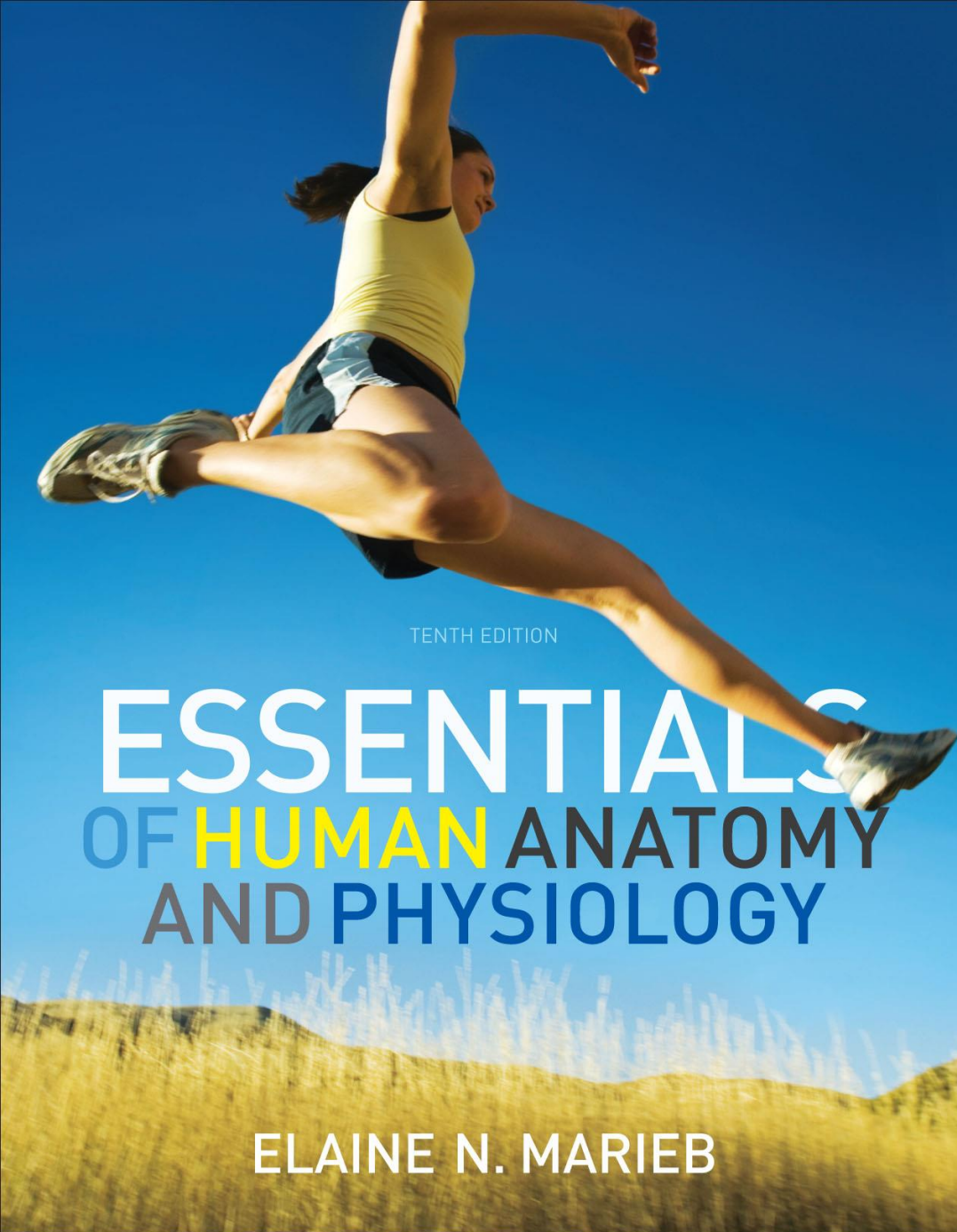


## PowerPoint® Lecture Slides

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Florence-Darlington Technical College

# CHAPTER 9

## The Endocrine System



TENTH EDITION

# ESSENTIALS OF HUMAN ANATOMY AND PHYSIOLOGY

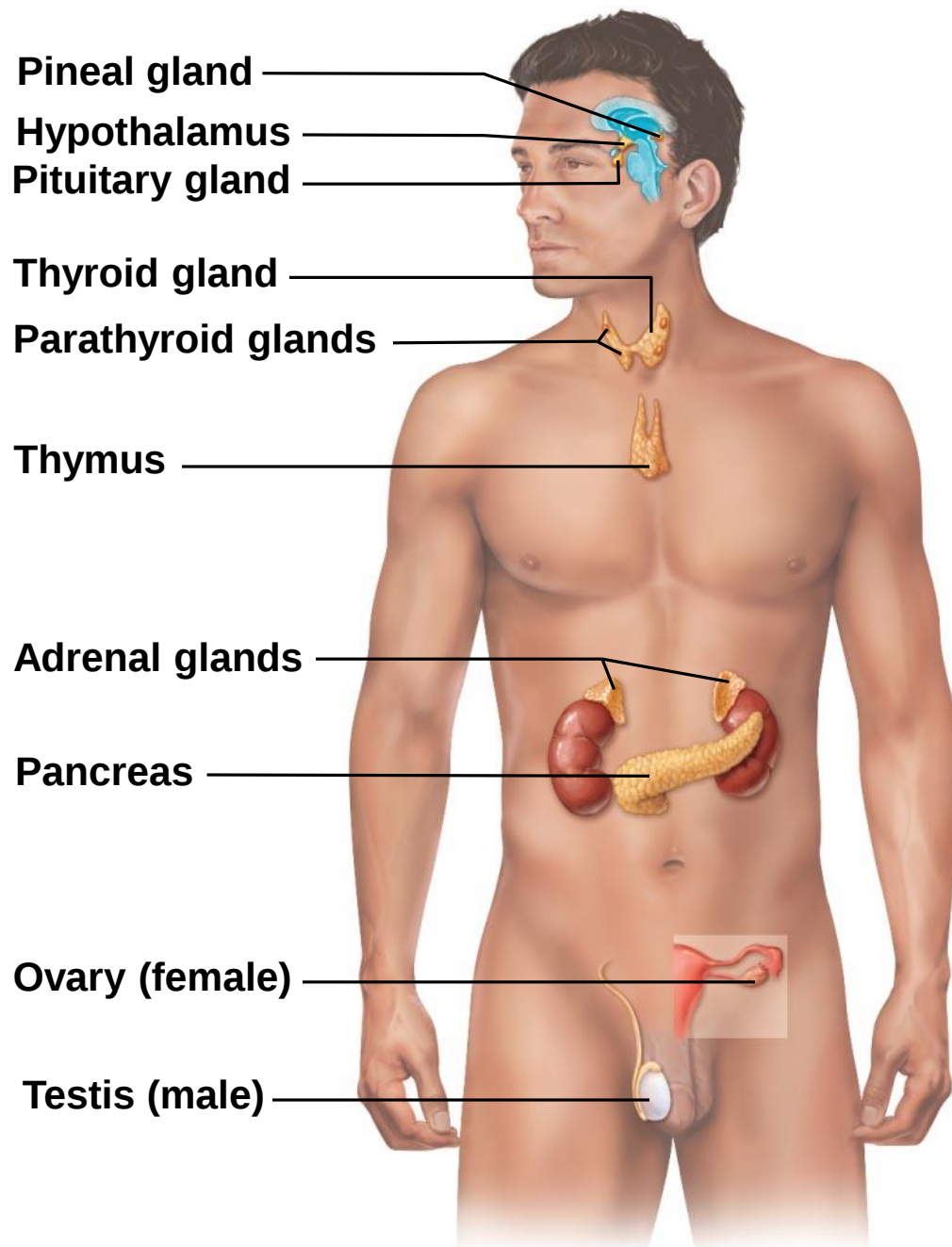
ELAINE N. MARIEB

# Endocrine System

- [https://www.youtube.com/watch?v=gjmS4\\_7kvDM](https://www.youtube.com/watch?v=gjmS4_7kvDM)

# Major Endocrine Organs

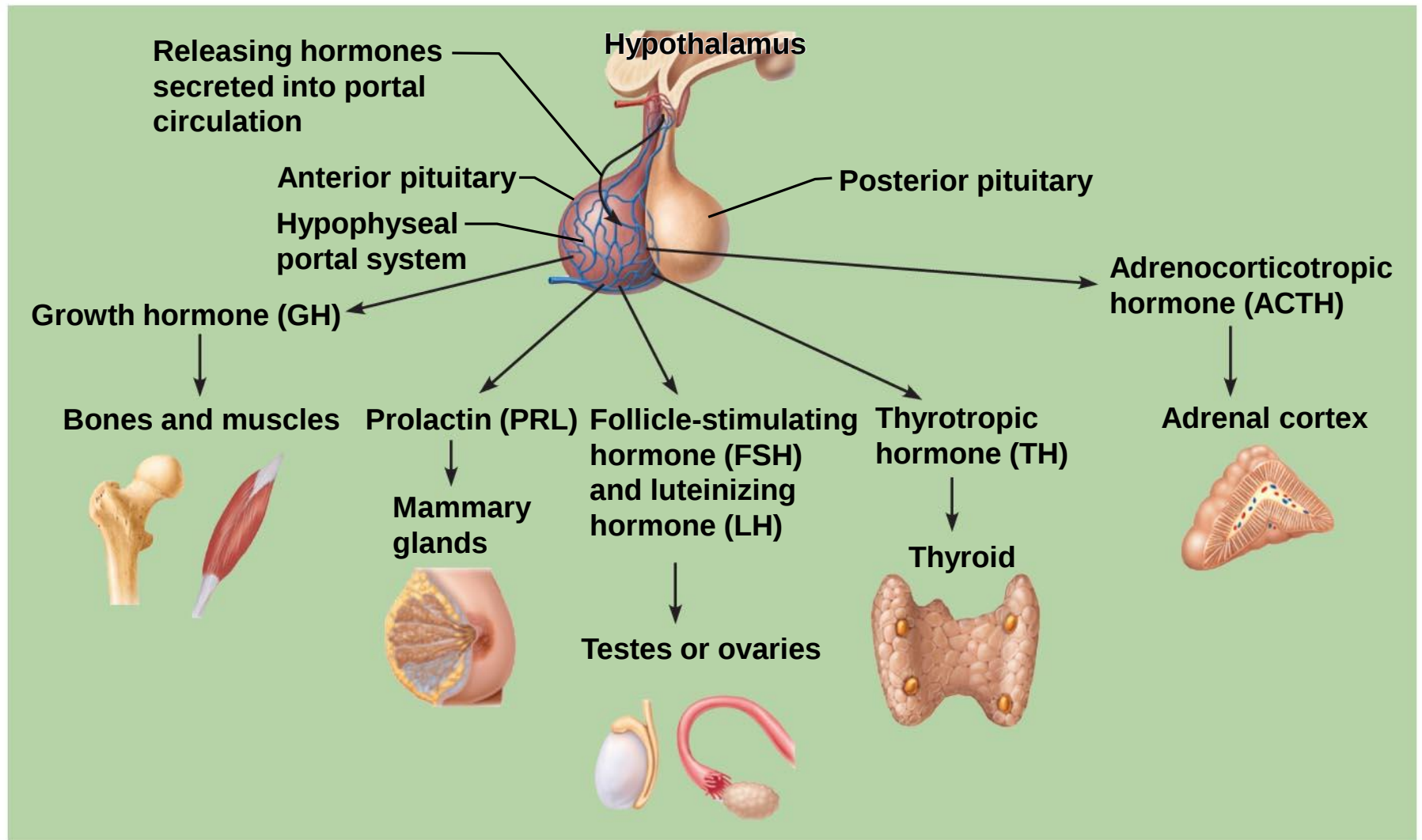
- 1. Pituitary gland
- 2. Hypothalamus
- 3. Thyroid gland
- 4. Parathyroid glands
- 5. Adrenal glands
- 6. Pineal gland
- 7. Thymus gland
- 8. Pancreas
- 9. Gonads (Ovaries and Testes)



**Figure 9.3**

# 1. Pituitary Gland

- Size of a pea
- Hangs by a stalk from the hypothalamus in the brain
- Protected by the sphenoid bone
- Has two functional lobes
  - Anterior pituitary — glandular tissue
  - Posterior pituitary — nervous tissue
- Often called the “master endocrine gland”



**Figure 9.4**

# Hormones of the Anterior Pituitary

- (1)Growth hormone (GH)

- General metabolic hormone
- Major effects are directed to growth of skeletal muscles and long bones
- Plays a role in determining final body size
- Causes amino acids to be built into proteins
- Causes fats to be broken down for a source of energy

# Hormones of the Anterior Pituitary

- Growth hormone (GH) disorders
  - Pituitary dwarfism results from hyposecretion of GH during childhood
  - Gigantism results from hypersecretion of GH during childhood
  - Acromegaly results from hypersecretion of GH during adulthood

Pituitary dwarf (left), Giant (center), Normal height woman (right)



**Figure 9.5**

# Hormones of the Anterior Pituitary

- (2) Prolactin (PRL)

- Stimulates and maintains milk production following childbirth
- Function in males is unknown

- (3) Adrenocorticotrophic hormone (ACTH)

- Regulates endocrine activity of the adrenal cortex

- (4) Thyroid-stimulating hormone (TSH)

- Influences growth and activity of the thyroid gland

# Hormones of the Anterior Pituitary

- **Gonadotropic** hormones
  - Regulate hormonal activity of the gonads
- **(5) Follicle-stimulating hormone (FSH)**
  - Stimulates follicle development in ovaries
  - Stimulates sperm development in testes
- **(6) Luteinizing hormone (LH)**
  - Triggers ovulation of an egg in females
  - Stimulates testosterone production in males

## 2. Pituitary–Hypothalamus Relationship

- Hormonal release is regulated by releasing and inhibiting hormones produced by the hypothalamus
- Hypothalamus produces **two** hormones
  - These hormones are transported to neurosecretory cells of the posterior pituitary
    - **Oxytocin**
    - **Antidiuretic hormone (ADH)**
  - The posterior pituitary is not strictly an endocrine gland, but does release hormones

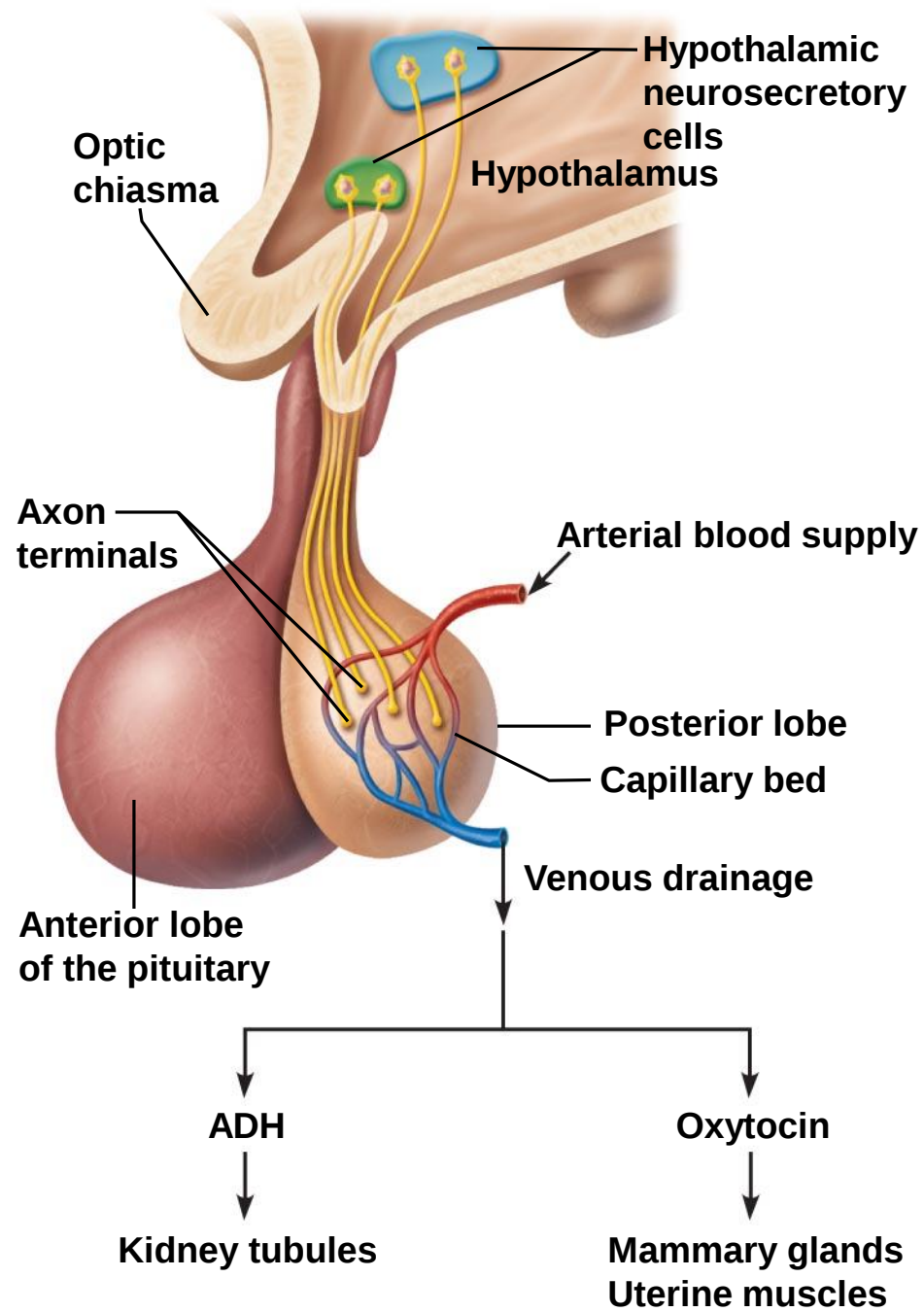
# Hormones of the Posterior Pituitary

- (1) Oxytocin

- Stimulates contractions of the uterus during labor, sexual relations, and breastfeeding
- Causes milk ejection in a nursing woman

# Hormones of the Posterior Pituitary

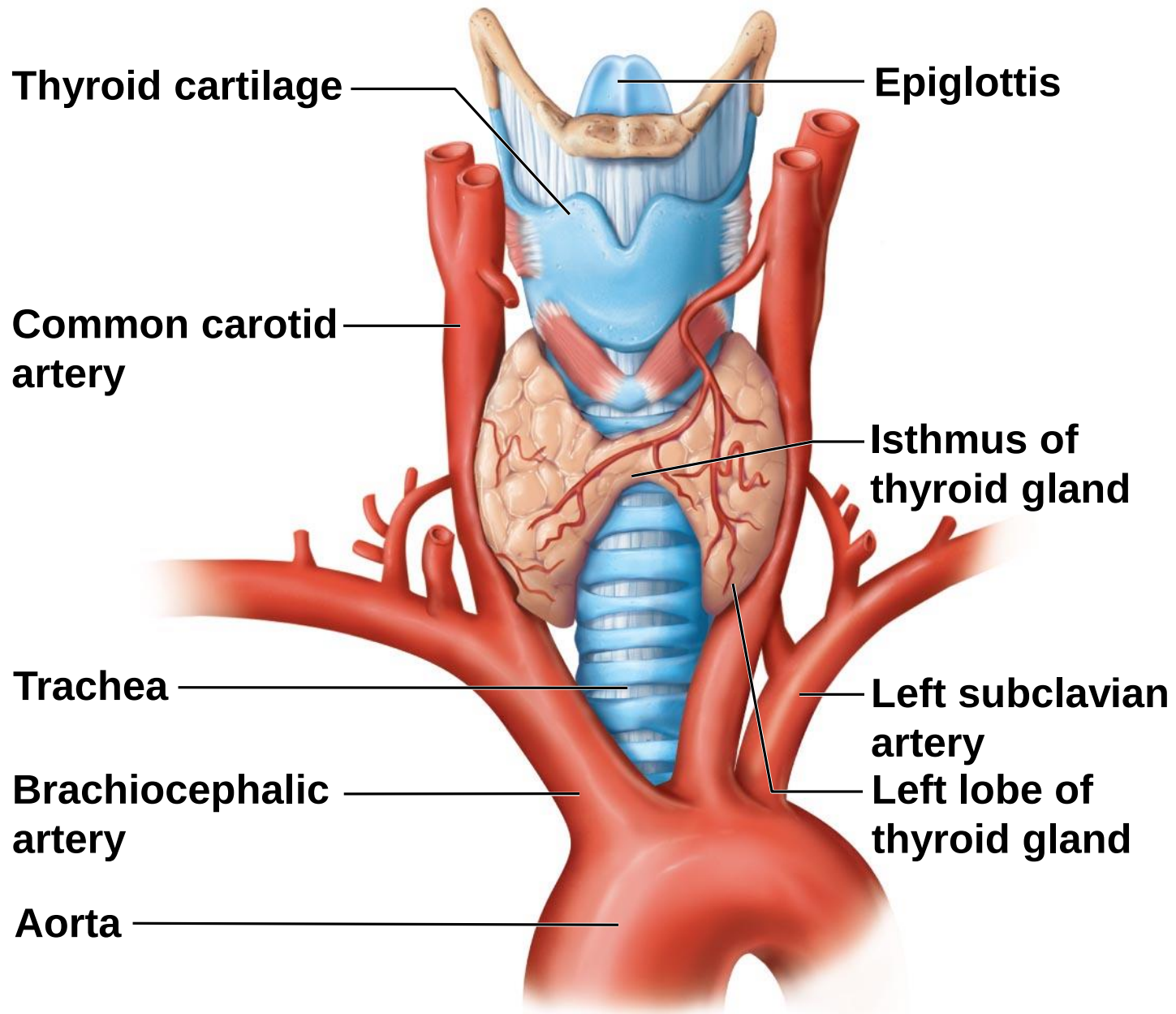
- (2) Antidiuretic hormone (ADH)
  - Inhibits urine production by promoting water reabsorption by the kidneys
    - Urine becomes more concentrated and has a deeper coloration
  - In large amounts, causes vasoconstriction leading to increased blood pressure
  - Also known as vasopressin



**Figure 9.6**

### 3. Thyroid Gland

- Found at the base of the throat
- Consists of two lobes and a connecting isthmus
- Produces **two** hormones:
  - **Thyroid hormone**
  - **Calcitonin**



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

**Figure 9.7a**

# Thyroid Gland

- (1) Thyroid hormone (TH)
  - Major metabolic hormone
  - Composed of two active iodine - containing hormones
    - Thyroxine ( $T_4$ ) — secreted by thyroid follicles
    - Triiodothyronine ( $T_3$ ) — conversion of  $T_4$  at target tissues



**(b) Photomicrograph of thyroid gland  
follicles (125×)**

**Figure 9.7b**

# Thyroid Gland

- Thyroid hormone disorders
  - Goiters
    - Thyroid gland enlarges due to lack of iodine
    - Salt is iodized to prevent goiters
  - Cretinism
    - Caused by **hyposecretion** of thyroxine
    - Results in dwarfism during childhood



**Figure 9.8**

# Thyroid Gland

- Thyroid hormone disorders (continued)
  - Myxedema
    - Caused by **hypothyroidism** in adults
    - Results in physical and mental sluggishness
  - Graves' disease
    - Caused by **hyperthyroidism**
    - Results in increased metabolism, heat intolerance, rapid heartbeat, weight loss, and exophthalmos



**Figure 9.9**

# Thyroid Gland

- (2) Calcitonin

- Decreases blood calcium levels by causing its deposition on bone
- Antagonistic to parathyroid hormone
- Produced by parafollicular cells
- Parafollicular cells are found between the follicles



**(b) Photomicrograph of thyroid gland  
follicles (125×)**

**Figure 9.7b**

## 4. Parathyroid Glands

- Tiny masses on the posterior of the thyroid
- Secrete (1) **parathyroid hormone (PTH)**
  - Stimulate osteoclasts to remove calcium from bone
  - Stimulate the kidneys and intestine to absorb more calcium
  - Raise calcium levels in the blood

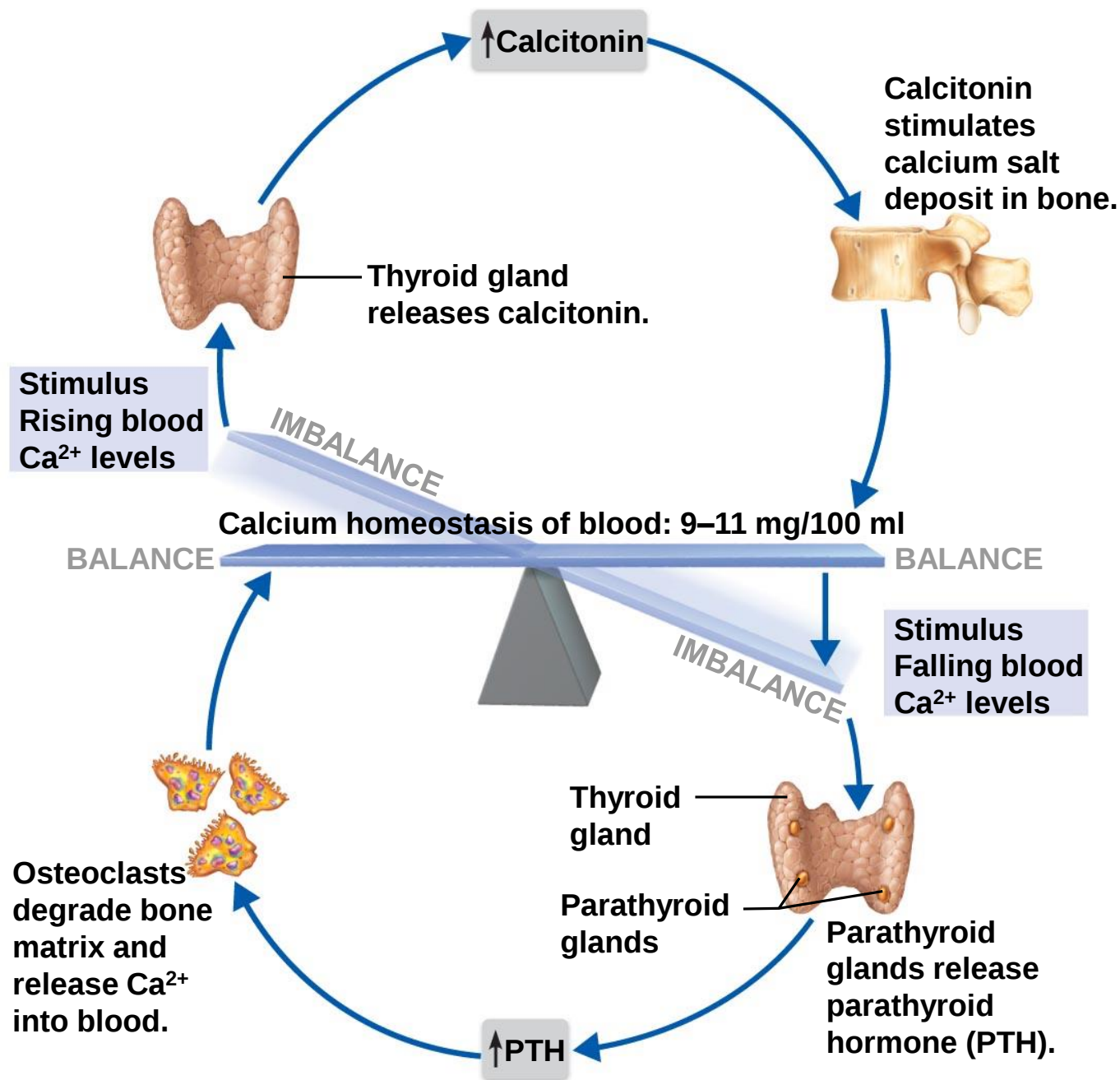
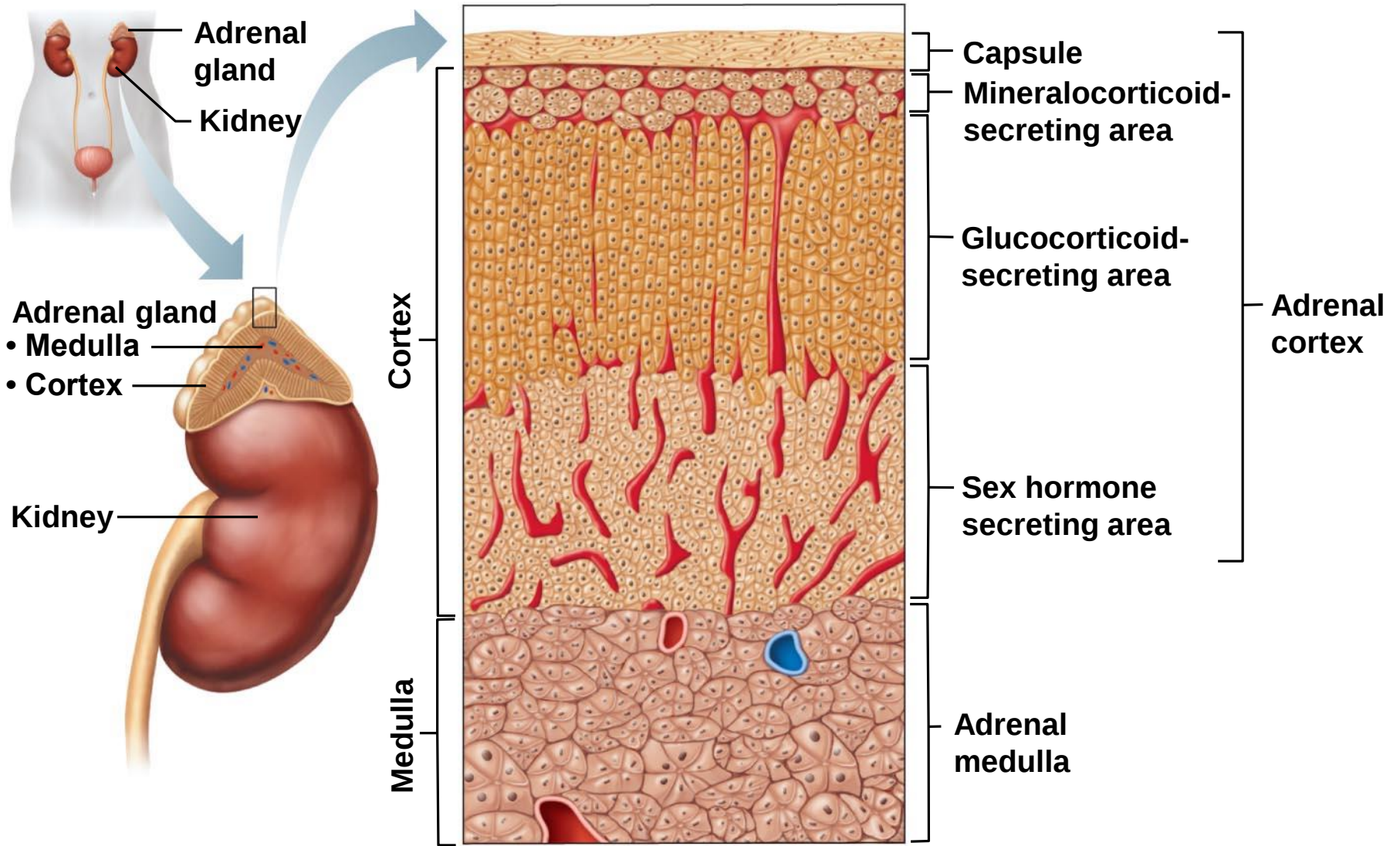


Figure 9.10

# 5. Adrenal Glands

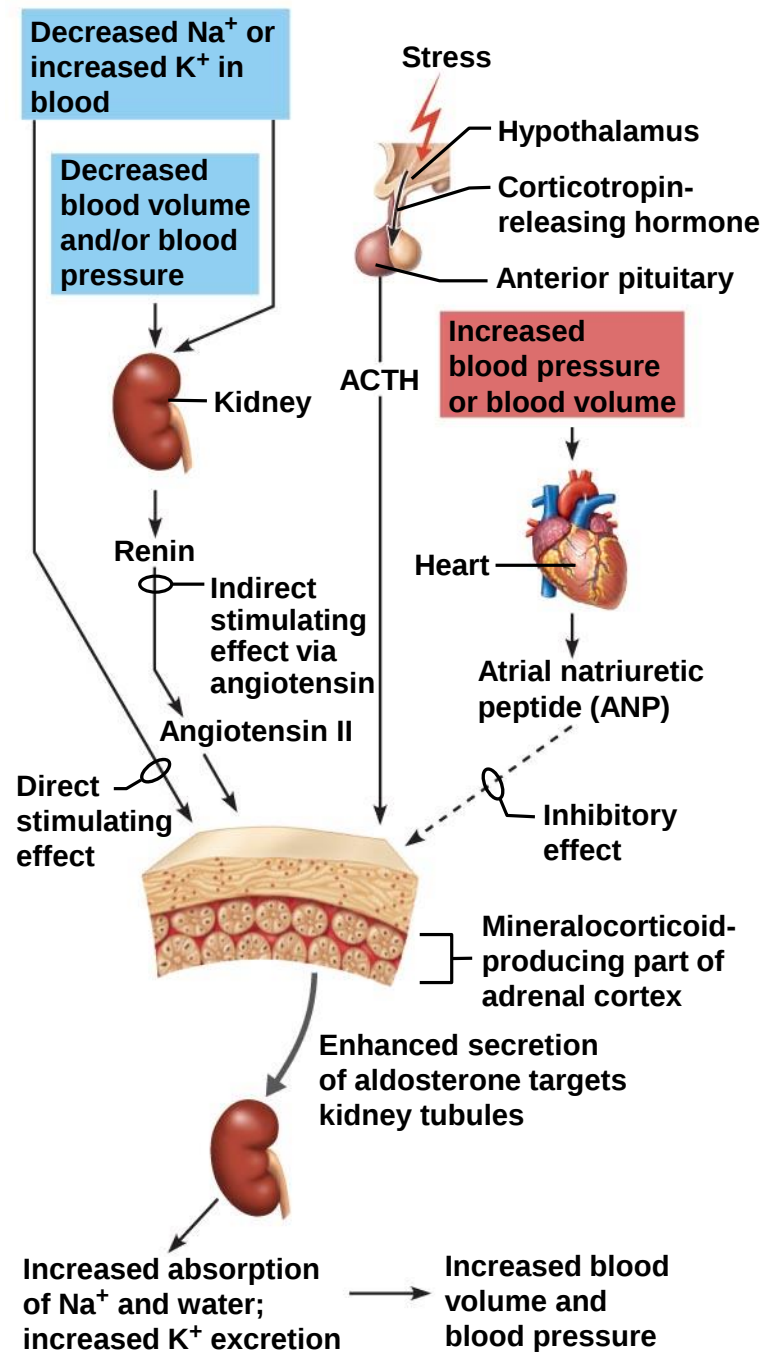
- Sit on top of the kidneys
- **Two** regions
  - **Adrenal cortex** — outer glandular region has three layers
    - Outermost: **Mineralocorticoids**
    - Middle: **Glucocorticoids**
    - Innermost: **Sex hormones**
  - **Adrenal medulla** — inner neural tissue region



**Figure 9.11**

# Hormones of the Adrenal Cortex

- (1) Mineralocorticoids (mainly aldosterone)
  - Produced in outer adrenal cortex
  - Regulate mineral content in blood
  - Regulate water and electrolyte balance
  - Target organ is the kidney
  - Production stimulated by renin and aldosterone
  - Production inhibited by atrial natriuretic peptide (ANP)

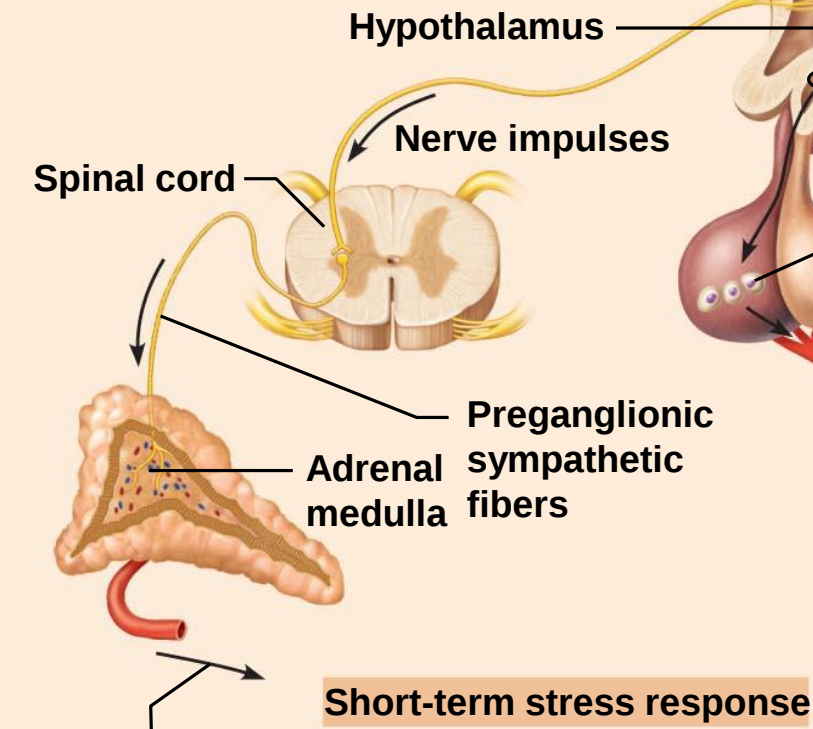


**Figure 9.12**

# Hormones of the Adrenal Cortex

- (2) Glucocorticoids (including cortisone and cortisol)
  - Produced in the middle layer of the adrenal cortex
  - Promote normal cell metabolism
  - Help resist long-term stressors
  - Released in response to increased blood levels of ACTH

## Short term

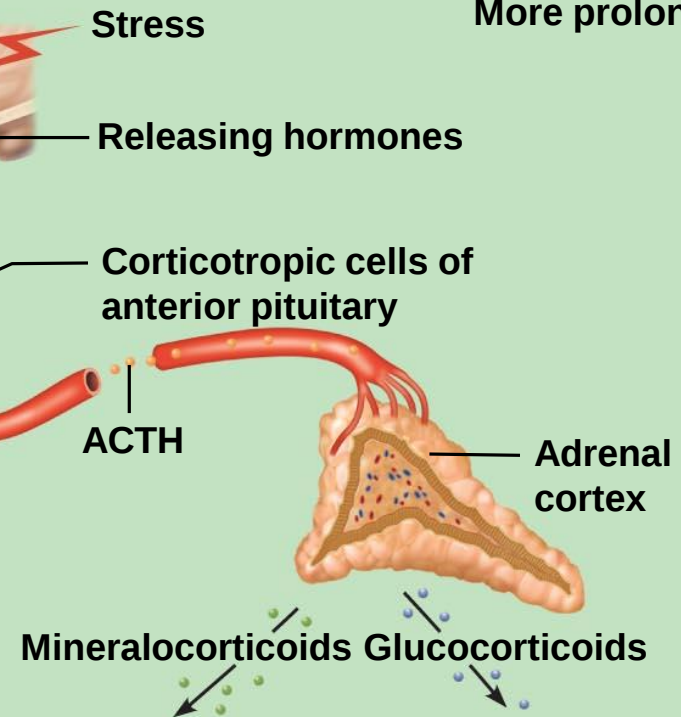


**Catecholamines  
(epinephrine and  
norepinephrine)**

### Short-term stress response

1. Increased heart rate
2. Increased blood pressure
3. Liver converts glycogen to glucose and releases glucose to blood
4. Dilation of bronchioles
5. Changes in blood flow patterns, leading to increased alertness and decreased digestive and kidney activity
6. Increased metabolic rate

## More prolonged



### Long-term stress response

- |                                              |                                                                     |
|----------------------------------------------|---------------------------------------------------------------------|
| 1. Retention of sodium and water by kidneys  | 1. Proteins and fats converted to glucose or broken down for energy |
| 2. Increased blood volume and blood pressure | 2. Increased blood sugar                                            |
|                                              | 3. Suppression of immune system                                     |

**Figure 9.13**

# Hormones of the Adrenal Cortex

- (3) Sex hormones

- Produced in the inner layer of the adrenal cortex
- Small amounts are made throughout life
- Mostly **androgens** (male sex hormones) are made but some **estrogens** (female sex hormones) are also formed

# Adrenal Glands

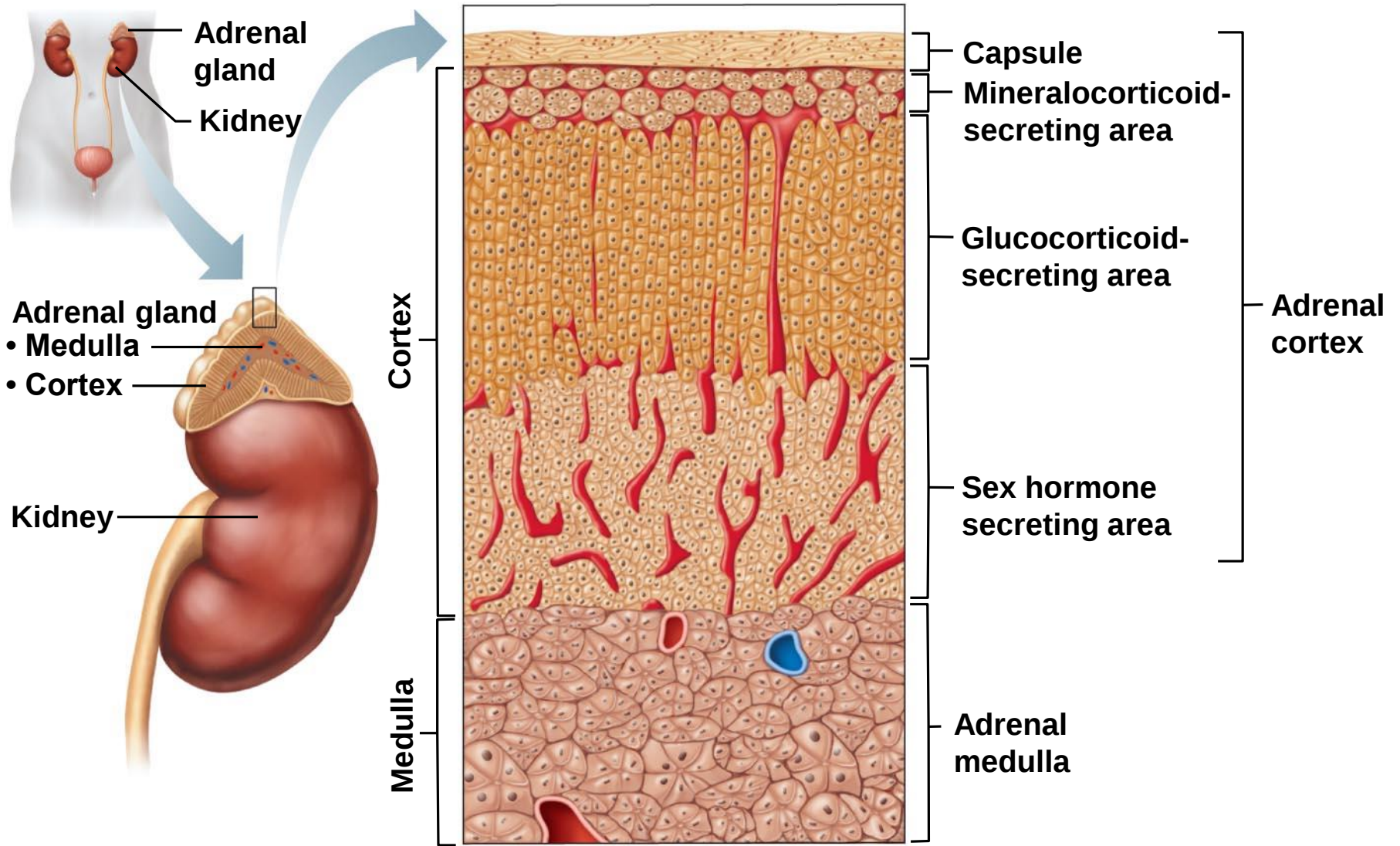
- Adrenal cortex disorders
  - Addison's disease
    - Results from **hyposecretion** of all adrenal cortex hormones
    - Bronze skin tone, muscles are weak, burnout, susceptibility to infection
  - Hyperaldosteronism
    - May result from an **ACTH-releasing tumor**
    - Excess water and sodium are retained leading to high blood pressure and edema

# Adrenal Glands

- Adrenal cortex disorders
  - Cushing's syndrome
    - Results from a **tumor in the middle cortical area of the adrenal cortex**
    - “Moon face,” “buffalo hump” on the upper back, high blood pressure, hyperglycemia, weakening of bones, depression
  - Masculinization
    - Results from **hypersecretion** of sex hormones
    - Beard and male distribution of hair growth

# Hormones of the Adrenal Medulla

- Produces two similar hormones (catecholamines)
  - Epinephrine (adrenaline)
  - Norepinephrine (noradrenaline)
- These hormones prepare the body to deal with short-term stress (“fight or flight”) by
  - Increasing heart rate, blood pressure, blood glucose levels
  - Dilating small passageways of lungs



**Figure 9.11**

## 6. Pineal Gland

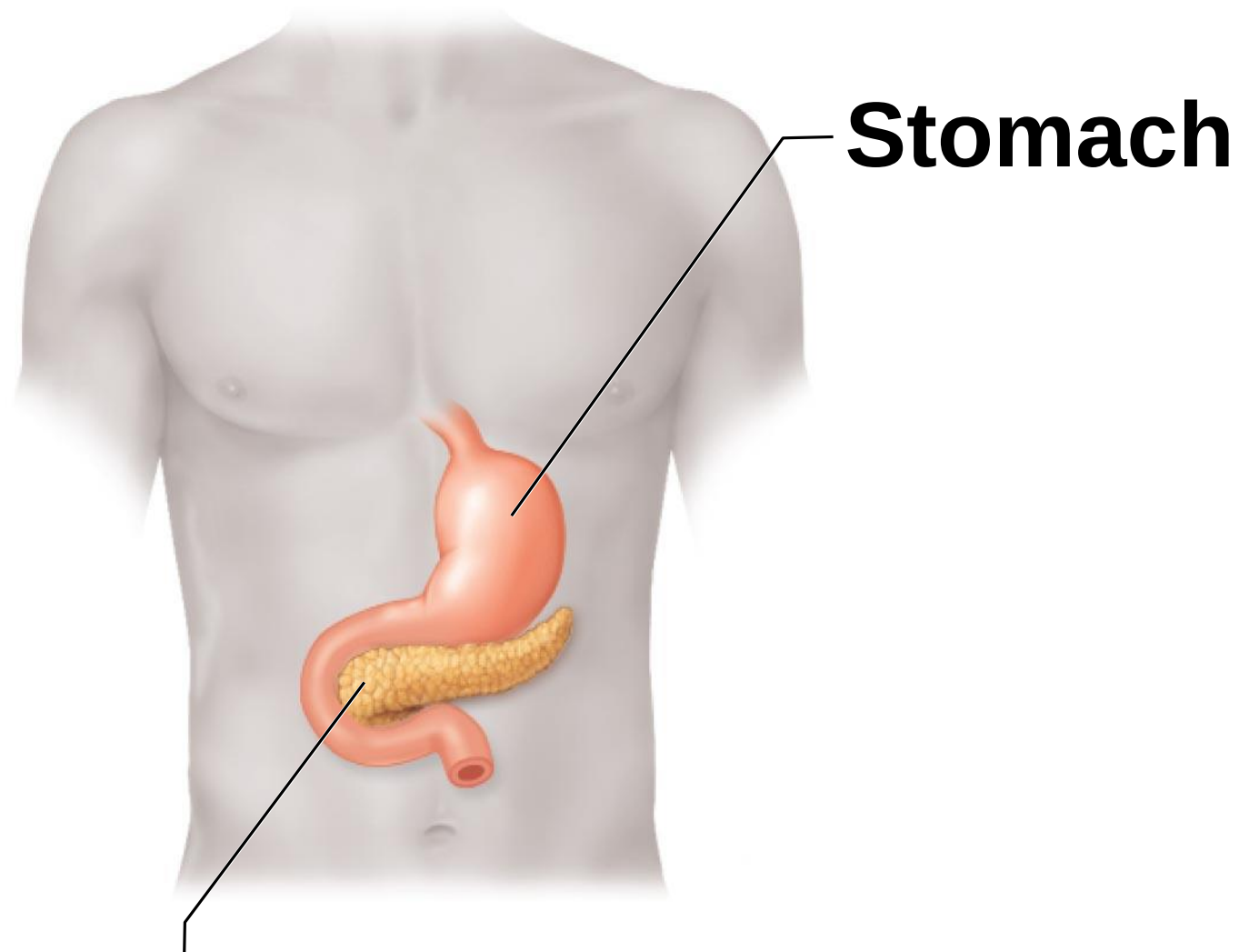
- Found on the third ventricle of the brain
- Secretes **melatonin**
  - Helps establish the body's wake and sleep cycles
  - Believed to coordinate the hormones of fertility in humans

## 7. Thymus Gland

- Located posterior to the sternum
- Largest in infants and children
- Produces **thymosin**
  - Matures some types of white blood cells
  - Important in developing the immune system

## 8. Pancreatic Islets

- The pancreas is a mixed gland and has both endocrine and exocrine functions
- The pancreatic islets produce hormones
  - **Insulin** — allows glucose to cross plasma membranes into cells from beta cells
  - **Glucagon** — allows glucose to enter the blood from alpha cells
- These hormones are antagonists that maintain blood sugar homeostasis

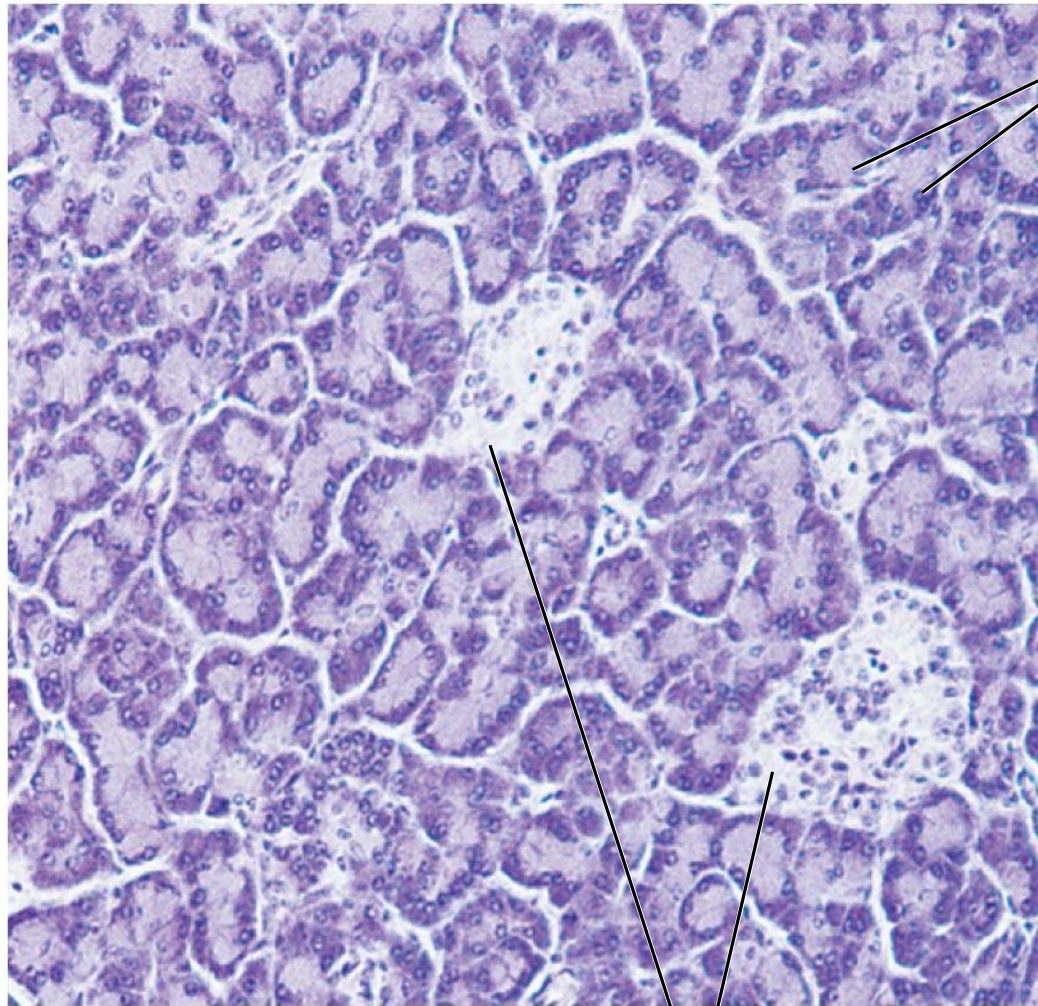


**Stomach**

**Pancreas**

**(a)**

**Figure 9.14a**

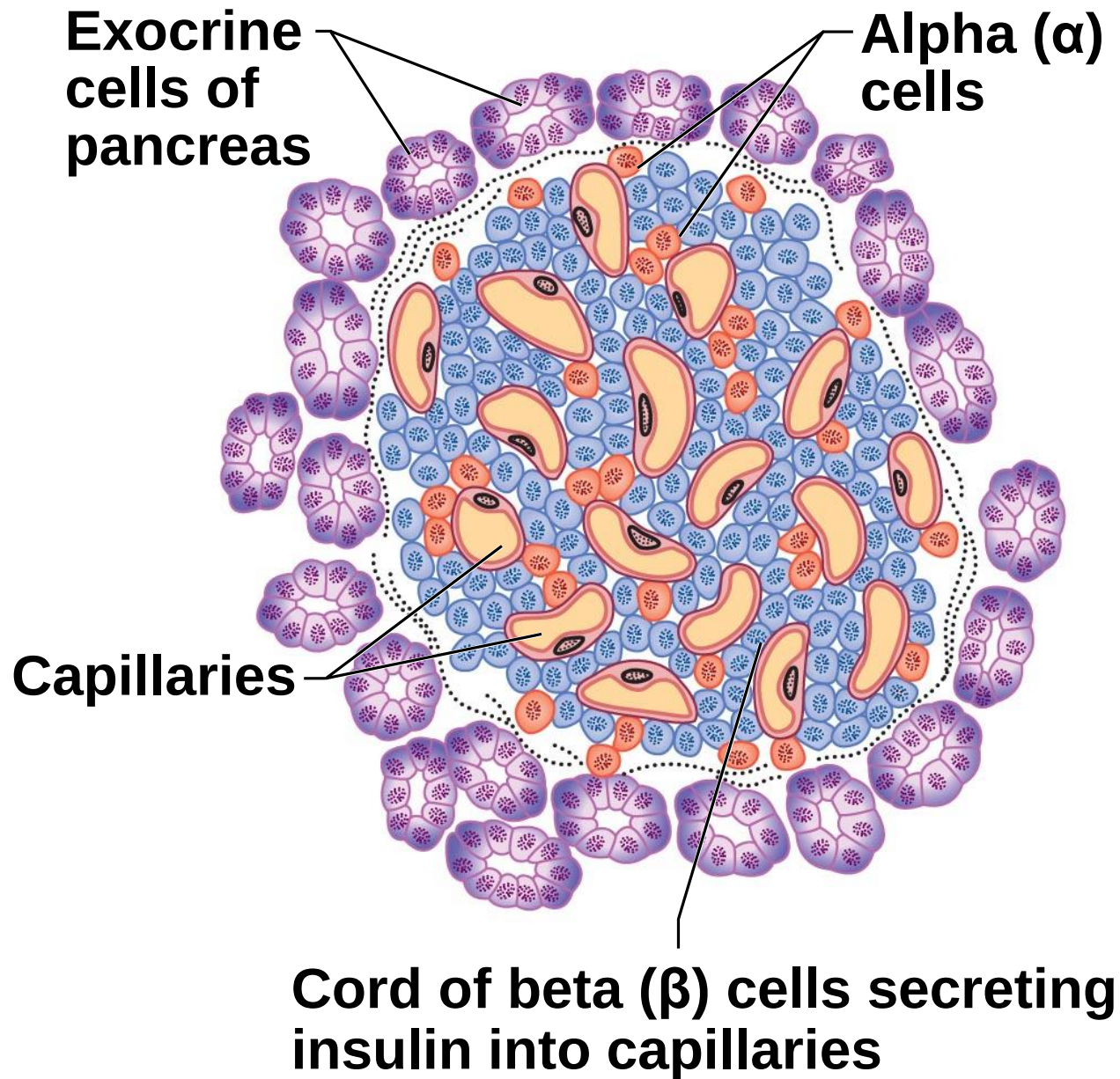


**Exocrine  
cells of  
pancreas**

**Pancreatic  
islets**

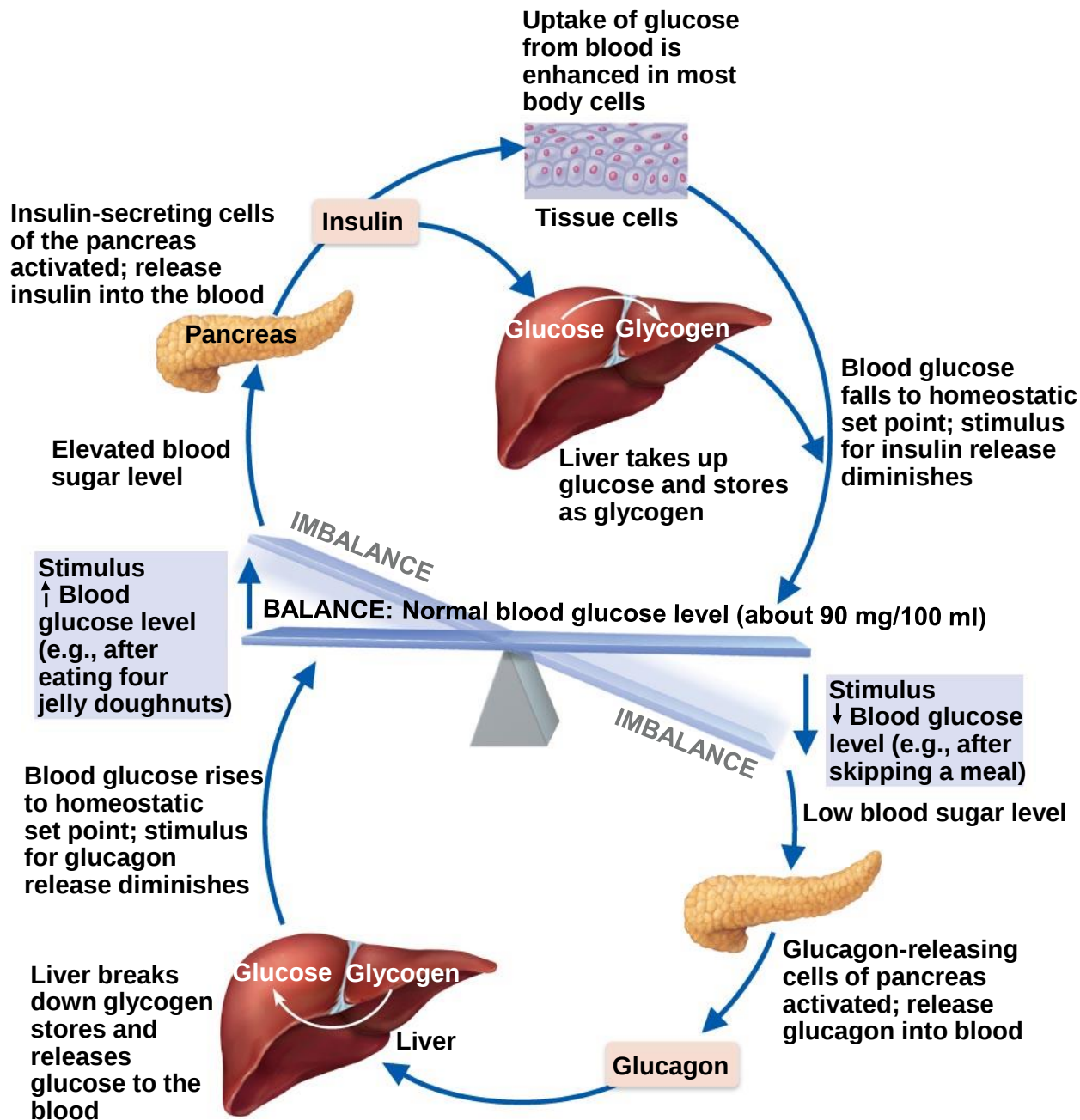
**(b)**

**Figure 9.14b**



**(c)**

**Figure 9.14c**



**Figure 9.15**

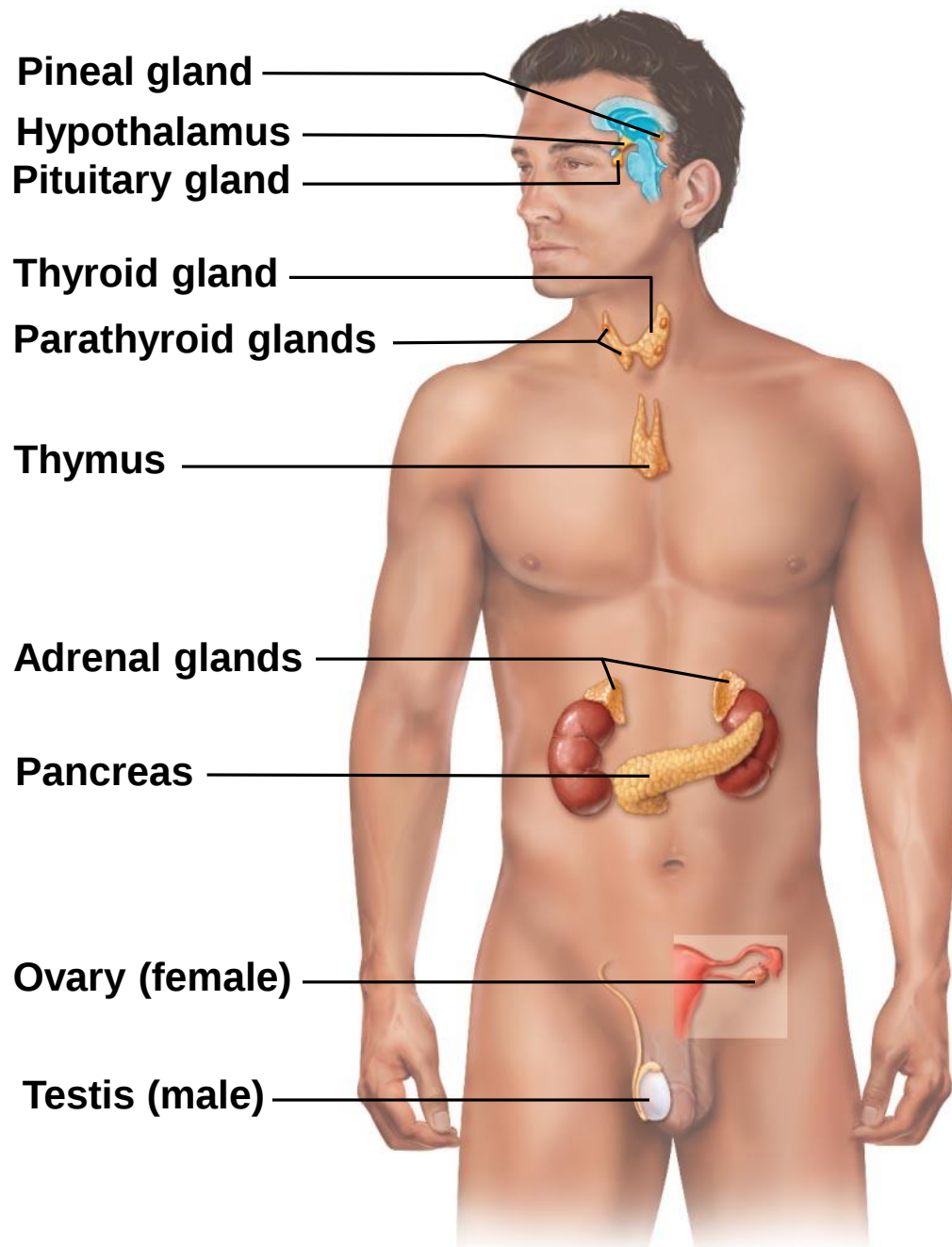
## 9. Gonads

- Ovaries

- Produce eggs
- Produce two groups of steroid hormone
  - Estrogens
  - Progesterone

- Testes

- Produce sperm
- Produce androgens, such as testosterone



**Figure 9.3**

# Hormones of the Ovaries

- (1) Estrogens

- Stimulate the development of female secondary sex characteristics

- Maturation of female reproductive organs

- With progesterone, estrogens also

- Promote breast development
  - Regulate menstrual cycle

# Hormones of the Ovaries

- (2) Progesterone
  - Acts with estrogen to bring about the menstrual cycle
  - Helps in the implantation of an embryo in the uterus
  - Helps prepare breasts for lactation

# Hormones of the Testes

- Produce several androgens
- (1) Testosterone is the most important androgen
  - Responsible for adult male secondary sex characteristics
    - Promotes growth and maturation of male reproductive system
    - Required for sperm cell production

# Other Hormone-Producing Tissues and Organs

- Parts of the small intestine
- Parts of the stomach
- Kidneys
- Heart
- Many other areas have scattered endocrine cells

# Endocrine Function of the Placenta

- Produces hormones that maintain the pregnancy
- Some hormones play a part in the delivery of the baby
- Produces human chorionic gonadotropin (hCG) in addition to estrogen, progesterone, and other hormones

# Developmental Aspects of the Endocrine System

- Most endocrine organs operate smoothly until old age ~ late 30's – 40's in 
  - Menopause is brought about by lack of efficiency of the ovaries
  - Problems associated with reduced estrogen are common
  - Growth hormone production declines with age
  - Many endocrine glands decrease output with age