Functions of the Endocrine System:

- **Hormone –**

Table 13.1

HORMONES FROM A TO T

Hormone	Source	Functions
Aldosterone	Adrenal cortex	Aids in regulating the levels of salt and water in the body.
Androgens	Adrenal cortex and gonads	Influence sex-related characteristics.
Adrenocorticotropic hormone (ACTH)	Pituitary gland	Stimulates the growth and secretions of the adrenal cortex.
Antidiuretic hormone (ADH)	Pituitary gland	Helps control blood pressure by reducing the amount of water that is excreted.
Calcitonin	Thyroid gland	Works with the parathyroid hormone to regulate calcium levels in the blood and tissues.
Cortisol	Adrenal cortex	Regulates the metabolism of carbohydrates, fats and proteins in the body. Also has an anti-inflammatory action.
Epinephrine	Adrenal medulla	Stimulates the sympathetic nervous system.
Estrogen	Ovaries	Develops and maintains the female secondary sex characteristics and regulates the menstrual cycle.
Follicle-stimulating hormone (FSH)	Pituitary gland	In the female, stimulates the secretion of estrogen and the growth of ova (eggs). In the male, stimulates the production of sperm.

Table 13.1 – Continued

HORMONES FROM A TO T

Hormone	Source	Functions
Glucagon	Pancreatic islets	Increases the level of glucose in the bloodstream.
Growth hormone (GH)	Pituitary gland	Regulates the growth of bone, muscle, and other body tissues.
Human chorionic gonadotropin (HCG)	Placenta	Stimulates the secretion of the hormones required to maintain pregnancy.
Insulin (In)	Pancreatic islets	Regulates the transport of glucose to body cells and stimulates the conversion of excess glucose to glycogen for storage.
Lactogenic hormone (LTH)	Pituitary gland	Stimulates and maintains the secretion of breast milk.
Luteinizing hormone (LH)	Pituitary gland	In the female, stimulates ovulation. In the male, stimulates testosterone secretion.
Melatonin	Pineal gland	Influences the sleep-wakefulness cycle.
Norepinephrine	Adrenal medulla	Stimulates the sympathetic nervous system.
Oxytocin (OXT)	Pituitary gland	Stimulates uterine contractions during childbirth. Causes milk to flow from the mammary glands after childbirth.
Parathyroid hormone (PTH)	Parathyroid glands	Works with calcitonin to regulate calcium levels in the blood and tissues.
Progesterone	Ovaries	Completes preparation of the uterus for possible pregnancy.
Testosterone	Testicles	Stimulates the development of male secondary sex characteristics.
Thymosin	Thymus	Plays an important role in the immune system.
Thyroid hormones (T_4 and T_3)	Thyroid gland	Regulate the rate of metabolism.
Thyroid-stimulating hormone (TSH)	Pituitary gland	Stimulates the secretion of hormones by the thyroid gland.

Steroid Hormones - control metabolism, inflammation, immune functions, salt and water balance, development of sexual characteristics, and the ability to withstand illness and injury

- **Steroid:**

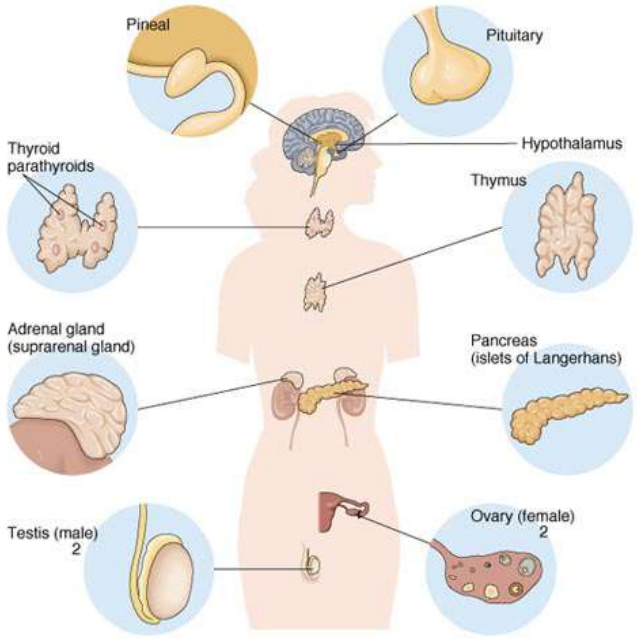
- **Anabolic Steroids:**

    - Side effects - liver damage, altered body chemistry, testicular shrinkage and breast development in males, plus unpredictable mood swings and violence
        - Steroid use by teenagers also stops long bone development, resulting in shortened stature

The Endocrine System

Structures of the Endocrine System:

Major Glands -

• One _____ **Gland** - divided into two lobes • One _____ **Gland** • Four _____ **Glands** • Two _____ **Glands** • One _____**(pancreatic islets)** • One _____ • One _____ **Gland** • Two _____ (ovaries in females, testes in males)	

Pathology of the Endocrine System:

- **Endocrinopathy -**
- **Hypercrinism -** condition caused by excessive secretion of any gland
- **Hypocrinism -** condition caused by deficient secretion of any gland

Diagnostic Procedures Related to the Endocrine System:

- Nuclear medicine and imaging techniques
- Urine and blood testing are used to measure endocrine hormone levels and to detect the presence of anabolic steroids

The Pituitary Gland:

Pea-sized; located at the base of the brain just below the hypothalamus and is composed of anterior and posterior lobes

AKA:

Functions of the Pituitary Gland – Anterior Lobe

1. Acts in response to stimuli from the hypothalamus of the brain	2. System of checks and balances maintains an appropriate blood level of each hormone

Secretions of the Pituitary Gland: Anterior Lobe -

Adrenocorticotropic Hormone (ACTH)/Adrenotropin:	**Follicle-Stimulating Hormone (FSH)/Follitropin:** ● female - ● males -
Growth Hormone (GH)/Somatotropin (STH):	**Lactogenic Hormone (LTH)/Prolactin:**
Luteinizing Hormone (LH)/Luteotropin: ● female - ● male -	**Melanocyte-stimulating Hormone (MSH)/Melanotropin:**
Thyroid-stimulating Hormone (TSH)/Thyrotropin:	

Secretions of the Pituitary Gland: Posterior Lobe

Antidiuretic Hormone (ADH): ● When ADH is secreted, less urine is produced. When a **diuretic** is administered, urine secretion increases	**Oxytocin:** ● After childbirth, stimulates the flow of milk from the mammary glands

Pathology of the Pituitary Gland

Alcohol Consumption: ● Results in increased urine output that can disrupt the body's fluid balance	**Acromegaly:** ● Due to the excessive secretion of GH **after** puberty
Gigantism/Giantism: ● Due to excessive secretion of GH **before** puberty	**Hyperpituitarism:**
Hypopituitarism:	**Pituitary Adenoma:** ● Causes excess hormone secretion ● ACTH-secreting tumor stimulates the excess production of cortisol = Cushing's syndrome

Pituitarism:	**Prolactin-producing adenoma/prolactinoma:** ● Causes it to produce too much prolactin ○ Females = ○ Males =

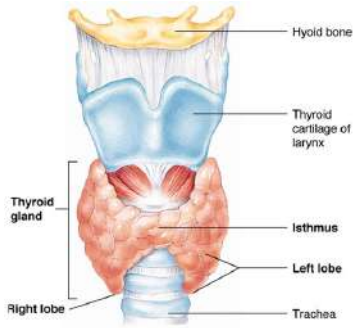
Diabetes Insipidus:

- Either allows too much fluid to be excreted, resulting in extreme:
  - **Polydipsia -**
  - **Polyuria -**
- Is **not** similar to Diabetes Mellitus

Treatment Procedures of the Pituitary Gland -

- **Hypophysectomy:**
- **Human Growth Hormone Therapy (GH)/Recombinant GH:** synthetic version of naturally occurring growth hormone
  -

The Thyroid Gland:

	**Functions of the Thyroid Gland -** Butterfly-shaped gland on either side of the larynx ● ●

Secretions of the Thyroid Gland -

- **Thyroxine (T_4) and Triiodothyronine (T_3) -**
- **Calcitonin/thyrocalcitonin** -
  - Decreases blood levels by moving calcium into storage in the bones and teeth

Pathology of the Thyroid Gland -

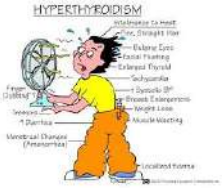
- **Thyroid Cancer:** first indicated by an enlargement of the thyroid gland
- **Insufficient Secretions of the Thyroid Gland:**

 **Hypothyroidism/Underactive Thyroid -** ● Symptoms: fatigue, depression, sensitivity to cold and decrease in metabolic rate	**Cretinism -** ● Can cause arrested physical and mental development 

The Endocrine System

Myxedema - ● Symptoms: enlarged tongue and puffiness of the hands and face	**Hashimoto's Thyroiditis -** ● setting up an inflammatory process that may progressively destroy the gland ● Causes a 

- **Excessive Thyroid** _____ **Secretions:** _____

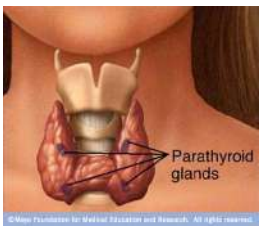


Hyperthyroidism - ● Symptoms: increased metabolic rate, increase sweating, nervousness, and weight loss	**Graves' Disease -**
Thyrotoxicosis/thyroid storm -	**Goiter/thyromegaly:** abnormal enlargement of the thyroid gland that produces a swelling in the front part of the neck 
Exophthalmos: abnormal protrusion of the eyes 	

Diagnostic and Treatment Procedures Related to the Thyroid Gland -

- **Thyroid Scan**
- **Antithyroid Drugs:**
- **Chemical Thyroidectomy/Radioactive Iodine Therapy:**
  - Used to treat hyperthyroid disease like Graves' disease
- **Lobectomy:**
- **Thyroid-stimulating Hormone Assay:**
  - Used to detect abnormal thyroid activity resulting from excessive pituitary stimulation

The Parathyroid Glands:

	**Functions of the Parathyroid Gland -** 4 glands each of which is about the size of a grain of rice and are located within the thyroid gland

Secretions of the Parathyroid Gland -

- Parathyroid Hormone (PTH)/Parathormone -
    - Increases calcium levels in the blood by mobilizing the release of calcium from storage in the bones and teeth

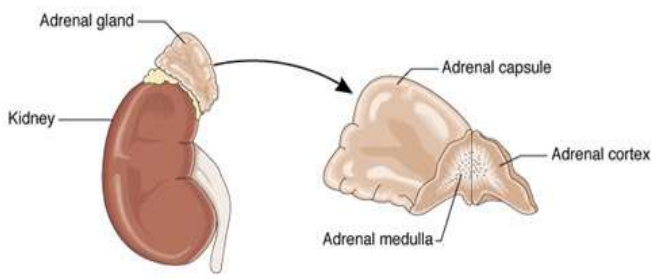
Pathology of the Parathyroid Glands -

- **Insufficient Parathyroid Secretion:**
    - **Hypoparathyroidism** -
        - Accompanied by hypocalcemia and in severe cases leads to tetany
            - **Tetany**:
    - **Hypocalcemia** -
- **Excessive Parathyroid Secretion:**
    - **Hyperparathyroidism (HP)** - overproduction of PTH
        -
    - **Hypercalcemia** -
    - **Primary HP** - caused by a diseased parathyroid gland
    - **Secondary HP** - caused by a problem elsewhere in the body

Treatment Procedure of the Parathyroid Glands -

- **Parathyroidectomy:**

The Adrenal Glands: (adrenals) located on top of each kidney



Functions of the Adrenal Glands -

-
    - **Electrolytes -** mineral substances found in the blood
-
-

Two parts: adrenal cortex and adrenal medulla

Secretions of the Adrenal Cortex -	**Secretions of the Adrenal Medulla -**
Corticosteroid: ● **Mineralocorticoids -** ○ **Aldosterone:** regulates the salt and water levels in the body by increasing sodium reabsorption in the kidneys ● **Glucocorticoids -** ○ Also influence blood pressure and have an anti-inflammatory effect ■ **Cortisol/hydrocortisone**: primary glucocorticoids	**Epinephrine/Adrenaline:** ● by increasing heart rate and increases blood pressure **Norepinephrine:** also stimulates the sympathetic nervous system

• **Gonadocorticoids:** (androgens)	

Pathology of the Adrenal Gland -

- **Adrenalitis:**

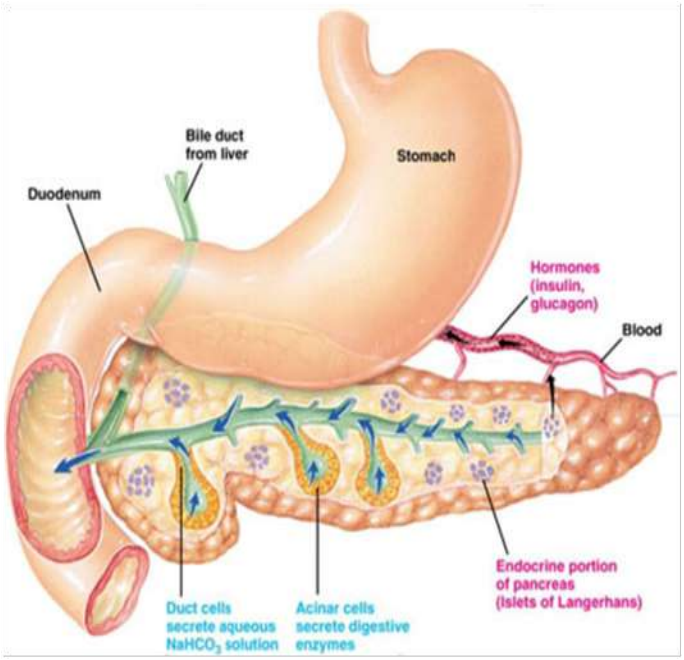
Insufficient Adrenal Secretions:	**Excessive Adrenal Secretions**:
Addison's Disease -  • Underproduction may be due to a disorder of the adrenal glands or to inadequate secretion of ACTH by the pituitary gland • Can produce a life-threatening addisonian crisis	**Aldosteronism -** abnormality of electrolyte balance caused by excessive secretion of aldosterone • **Primary Aldosteronism/Conn's Syndrome -** • **Secondary Aldosteronism -** • **Pheochromocytoma -** • **Cushing's**  **Syndrome/hypercortisolism -** p ○ Symptoms: rounded or moon face ○ Caused by an overproduction of cortisol by the body or by taking glucocorticoid hormone medications to treat inflammatory diseases such as asthma and rheumatoid arthritis

Treatment Procedures of the Adrenal Glands -

- **Laparoscopic Adrenalectomy:**

- **Cortisone/hydrocortisone**:
  - Also suppresses inflammation and works as an immunosuppressant to prevent organ rejection after transplants
- **Epinephrine:**

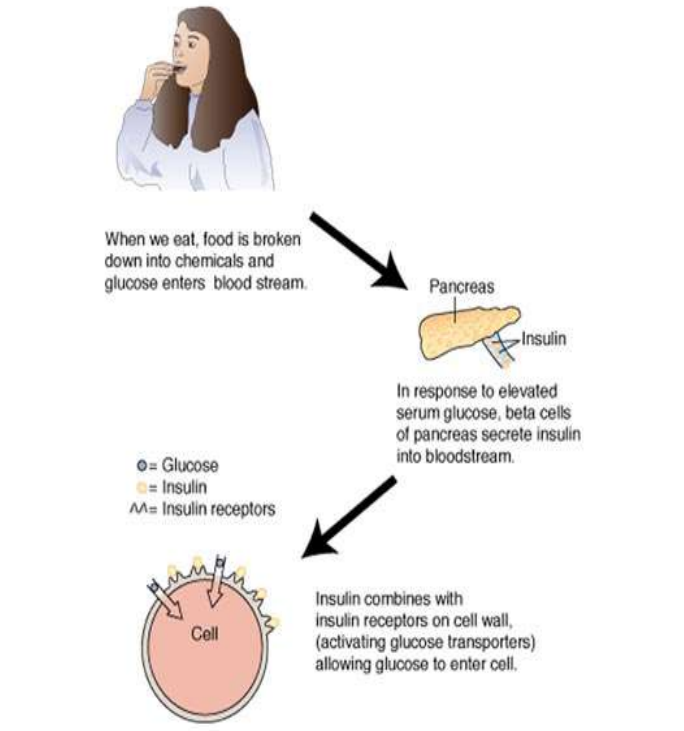
The Pancreatic Islets:



Functions of the Pancreatic Islets -

- Aka **Islets of Langerhans**
-

Secretions of the Pancreatic Islets -



- **Glucagon:** produced by the **alpha cells**
  -
  - Increases the amount of glucose in the bloodstream by stimulating the liver to convert glycogen into glucose
- **Insulin:** secreted by the **beta cells**
  - Response to high blood sugar
  - 1.
  - 2.

Pathology of the Pancreatic Islets -

- **Hyperglycemia:**
  - Symptoms - polyuria and polydipsia
- **Hyperinsulinism:**
- **Hypoglycemia:**
- **Insulinoma:**
- **Pancreatalgia:**

- **Pancreatitis:**

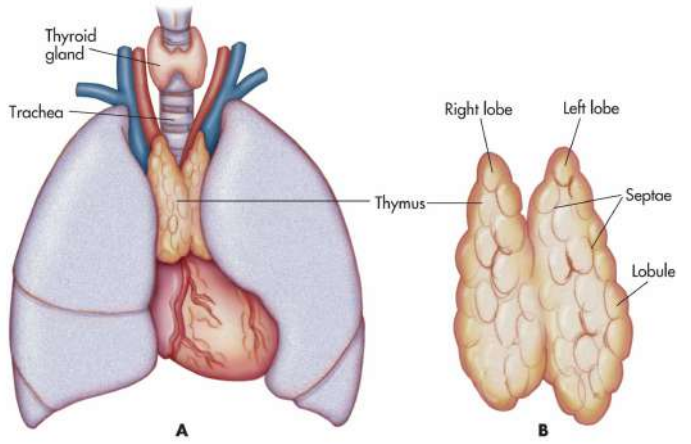
Diabetes Mellitus -

- **Type 1 Diabetes:** insulin-dependent diabetes mellitus (IDDM)/juvenile diabetes
  -
  - Due to destruction of pancreatic islet beta cells, the body does not secrete enough insulin
  - Treated with carefully regulated insulin replacement therapy
    - Symptoms - increase urination, constant thirst and hunger, weight loss, blurred vision, extreme fatigue, and slow healing
- **Type 2 Diabetes:** noninsulin-dependent diabetes mellitus (NIDDM)/adult-onset diabetes
  - _____ the body doesn't use it effectively
  - Treated with diet, exercise and medications
    - Symptoms - the same as type 1 plus recurring infections, irritability and a tingling sensation in the hands and feet
- **Gestational Diabetes:** GMD occurs during some pregnancies
- **Diagnostic Procedures:**
  - **Fasting Blood Sugar (FBS)** - glucose levels after the patient hasn't eaten for 8-12 hours; screen for and monitor treatment
  - **Glucose Tolerance Test (GTT)** - used to confirm diabetes and to aid in diagnosing hypoglycemia
  - **Fingerstick Blood Sugar Monitoring Test -** performed at least once daily to determine how much insulin or other medications are required
  - **Hemoglobin A1c Testing (HgA1c)/glycohemoglobin testing (GHb) -** average blood glucose level over the previous three to four months
    - Monitors how well blood sugar levels have been controlled during this time
    - GHb forms when glucose in the blood attaches to the hemoglobin
  - **Fructosamine Test -** average glucose levels over the past three weeks
    - Detects changes more rapidly than the HgA1x test
- **Diabetic Emergencies:**
  - **Hypoglycemia -** very low blood sugar
    - Treatment is to raise the blood sugar rapidly with glucose tablets or another form of readily absorbed sugar
  - **Hyperglycemia -** very high blood sugar (**diabetic ketoacidosis/DKA**)
    - Acute life-threatening complication is caused by a severe insulin deficiency = diabetic coma
- **Dlabetic Complications:**
  - Most result from damage to the blood vessels (capillaries) caused by long-term high blood sugar
  - **Heart Disease** - occurs because excess blood sugar makes the walls of the blood vessels sticky
  - **Kidney Disease -** lead to renal failure due to damage of the blood vessels that reduces blood flow through the kidneys
  - **Peripheral Neuropathy -**
  - **Diabetic Retinopathy (DR)** - causes damage to the retina of the eye
    - **Macular edema:** fluids from blood vessels leak into the eye can cause the macula to swell
    - **Proliferative Retinopathy:** fragile new blood vessels form and break, clouding vision and damaging the retina

Treatment Procedures of the Pancreas -

- **Pancreatectomy:**

The Thymus:



Functions of the Thymus -

-

Secretions of the Thymus -

- **Thymosin:**

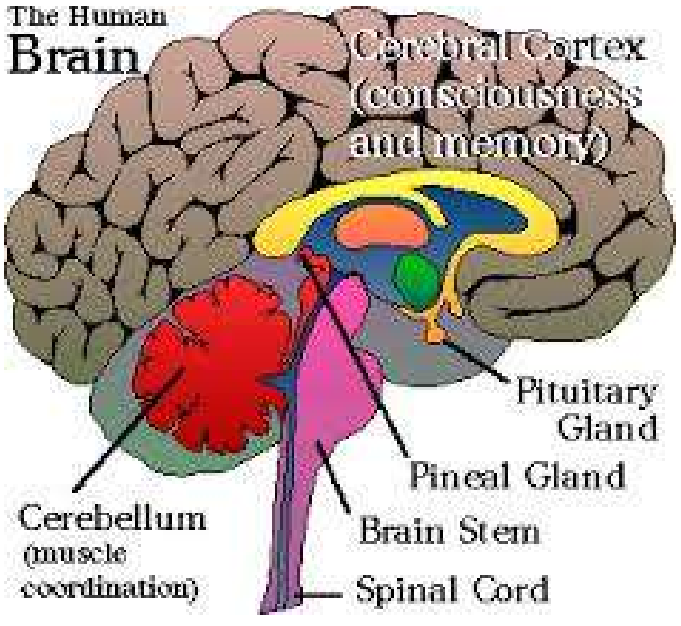
Pathology of the Thymus -

- **Thymitis**
- **Thymoma**

Treatment Procedure of the Thymus -

- **Thymectomy**

The Pineal Gland:



Functions of the Pineal Gland -

-

Secretions of the Pineal Gland -

- **Melatonin:**
  - **Circadian cycle -** refers to the biological functions that occur within a 24-hour period

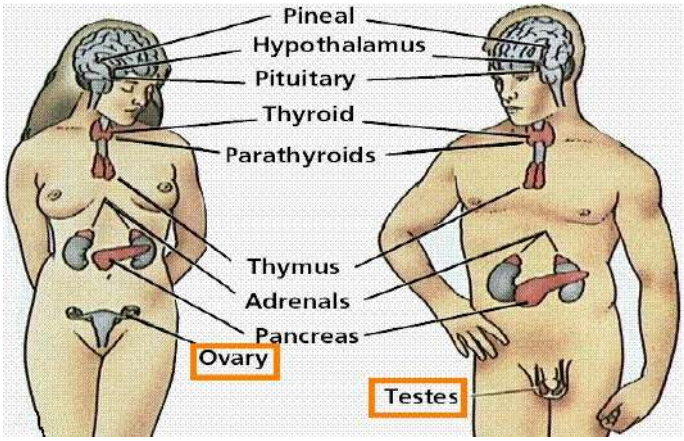
Pathology of the Pineal Gland -

- **Pinealopathy:**

Treatment Procedures of the Pineal Gland -

- **Pinealectomy:**

The Gonads:



Functions of the Gonads -

ovaries and testicles

- produce gametes
  - **Gametes -** reproductive cell (sperm and ova)
- **Gonadotropic hormone/gonadotropin** - any hormone that stimulates the gonad

Secretions of the Testicles -

- **Testosterone:**

Secretions of the Ovaries -

- **Estrogen:**

- **Progesterone:**

  - If pregnancy occurs, the placenta will take over; if not then the secretion stops and is followed by the menstrual period
- **The Placenta:**
  - Formed during pregnancy that allows the exchange of nutrients, oxygen, and waste products between the mother and developing child during pregnancy
  - **Human chorionic gonadotropin (HCG) -** hormone secreted by the placenta during pregnancy
    - Stimulates the corpus luteum to continue producing the hormones required to maintain pregnancy
    - Also stimulates the hormones required to stimulate lactation after childbirth

Pathology of the Gonads -

- **Hypergonadism:**
- **Hypogonadism:**
- **Gynecomastia:**

Career Opportunities:
Nuclear Medicine Technologist
Diabetes Dietician
Endocrinologist
Diabetes Educator