

## Endocrine Systems

### The Human Endocrine System

#### A. Endocrine Glands

1. Secrete hormones directly into the bloodstream

a. pineal gland	hypothalamus	pituitary gland
thyroid gland	parathyroid gland	thymus gland
adrenal glands	pancreas	ovaries
testes		

#### B. Target Organs

1. Organs at which hormones have their effects
  - a. Hormones bind at receptors on or inside target cells

### Second Messengers

#### A. Function

1. Carries message from the plasma membrane to the interior of the cell

#### B. Examples of Second Messengers

1. cAMP - cyclic adenosine monophosphate
2. cGMP - cyclic guanosine monophosphate
3.  $Ca^{+2}$  - calcium ions

### Control of Hormonal Secretions

#### A. Feedback System

1. The last step in a cycle affects the first step

#### B. Negative Feedback Systems

1. Endocrine gland decreases its activity in response to an increased concentration of the substance it regulates
  - a. Most common type of feedback

#### C. Positive Feedback Systems

1. Endocrine gland increases its activity in response to an increase in concentration of the substance it regulates
  - a. Rare type of feedback

### Control of Blood Glucose

#### A. Islets of Langerhans

1. Endocrine glands cells of the pancreas

#### B. Response to High Blood Glucose Level

1. Pancreas secretes insulin
  - a. Glucose is taken up by muscles and the liver
  - b. Glucose is stored as glycogen

#### C. Response to Low Blood Glucose Level

1. Pancreas secretes glucagon
  - a. Glycogen is broken down to glucose
  - b. Glucose is released into the bloodstream

## Control of Blood Calcium

### A. Parathyroid Glands

1. Tiny glands located behind the thyroid glands
  - a. Secretes parathyroid hormone (PTH)

### B. Parathyroid Hormone

1. Regulates the level of calcium in the blood
  - a. Stimulates the release of calcium from bone
  - b. Activates Vitamin D
    - (1) Vitamin D increases absorption of calcium from the intestine

### C. Calcitonin (a thyroid hormone)

1. Regulates the level of calcium in the blood
  - a. Stimulates the uptake of calcium by bones
  - b. Inhibits absorption of calcium in the intestine

## Other Glands and Hormones

### A. Pineal Gland

1. Secretes hormone melatonin
  - a. Function is not known
  - b. At lowest level after onset of puberty
    - (1) Possible inhibitor of sexual development
2. Regulates annual reproductive cycles in other animals

### B. Thymus Gland

1. Functions in the maturation of immune T cells
2. Gland is larger in young children than in adults

### C. Prostaglandins

1. Hormones produced by most body tissues
  - a. Blood vessel diameter
  - b. Blood clotting
  - c. Inflammation reactions
  - d. Ovulation
  - e. Uterine contractions during labor

### D. Bradykinins

1. Polypeptides secreted by various body organs
  - a. Heat loss in skin
  - b. Dissolving blood clots
  - c. Countering effects of prostaglandins

## The Hypothalamus and Pituitary

### A. Hypothalamus

1. Regulates many of the functions of the Pituitary gland
2. Secretes several hormones, some of which are stored in the pituitary gland

### B. Pituitary Gland

1. Shape of a pea, 1.5 cm in diameter
2. Attached to the underside of the hypothalamus

### C. Hormones and their functions

1. See table 23.1

## Growth

### A. Growth Hormone (GH)

1. Regulates the rate of growth
  - a. Increases protein synthesis
  - b. Increases burning of fats and storage of carbohydrate

### B. Regulation of GH

1. Growth Hormone Releasing Hormone (GHRH)
  - a. Hypothalamic hormone
  - b. Stimulates release of GH
2. Somatostatin
  - a. Hypothalamic hormone
  - b. Inhibits the release of GH

## Metabolism

### A. Thyroxin

1. Major hormone secretion of the thyroid gland
  - a. Controls rate at which food is metabolized
  - b. Iodine is required in the manufacture of thyroxin

### B. Regulation of Thyroxin

1. Thyroid Stimulating Hormone (TSH)
  - a. Produced in anterior pituitary
  - b. Stimulates the release of Thyroxin
2. Thyroid Releasing Hormone (TRH)
  - a. Produced in the hypothalamus
  - b. Controls the release of TSH

## Milk Production

### A. Prolactin

1. Produced in the anterior pituitary
  - a. Initiates milk production in the mammary glands
2. Regulation by prolactin-inhibiting hormone (PIH) from hypothalamus
  - a. High levels of estrogen during pregnancy stimulate release of PIH
    - (1) PIH inhibits prolactin release
  - b. Low levels of estrogen after pregnancy inhibit release of PIH
    - (2) Absence of PIH stimulates prolactin release

### B. Oxytocin

1. Produced in the hypothalamus
2. Released by the posterior pituitary
  - a. Causes milk producing glands to contract and move milk into the nipple area
  - b. Stimulates the contraction of the uterus during labor

## Adrenal Cortex Hormones

### A. Corticosteroids

1. Gonadocorticoids
  - a. Male and female hormones that supplement those produced by the reproductive organs
2. Mineralocorticoids
  - a. Regulate ion balance
3. Glucocorticoids
  - a. Fight inflammation
  - b. Regulate metabolism of proteins, fats and carbohydrates

### B. Regulation of Glucocorticoids

1. Corticotropin releasing hormone (CRH)
  - a. Hypothalamic hormone that stimulates the release of ACTH
2. Adrenocorticotrophic hormone (ACTH)
  - a. Anterior Pituitary Hormone
  - b. Stimulates the release of glucocorticoids by the adrenal cortex

## The Fight or Flight Response

### A. Epinephrine (adrenaline) and Norepinephrine

1. Increase mental alertness
2. Increase heart rate
3. Increase breathing rate
4. Dilate coronary blood vessels
5. Speed up metabolism

### B. Fight or Flight

1. Hormones stimulate and sustain Sympathetic response

## Stress

### A. Causes of Stress

Extreme heat or cold

Loud sounds

Emotional upset

Injuries

Infections

Prolonged heavy exercise

Danger

### B. Stages of Stress

#### 1. First stage

a. Body activates the fight or flight response

#### 2. Second stage

a. High levels of corticosteroids inhibit the immune system

#### 3. Third stage

a. Body attempts to recover to a normal state

(1) Failure to recover = exhaustion