

# *Inquiry into Life*

*Eleventh Edition*

**Sylvia S. Mader**

## Chapter 20 Lecture Outline

Prepared by: Wendy Vermillion  
*Columbus State Community College*

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



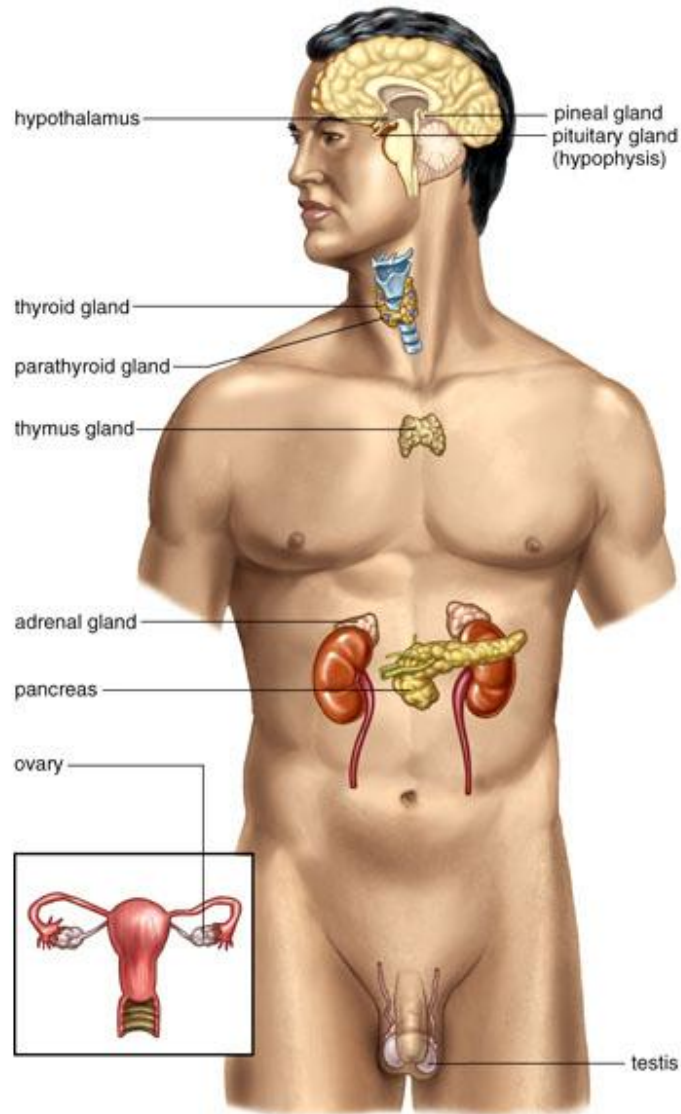
Copyright The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

# 20.1 Endocrine glands

- Overview of the endocrine system
  - Consists of glands and tissues that produce **hormones**
    - Chemical signals that stimulate a response in a target tissue
  - Endocrine glands lack duct
    - Secrete hormones directly into tissue fluids
    - From there they diffuse into the blood
- The major glands of the endocrine system are illustrated in the following diagram

# The endocrine system

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



• Fig. 20.1

# Endocrine glands cont'd.

- **Hormones and homeostasis**
  - Endocrine and nervous systems play important roles in homeostasis
    - The nervous system generally provides immediate controls, while the endocrine system provides long term regulation
  - Control of hormone release- 2 mechanisms
    - **Negative feedback**
      - gland is controlled by either the condition it is regulating or by the hormone it is producing Ex: control of blood glucose by insulin
    - **Control by the presence of an antagonistic hormone**
      - Ex: calcitonin decreases blood calcium while parathyroid hormone increases it

# 20.2 Hypothalamus and pituitary gland

- Hypothalamus- important homeostatic control center
  - Regulates water balance, hunger and satiety, body temperature, water balance
  - Controls the pituitary gland
    - Composed of 2 bodies of glandular tissue of different embryologic origin
      - **Anterior pituitary**-secretes at least 6 different hormones in response to releasing factors from the hypothalamus
      - **Posterior pituitary**- stored ADH and oxytocin which are actually produced in the hypothalamus
        - » Diabetes insipidus- inability to produce ADH
        - » Oxytocin -causes uterine contractions and milk letdown in lactation

# Hypothalamus and pituitary gland cont'd.

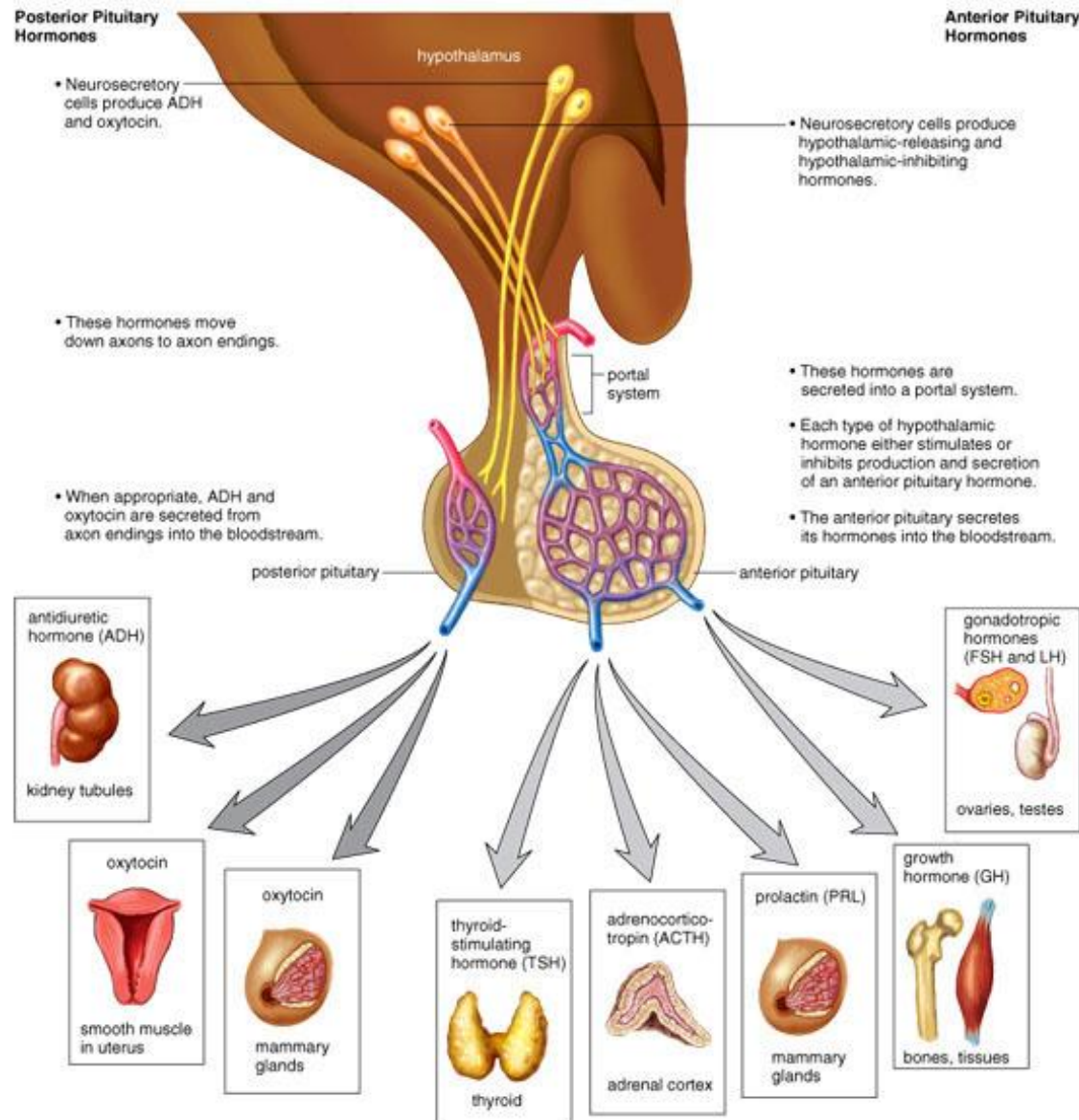
- Anterior pituitary
  - Hypothalamus controls anterior pituitary by hypothalamic-releasing hormones and in some cases hypothalamic-inhibiting hormones
    - 3 anterior pituitary hormones have target effect on other glands
      - TSH-thyroid stimulating hormone stimulates thyroid gland to produce thyroid hormone
      - ACTH-adrenocorticotrophic hormone stimulates the adrenal cortex to produce glucocorticoids
      - Gonadotrophic hormones stimulate the gonads to produce estrogen and testosterone

# Hypothalamus and pituitary gland cont'd.

- Anterior pituitary cont'd.
  - 3 anterior pituitary hormones do not affect other glands
    - **MSH**- melanocyte stimulating hormone stimulates the pigment producing melanocytes of the skin
    - **Growth hormone** stimulates bone and muscle growth, increases protein synthesis and fat metabolism
    - **Prolactin** stimulates the mammary glands to synthesize milk
- Effects of growth hormone (GH)
  - Greatest production occurs during childhood
    - Lack of GH- **pituitary dwarfism**
    - Excess- **giantism**
  - Excess production in adulthood- **acromegaly**
    - Growth plates of bone have closed so no increased growth in height
    - Feet, hands, and face become “heavy” in appearance

# Hypothalamus and the pituitary

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



• Fig. 20.2

# Effect of growth hormone

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



a.



b.

- Fig. 20.3

# Acromegaly

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



Age 9



Age 16



Age 33



Age 56

- Fig. 20.4

# 20.3 Thyroid and parathyroid glands

- The thyroid gland
  - TSH produced in response to hypothalamic releasing factor
    - increase metabolic rate
    - Stimulate all body cells
    - More glucose is utilized to form ATP
    - Necessary for normal growth and nervous system function
  - Thyroid requires iodine to produce these hormones
    - Iodine deficiency causes simple goiter

# Thyroid and parathyroid glands cont'd.

- The thyroid cont'd.

- **Cretinism**- results from abnormal thyroid development

- Short, stocky body type
    - Severe hypothyroidism
    - Mental retardation
    - Treatment must begin in first 8 weeks of life

- **Myxedema**

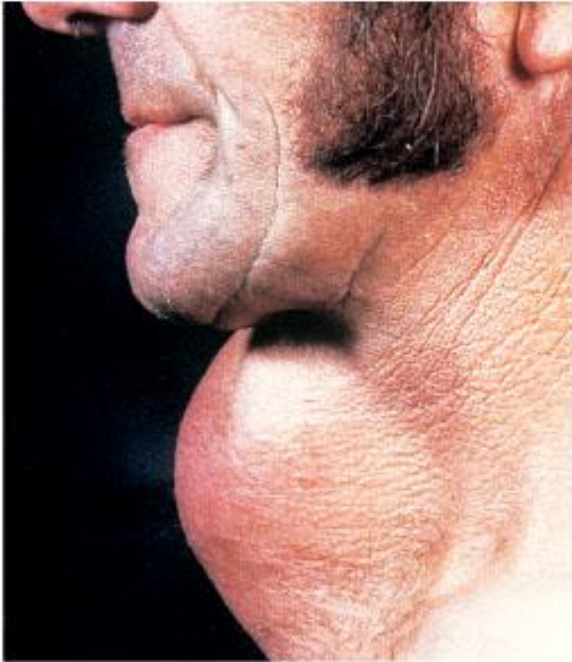
- Hypothyroidism in adults-lethargy, weight gain, loss of hair

- **Grave's disease-hyperthyroidism**

- Causes exophthalmic goiter-edema behind eyes causes bulging
    - Hyperactivity, arrhythmias

# Abnormalities of the thyroid

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



a. Simple goiter



b. Cretinism



c. Exophthalmic goiter

- Fig. 20.5

# Thyroid and parathyroid glands cont'd.

- Thyroid cont'd.
  - **Calcitonin**
    - Calcium-regulating hormone
    - Produced in response to increased blood calcium levels
    - Causes uptake of calcium by bone

# Thyroid and parathyroid glands cont'd.

- The parathyroid glands
  - Produce parathyroid hormone **PTH**
  - Insufficient PTH causes decrease in blood calcium
    - **Tetany**-continuous muscle contraction from hyper excitability of nerves

# 20.4 Adrenal glands

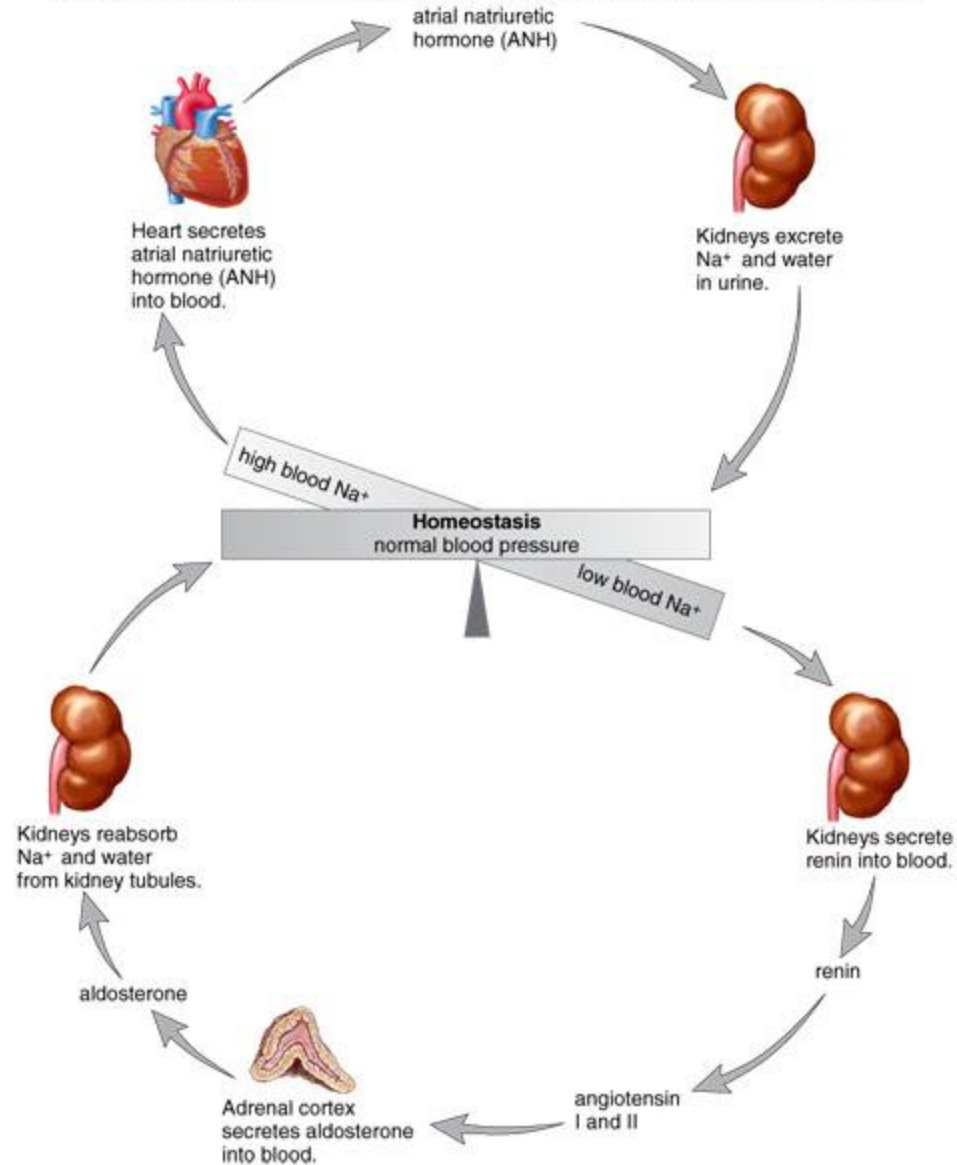
- Adrenal gland structure
  - Outer **cortex** and inner **medulla**
  - Distinctly different in origin and function
    - Cortex is under the control of ACTH
    - Medulla is a neurosecretory structure
- Adrenal medulla
  - Hypothalamus initiates neural impulses which travel through brain stem, cord, and then sympathetic fibers to the medulla
  - **Epinephrine** and **norepinephrine** released
    - Fight or flight responses
    - Provide a short-term, immediate response to stress

# Adrenal glands cont'd.

- Adrenal cortex
  - Long-term stress response
  - Produces 2 main groups of hormones
    - Mineralocorticoids
      - Regulate salt and water balance
      - Aids in regulation of blood volume and pressure
    - Glucocorticoids
      - Under control of ACTH
      - Regulates carbohydrate, protein, and fat metabolism
        - » Causes increase in blood glucose
      - Anti-inflammatory
  - Also produces small amounts of the sex hormones

# Regulation of blood pressure and volume

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



• Fig. 20.8

# Adrenal glands cont'd.

- Malfunction of the adrenal cortex
  - Addison's disease
    - ACTH accumulates and causing bronzing of the skin from stimulation of melanocytes
    - Without cortisol, there is no mobilization of glucose under stress
      - Can be life-threatening
    - Hyposecretion of aldosterone-most serious
      - Can cause **hyperkalemia** (elevated blood potassium) which can cause cardiac arrest

# Addison's disease

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



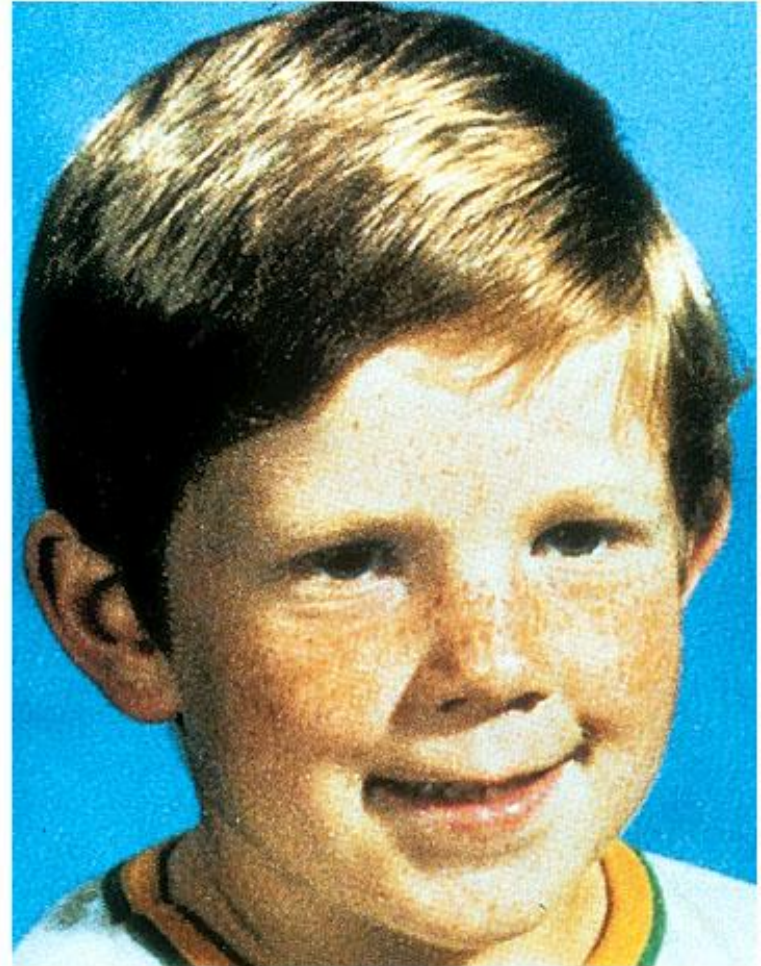
- Fig. 20.9

# Adrenal glands cont'd.

- Malfunction of the adrenal cortex cont'd.
  - **Cushing's syndrome**
    - Hypersecretion of the adrenal cortex
    - Excess cortisol is primary problem
      - **Diabetes mellitus** from increased blood glucose
      - Subcutaneous fat deposited in midsection
      - High blood pressure

# Cushing's syndrome

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



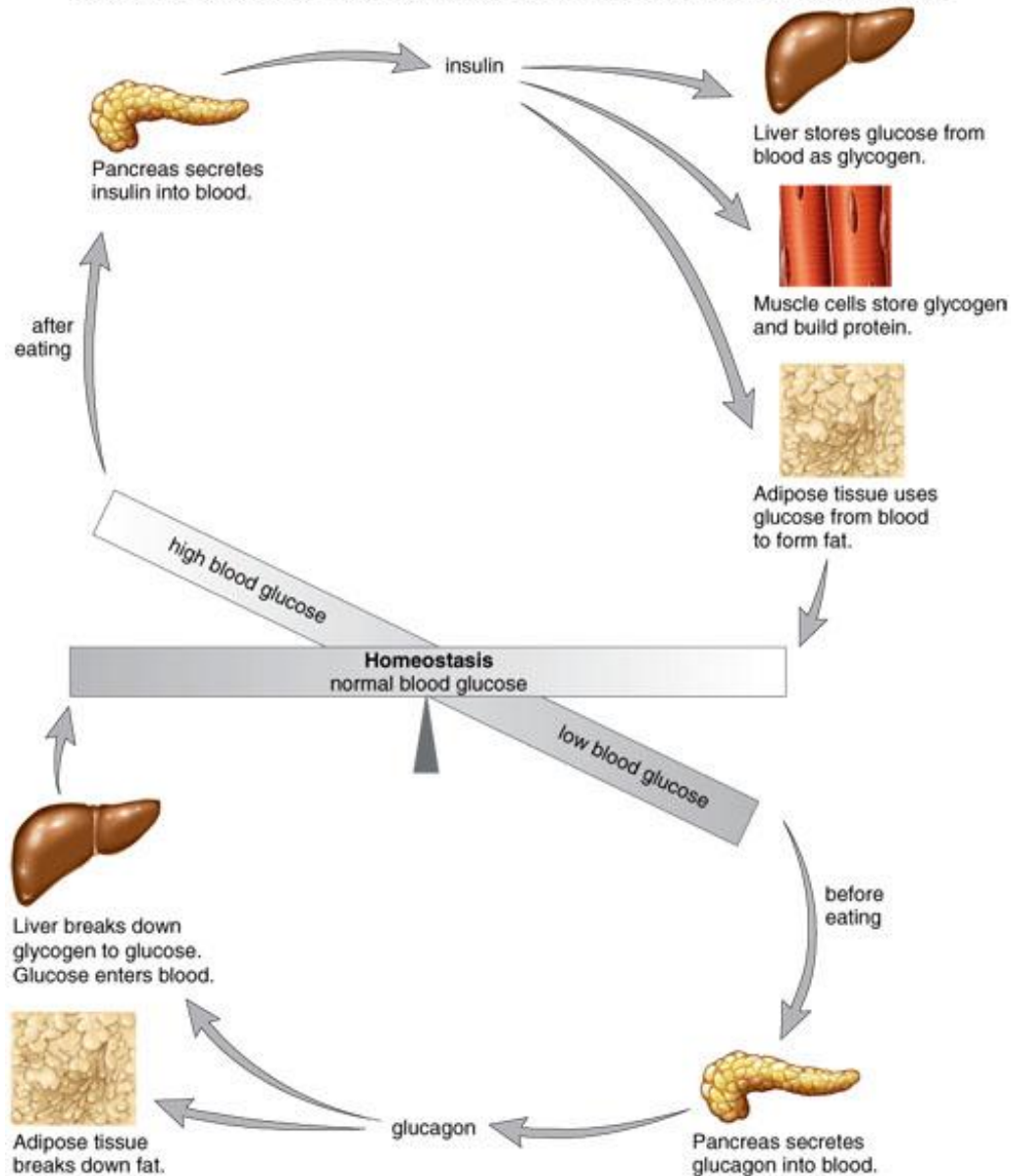
- Fig. 20.10

# 20.5 Pancreas

- **Pancreas**
  - Pancreatic islets are the endocrine portion of the gland
  - Produce insulin and glucagon-antagonistic hormones
- **Insulin**
  - Released after eating
  - Stimulates uptake of glucose by cells
    - Especially muscle, liver, and adipose cells
    - Decreases blood glucose
- **Glucagon**
  - Released before eating when glucose is low
  - Targets liver and adipose tissue
  - Increases blood glucose

# Regulation of blood glucose

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



• Fig. 20.11

# Pancreas cont'd.

- Diabetes mellitus

- Cells cannot take up glucose
  - As blood glucose rises, glucose and water are lost in the urine
  - Causes increased thirst, increased hunger
- Two types of diabetes mellitus
  - Type 1- insulin dependent
    - Lack of insulin- may be due to exposure to environmental agent such as a virus
    - Cytotoxic T cells attack pancreatic islets
    - Cells break down fats for energy-ketones build up in blood
      - » Ketoacidosis→coma, death
    - Insulin overdose- causes hypoglycemia, unconsciousness
      - » Immediate ingestion of glucose to counteract

# Pancreas cont'd.

- Diabetes mellitus cont'd.
  - Type 2 diabetes mellitus
    - Insulin-resistant
    - Obesity- adipose tissue produces a substance that impairs insulin receptor function
    - Insulin levels are often low, and cells may not have sufficient insulin receptors
    - Controlled by diet, exercise, medications
- Long term complications of diabetes mellitus
  - Blindness, kidney disease, cardiovascular disorders

# 20.6 Other endocrine glands

- Testes
  - Produce testosterone
  - Responsible for male secondary sex characteristics
    - » Growth of penis and testes, beard growth, enlargement of vocal folds and larynx
    - » Stimulates oil production by oil glands
    - » Involved in pattern baldness
    - » Increased muscle development

# Other endocrine glands cont'd.

- Ovaries
  - Estrogen
    - Stimulates growth of uterus and vagina
    - Egg maturation
    - Female secondary sex characteristics
      - Breast development along with progesterone
      - Fat deposition
  - Progesterone
    - Regulation of uterine cycle along with estrogen

# Other endocrine glands cont'd.

- Thymus gland
  - Largest and most active in childhood
  - Produces **melatonin**
    - Sleep-wake cycle
    - Circadian rhythms
    - Regulates sexual development