The Endocrine System
<table>
<thead>
<tr>
<th>Combining Form</th>
<th>Medical Term</th>
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<tbody>
<tr>
<td>Aden/o</td>
<td>gland</td>
</tr>
<tr>
<td>Adren/o</td>
<td>adrenal gland</td>
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<tr>
<td>Adrenal/o</td>
<td>adrenal gland</td>
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<tr>
<td>Calc/o</td>
<td>calcium</td>
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<tr>
<td>Gluc/o</td>
<td>sugar</td>
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<tr>
<td>Glyc/o</td>
<td>sugar</td>
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<tr>
<td>Pancreat/o</td>
<td>pancreas</td>
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<td>Pituitar/o</td>
<td>pituitary</td>
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<tr>
<td>Combining forms</td>
<td>Meaning</td>
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<td>Thyroid/o</td>
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<td>Thyr/o</td>
<td>thyroid</td>
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<td>Thym/o</td>
<td>thymus</td>
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<tr>
<td>Toxic/o</td>
<td>poison</td>
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<tr>
<td>Prefix</td>
<td>Description</td>
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<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Hyper-</td>
<td>above, excessive, more than</td>
</tr>
<tr>
<td>Hypo-</td>
<td>below, less than</td>
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<tr>
<td>-al</td>
<td>pertaining to</td>
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<tr>
<td>-ectomy</td>
<td>excision, removal of</td>
</tr>
<tr>
<td>-emia</td>
<td>blood condition</td>
</tr>
<tr>
<td>-genesis</td>
<td>production, generation</td>
</tr>
<tr>
<td>-ism</td>
<td>condition</td>
</tr>
<tr>
<td>-itis</td>
<td>inflammation</td>
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</tbody>
</table>
Prefixes/ Suffixes

- **-logist** specialist in the study of
- **-logy** study of
- **-megaly** enlargement
- **-oma** tumor
- **-pathy** disease
- **-trophyl** development/ nourishment
Vocabulary

- **GH – Growth Hormone**, stimulates production of protein and growth in body cells
- **TSH - Thyroid-Stimulating Hormone** – stimulate thyroid to produce hormones that regulate metabolism
- **ACTH - Adrenocorticotropic Hormone** – hormone to regulate water balance, electrolyte balance, glucose and blood pressure.
- **FSH- Follicle Stimulating Hormone**- hormone that regulates the development of the egg in the ovary
- **PTH- Parathyroid Hormone**- hormone that regulates calcium levels
Vocabulary

**Endocrine** - gland that secretes directly into the bloodstream

**Hormones** - substance secreted into the bloodstream that travels to another body part to affect its function

**Goiter** - enlargement of the thyroid gland
General Functions of the Endocrine System

• The endocrine system is made up of glands that release their products (hormones) directly into the bloodstream. These products send messages throughout the entire body.

• The response of hormones is slower and longer-lasting than those of nerve impulses. The effects may last up to several hours or days.

• The functions of the endocrine system include:
  – regulation of growth,
  – development
  – maturation
  – regulation of chemicals
  – metabolism.
Once released into the bloodstream...

- Only receptor cells made for the specific hormone can be affected by the hormone.
- The hormone is carried by a protein from the gland that produces it and the receptor cell recognizes it and accepts it.
Approximately the size of a pea, the Pineal Gland is located in the center of the brain.

- Produces Melatonin
  - Melatonin is stimulated by darkness and suppressed by light.
  - Melatonin helps regulate sleep cycles on a 24-hour basis (circadian rhythm)
  - Timing and release of female reproductive hormones is controlled by melatonin.
Pineal Gland
Hypothalamus

- “Brain” of the brain
- Hypothalamus stimulates the pituitary to release its hormones
- The hypothalamus receives information from the brain stem and stimulates the pituitary gland according to the information given.
Pituitary Gland

- Pituitary Gland
  - The pituitary gland is a small pea-shaped gland that is hanging from the underside of the brain.
  - It is often referred to as the “Master Gland” since it produces so many (nine) of the body’s hormones.
  - The pituitary gland works closely with the hypothalamus which helps to regulate the secretions from the pituitary gland.
Growth Hormone

- Growth Hormone (GH)
- Produced by the anterior part of the pituitary gland, growth hormone stimulates the production of proteins and growth in body cells.
GH Disorders

- **Dwarfism** occurs when there is too little GH during developmental years.

- **Gigantism** occurs when there is too much GH during developmental years.

- **Acromegaly** occurs when there is too much GH during adult years.
Adrenocorticotropic Hormone (ACTH)

- Produced by the anterior part of the pituitary gland, ACTH stimulates the adrenal cortex (outer layer) to produce hormones that regulate water balance, electrolyte balance, glucose levels, and blood pressure.
Thyroid Stimulating Hormone

- Thyroid-Stimulating Hormone (TSH)
- Produced by the anterior part of the pituitary gland, TSH stimulates the thyroid gland to produce its hormones which regulate the body’s metabolism.
Graves’ Disease

Graves' disease is a thyroid condition that results from abnormal stimulation of the thyroid gland by thyroid stimulating hormone (causes hyperthyroidism).
Follicle Stimulating Hormone

- Secreted by the anterior pituitary
- FSH
- Stimulates production of egg cell in the ovaries
Oxytocin

• Stored in the posterior pituitary gland, oxytocin stimulates uterine contractions during childbirth and helps to release milk from the milk ducts of nursing mothers.
Anti-Diuretic Hormone

- Secreted by the posterior pituitary
- ADH
- Causes re-absorption of water in the kidneys
The thyroid gland is a bow-tie shaped gland located in the neck just below the voice box (larynx) and around the upper part of the windpipe (trachea).

Thyroxin is the hormone which affects nearly all the cells of the body by regulating their metabolic rates, or the ability of cells to convert food to energy through cellular respiration.
Hypothyroidism occurs when the thyroid gland fails to produce enough thyroid hormone.

- May result in mental retardation and stunted growth.
- Cretinism (early onset, infants & young children).
- Myxedema (later onset).
Hypothyroidism

Intolerance to Cold
Receding Hairline
Facial & Eyelid Edema
Dull-Blank Expression
Extreme Fatigue
Thick Tongue - Slow Speech
Anorexia
Brittle Nails & Hair
Muscle Aches & Weakness
Skin (Coarse & Scaly)
Constipation
Menstrual Disturbances

Late Clinical Manifestations
Subnormal Temp
Bradycardia
Weight Gain
↓ LOC
Thickened Skin
Cardiac Complications
Cretinism

- Hyposecretion of Thyroxin during early growth years leads to low metabolic rate, retarded growth and sexual development, mental retardation, and distorted facial features.
Myxedema

- Low Thyroxin levels later in life can lead to low metabolic rate, lessened mental and physical vigor, weight gain, hair loss, and accumulation of mucous fluid that is often most noticeable around the eyes.
Hyperthyroidism

- **Hyperthyroidism** occurs when the thyroid gland produces too much of the thyroid hormones.

- Common symptoms include:
  - Increased metabolic rate
  - Weight loss but increase appetite
  - Nervous irritability, restless and excessively active
  - Exophthalmos (protruding eyes) from Graves’ Disease
  - Goiter
Goiter

• Hyperthyroidism when paired with low dietary intake of iodine causes painless enlargement of the thyroid

• Rarely seen in US due to regulation mandating iodized salt
Hyperthyroidism

Hyperthyroidism

- Intolerance to Heat
- Fine, Straight Hair
- Bulging Eyes
- Facial Flushing
- Enlarged Thyroid
- Tachycardia
- ↑ Systolic BP
- Breast Enlargement
- Weight Loss
- Muscle Wasting
- ↑ Diarrhea
- Menstrual Changes (Amenorrhea)
- Localized Edema
- Finger Clubbing
Parathyroid

- Parathyroid glands are small glands of the endocrine system which are located in the neck behind the thyroid.
- There are four glands that are each normally the size of a grain of rice.
- Parathyroid Hormone (PTH) controls the calcium in our bodies:
  - how much calcium is in our bones
  - how much calcium is in our blood.
Hyperparathyroidism

- Hyperparathyroidism occurs when one (or more) of the four parathyroid glands grows into a tumor and constantly makes excess parathyroid hormone which goes to the bones and removes calcium from the bones.
Hyperparathyroidism

Symptoms of hyperparathyroidism are classically summarized by the mnemonic "stones, bones, abdominal groans and psychic moans".

- "Stones" refers to kidney stones. These can ultimately lead to renal failure.
- "Bones" refers to bone-related complications, pain and sometimes pathological fractures (osteoporosis)
- "Abdominal groans" refers to gastrointestinal symptoms of constipation, indigestion, nausea and vomiting.
- "Psychic moans" refers to effects on the central nervous system. Symptoms include fatigue, depression, memory loss, delirium, and coma.
Stones
Bones
Psychic Moans
Stones
Groans
The pancreas is a fish-shaped gland located behind the stomach. The pancreas is considered to be an endocrine gland when it produces hormones and is also part of the digestive system when it produces digestive enzymes.
PANCREAS

Sampling Site

Duodenum

Tumor
Insulin

• Insulin is released when the blood sugar (glucose) is high.

• It helps the body cells to move glucose into the cells and helps the liver and muscle to convert glucose into glycogen.

• It also helps to convert excess glucose to fat which is then stored.
Glucagon

- Glucagon is released when the blood sugar (glucose) is low.
- It helps to break down the glycogen in the liver and the muscles into glucose which then raises the blood glucose levels.
• **Type I Diabetes Mellitus** is a lifelong disease that occurs when the pancreas does not produce enough insulin to regulate blood sugar.

• Without insulin, the glucose increases in the bloodstream instead of going into the body cells where it can be used for energy which leads to increased hunger.
Type II Diabetes Mellitus is a life-long disease marked by high levels of sugar in the blood that occurs when the body does not respond correctly to insulin.

In other words, glucose cannot enter the body cells to be used in energy production. It is the most common form of diabetes.
Gestational Diabetes Mellitus

- Gestational Diabetes Mellitus occurs when the diabetes is first diagnosed during pregnancy.
- Usually blood sugar returns to normal soon after delivery.
- If a woman develops gestational diabetes, they are at an increased risk of developing Type II later in life.
The adrenal glands are two triangular-shaped glands that sit on top of each kidney.

There are two sections:
- Cortex (outer layer)
- Medulla (inner layer)
Cortisol

- Cortisol is released from the adrenal cortex, the outer layer of the **adrenal gland**. It helps to control the rate of metabolism of carbohydrates, fats, and proteins.

- It is known as the stress hormone and is released during times of continuous stress.

- While cortisol has many positive aspects, a negative aspect is that it suppresses the action of the white blood cells which makes a person more susceptible to illness.
Addison's Disease

- **Addison's disease** is caused by low cortisol levels.
- Symptoms usually develop slowly, often over several months and may include:
  - Muscle weakness and fatigue
  - Weight loss and decreased appetite
  - Darkening of your skin (hyperpigmentation)
  - Low blood pressure, even fainting
  - Salt craving
  - Low blood sugar (hypoglycemia)
  - Nausea, diarrhea or vomiting
  - Muscle or joint pains
  - Irritability
  - Depression
  - Body hair loss
Adrenaline (epinephrine) is released from the **adrenal medulla**, or the middle section.

Adrenaline makes up 80% of the secretions from the adrenal medulla.

It helps to regulate the stress (sympathetic) response or the “fight or flight.”
Norepinephrine

- Norepinephrine (noradrenaline) is released from the adrenal medulla, or the middle section.
- Norepinephrine makes up 20% of the secretions from the adrenal medulla.
- Along with adrenaline, it helps to regulate the stress (sympathetic) response or the “fight or flight.” Norepinephrine does the parasympathetic response.
Fight-or-Flight Response

1) Adrenaline released into blood.
2) Heart rate and blood pressure increase.
3) Flow of blood to brain increases.
4) Breathing rate increases.
5) More sugar released into blood. Ability of blood clot increases.
6) Sweating increases.
7) Flow of blood to digestive system reduced. Digestion slows. More stomach acid produced.
8) Pupils open wide.
10) Lump forms in throat as muscles contract.
The Sympathetic Response

- increased heart rate
- increased breathing rate
- increased blood flow to the muscles
- increased blood pressure
- increase in the depth of breathing
- increasing oxygen intake
- release of extra glucose for more energy
- sweaty hands and palms

**parasympathetic response reverses all these**
Thymus Gland

- Releases the hormone **Thymogen**
- Found under the sternum, the gland shrinks as you get older into adulthood
- Helps with the development of antibodies in the immune system
Gonads

• Ovaries
  – Located on both sides of the uterus below the opening of the fallopian tubes.
  – Produce estrogen and progesterone which affect the female characteristics and reproductive functions.

• Testes
  – Egg-shaped organ that hang in a pouch of skin called the scrotum outside the male body.
  – Produce testosterone which affects male characteristics and the production of sperm.
<table>
<thead>
<tr>
<th>GLAND</th>
<th>LOCATION</th>
<th>HORMONES</th>
<th>FUNCTIONS</th>
<th>DISEASES</th>
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</thead>
<tbody>
<tr>
<td>Pineal</td>
<td>In the center of the brain</td>
<td>Melatonin</td>
<td>Circadian Rhythm</td>
<td></td>
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<tr>
<td>Pituitary</td>
<td>Hanging from the anterior underside of the brain</td>
<td>GH</td>
<td>Skeletal /muscular growth</td>
<td>Dwarfism/Gigantism/Acromegaly</td>
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<td></td>
<td></td>
<td>ACTH</td>
<td>Stimulation Adrenal Gland</td>
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<td>TSH</td>
<td>Stimulation Thyroid Gland</td>
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<td></td>
<td></td>
<td>FSH</td>
<td>Stimulation egg production</td>
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<td></td>
<td>Oxytocin</td>
<td>Uterine contractions/ milk release</td>
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<td>Thyroid</td>
<td>In the neck just below the larynx</td>
<td>Thyroxin</td>
<td>metabolism</td>
<td>Hypothyroidism</td>
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<td>Hyperthyroidism</td>
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<tr>
<td>Parathyroid</td>
<td>Four glands on the posterior aspect of the Thyroid Gland</td>
<td>PTH</td>
<td>Calcium regulation (blood and bones)</td>
<td>Hyperparathyroidism</td>
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<tr>
<td>Adrenal</td>
<td>Superior to each Kidney</td>
<td>Cortisol</td>
<td>Stress Hormone –Metabolism</td>
<td>Addison’s</td>
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<td>Epinephrine</td>
<td>Sympathetic Response</td>
<td>Fight or Flight Response</td>
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<td>Norepinephrine</td>
<td>Reverses Sympathetic Response</td>
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<td>Pancreas</td>
<td>Behind the Stomach</td>
<td>Insulin</td>
<td>Decreases blood sugar</td>
<td>Diabetes (Type I, II, Gestational)</td>
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<td>Glucagon</td>
<td>Increases blood sugar</td>
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<td>Behind the Sternum</td>
<td>Thymogen</td>
<td>Build immune system</td>
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<td>On both sides of the uterus in women</td>
<td>Estrogen, Progesterone</td>
<td>Secondary sex characteristics</td>
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<tr>
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<td>In the scrotum in men</td>
<td>Testosterone</td>
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