1 The Endocrine System glands and disorders.

2 Major Endocrine Organs
   - Pituitary gland
   - Thyroid gland
   - Parathyroid glands
   - Adrenal glands
   - Pineal gland
   - Thymus gland
   - Pancreas
   - Gonads (Ovaries and Testes)
   - Hypothalamus

3 Location of Major Endocrine Organs

4 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”

5  **Hormones of the Anterior Pituitary**

- Six anterior pituitary hormones
  - Two affect non-endocrine targets
    - Growth hormone
- Prolactin
- Four stimulate other endocrine glands (tropic hormones)
  - Thyroid-stimulating hormone (thyrotropic hormone)
  - Adrenocorticotropic hormone
  - Two gonadotropic hormones

**Hormones of the Anterior Pituitary**

- Characteristics of all anterior pituitary hormones
  - Proteins (or peptides)
  - Act through second-messenger systems
Regulated by hormonal stimuli, mostly negative feedback

7 **Hormones of the Anterior Pituitary**

8 **Hormones of the Anterior Pituitary**

- **Growth hormone**
  - 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

9 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

10 Hormones of the Anterior Pituitary
Gigantism results from hypersecretion of GH during childhood

11 **Hormones of the Anterior Pituitary**

Dwarfism

Pituitary dwarfism results from hyposecretion of GH during childhood

12

13 **Hormones of the Anterior Pituitary**

- Prolactin (PRL)
  - Stimulates and maintains milk production following
childbirth

- Function in males is unknown
  - Adrenocorticotropic hormone (ACTH)
    - Regulates endocrine activity of the adrenal cortex
  - Thyroid-stimulating hormone (TSH)
    - Influences growth and activity of the thyroid gland

14  

**Hormones of the Anterior Pituitary**

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

**Pituitary–Hypothalamus Relationship**
- Hormonal release is regulated by releasing and inhibiting hormones produced by the
The hypothalamus

- Hypothalamus produces two hormones
  - These hormones are transported to neurosecretory cells of the posterior pituitary
    - Oxytocin
    - Antidiuretic hormone
  - The posterior pituitary is not strictly an endocrine gland, but does release hormones

**Hormones of the Posterior Pituitary**

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

17 **Hormones of the Posterior Pituitary**

- Antidiuretic hormone (ADH)
  - Inhibits urine production by promoting water reabsorption by the kidneys
  - In large amounts, causes vasoconstriction leading to increased blood pressure
  - Also known as vasopressin

18 **Hormones of the Posterior Pituitary**

19 **Thyroid Gland**

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

### Thyroid Gland

- Thyroid hormone
  - 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
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

Thyroid Gland

Thyroid Gland

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
Myxedema

Thyroid Gland

- 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

Parathyroid Glands

- Tiny masses on the posterior of the thyroid
- Secrete 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

**Adrenal Glands**

- Sit on top of the kidneys
- Two regions
  - Adrenal cortex—outer glandular region has three layers
    - Mineralocorticoids secreting area
    - Glucocorticoids secreting area
- Sex hormones secreting area
  - Adrenal medulla—inner neural tissue region

32 **Hormones of the Adrenal Cortex**

33 **Hormones of the Adrenal Cortex**
- 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)

34 Hormones of the Adrenal Cortex

35 Hormones of the Adrenal Cortex
▪ 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

Roles of the Hypothalamus and Adrenal Glands in the Stress Response

Hormones of the Adrenal Cortex

- 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 (cushings syndrome)
    - May result from an ACTH-releasing tumor
    - Excess water and sodium are retained leading to high blood pressure and edema

Adrenal glands can
malfunction

- Addison’s disease – hyposecretion of glucocorticoids by the adrenal cortex characterized by bronzing of the skin

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

41  Cushings syndrome

42  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

43 **Hormones of the Adrenal Cortex**

44 **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

**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
- Secretion controlled by exposure to light.
**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

**Gonads**

- Ovaries
  - Produce eggs
  - Produce two groups of steroid hormone
    - Estrogens
    - Progesterone
- Testes
- Produce sperm
- Produce androgens, such as testosterone

**Hormones of the Ovaries**

- Estrogens
  - Stimulate the development of secondary female characteristics
  - Mature female reproductive organs
  - With progesterone, estrogens also
    - Promote breast development
    - Regulate menstrual cycle

**Hormones of the Ovaries**

- 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

50  

**Hormones of the Testes**

- Produce several androgens
- 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

Other Hormone-Producing Tissues and Organs

Other Hormone-Producing Tissues and Organs

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
  - 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