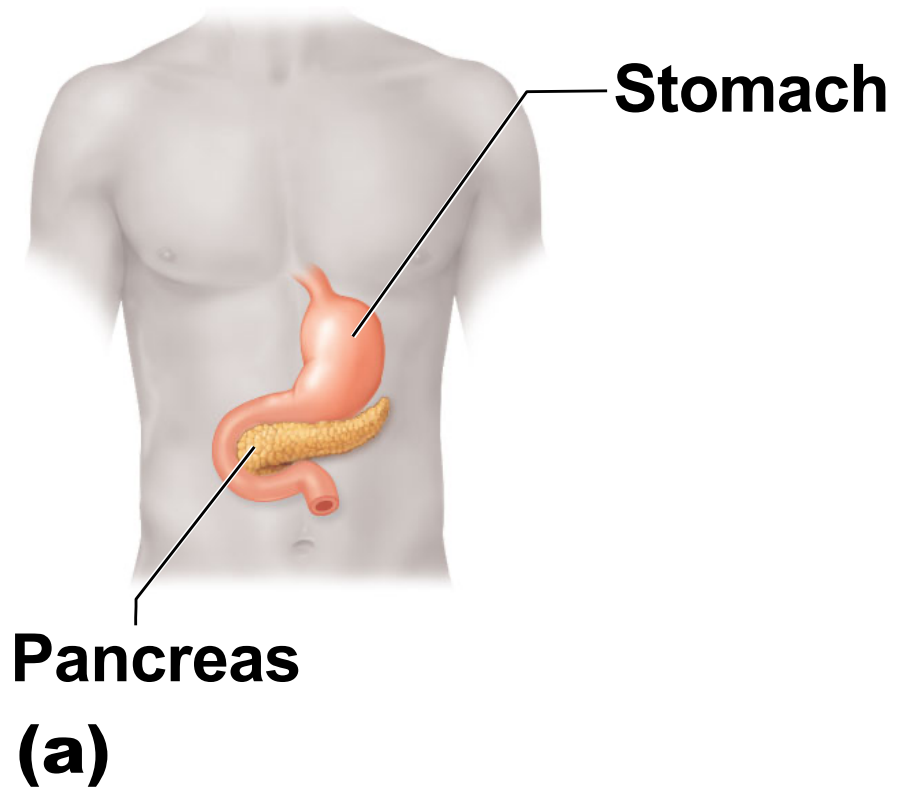




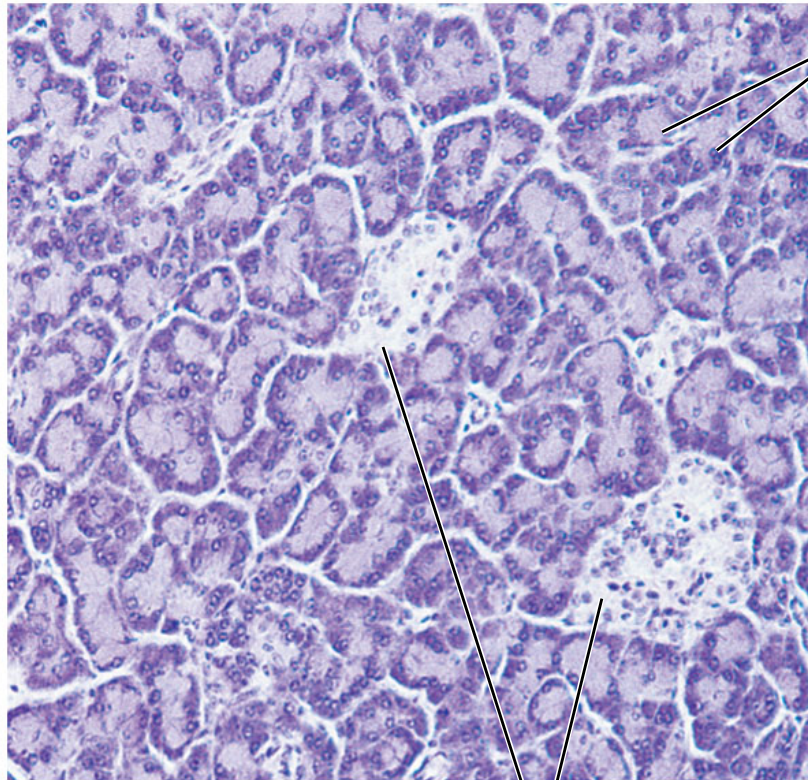
## Short term

## More prolonged







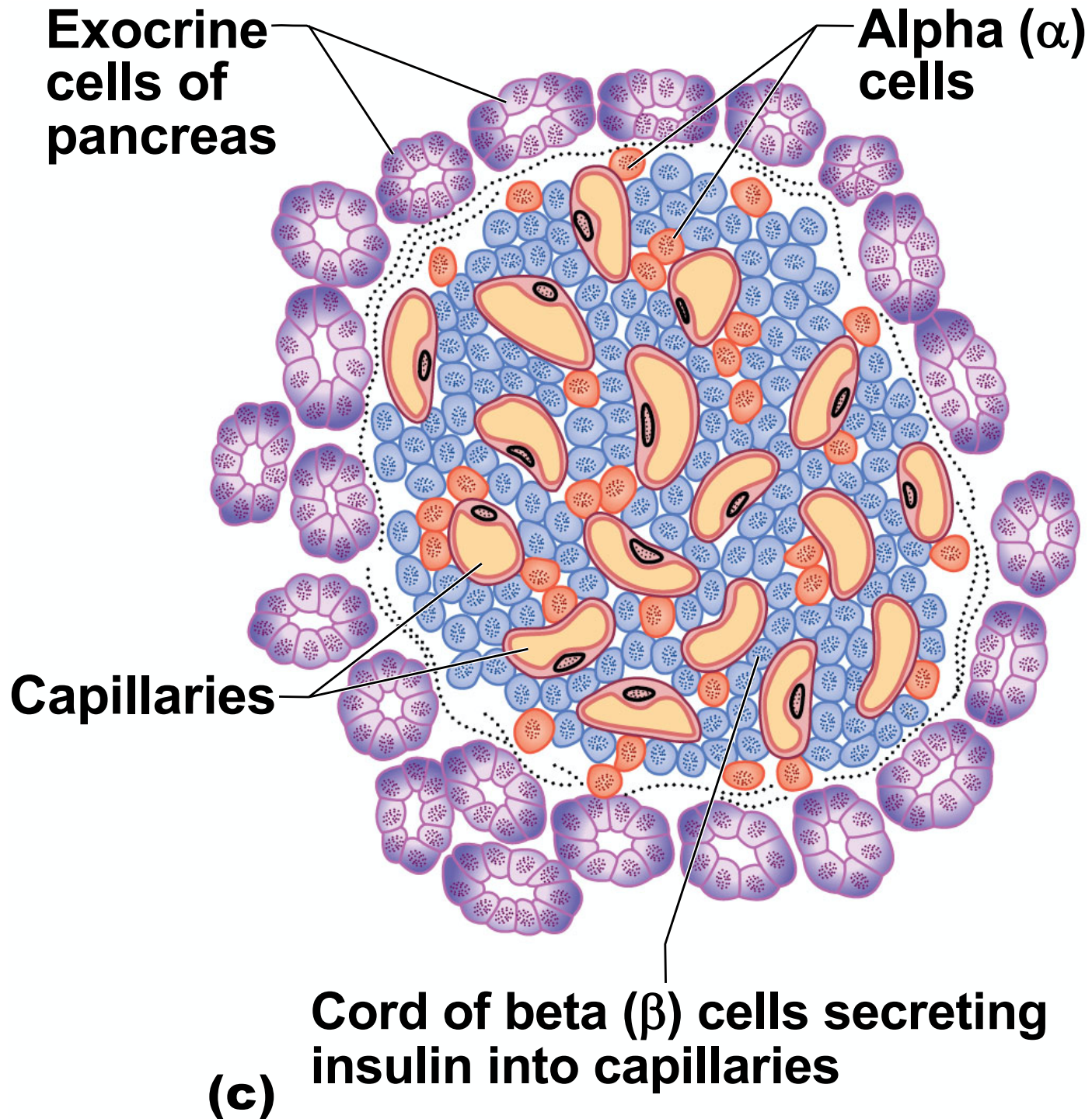


**Exocrine  
cells of  
pancreas**

**Pancreatic  
islets**

**(b)**





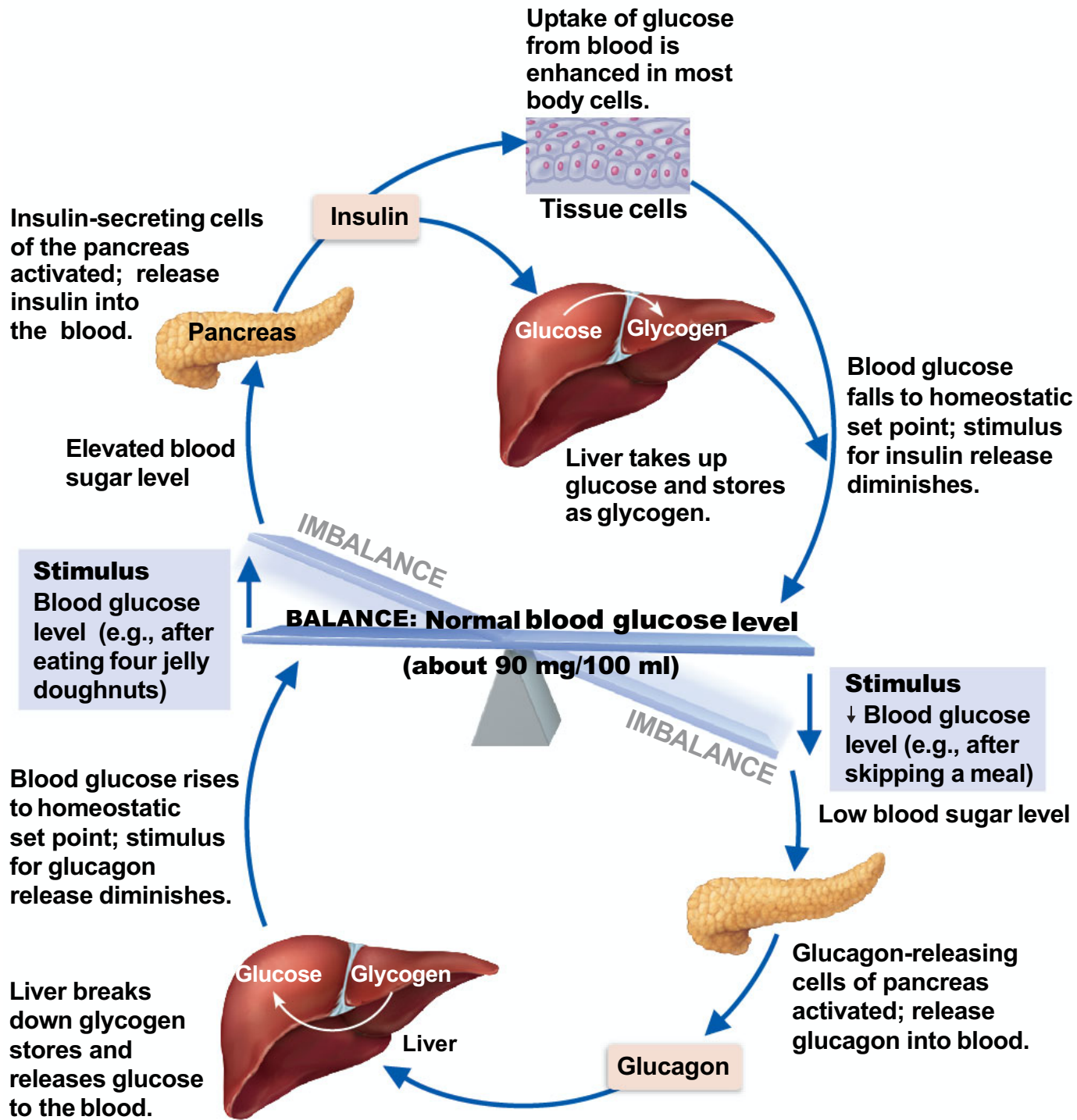








Table 9.1 Major Endocrine Glands and Some of Their Hormones

Gland	Hormone	Chemical class*	Major actions	Regulated by	
Hypothalamus			Hormones released by the posterior pituitary; releasing and inhibiting hormones that regulate the anterior pituitary (see below)		
Pituitary gland					
<ul style="list-style-type: none"> <li>Posterior lobe (releases hormones made by the hypothalamus)</li> </ul>		Oxytocin	Peptide	Stimulates contraction of uterus and the milk "let-down" reflex	Nervous system (hypothalamus), in response to uterine stretching and/or suckling of a baby
		Antidiuretic hormone (ADH)	Peptide	Promotes retention of water by kidneys	Hypothalamus, in response to water/salt imbalance
<ul style="list-style-type: none"> <li>Anterior lobe</li> </ul>		Growth hormone (GH)	Protein	Stimulates growth (especially of bones and muscles) and metabolism	Hypothalamic releasing and inhibiting hormones
		Prolactin (PRL)	Protein	Stimulates milk production	Hypothalamic hormones
		Follicle-stimulating hormone (FSH)	Protein	Stimulates production of ova and sperm	Hypothalamic hormones
		Luteinizing hormone (LH)	Protein	Stimulates ovaries and testes	Hypothalamic hormones
		Thyroid-stimulating hormone (TSH)	Protein	Stimulates thyroid gland	Thyroxine in blood; hypothalamic hormones
		Adrenocorticotropic hormone (ACTH)	Protein	Stimulates adrenal cortex to secrete glucocorticoids	Glucocorticoids; hypothalamic hormones

\* Any class not indicated as steroid is amino acid based.


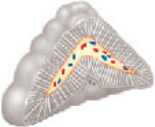
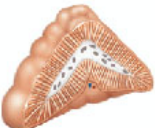
**Table 9.1 Major Endocrine Glands and Some of Their Hormones** (continued)

Gland		Hormone	Chemical class*	Major actions	Regulated by
Pineal gland		Melatonin	Amine	Involved in biological rhythms (daily and seasonal)	Light/dark cycles
Thyroid gland		Thyroxine (T <sub>4</sub> ) and triiodothyronine (T <sub>3</sub> )	Amine	Stimulates metabolism	TSH
		Calcitonin	Peptide	Reduces blood calcium ion level	Calcium ion level in blood
Parathyroid glands		Parathyroid hormone (PTH)	Peptide	Raises blood calcium ion level	Calcium ion level in blood

\* Any class not indicated as steroid is amino acid based.






Table 9.1 Major Endocrine Glands and Some of Their Hormones (continued)

Gland		Hormone	Chemical class*	Major actions	Regulated by
Thymus		Thymosin	Peptide	"Programs" T lymphocytes	Not known
Adrenal glands					
• Adrenal medulla		Epinephrine and norepinephrine	Amines	Raise blood glucose level; increase rate of metabolism; constrict certain blood vessels	Nervous system (sympathetic division)
• Adrenal cortex		Glucocorticoids	Steroids	Increase blood glucose level	ACTH
		Mineralocorticoids	Steroids	Promote reabsorption of Na <sup>+</sup> and excretion of K <sup>+</sup> (potassium) in kidneys	Changes in blood volume or blood pressure; K <sup>+</sup> or Na <sup>+</sup> level in blood
		Androgens and estrogens (see entry under gonads)			

\* Any class not indicated as steroid is amino acid based.

Table 9.1 Major Endocrine Glands and Some of Their Hormones (continued)

Gland		Hormone	Chemical class*	Major actions	Regulated by
Pancreas		Insulin	Protein	Reduces blood glucose level	Glucose level in blood
		Glucagon	Protein	Raises blood glucose level	Glucose level in blood
Gonads					
• Testes		Androgens	Steroids	Support sperm formation; development and maintenance of male secondary sex characteristics	FSH and LH
		• Ovaries		Estrogens	Steroids
Progesterone	Steroids			Promotes growth of uterine lining	FSH and LH

\* Any class not indicated as steroid is amino acid based.