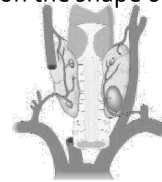


The Endocrine System

Thyroid Gland

- It is the biggest gland in the neck with two lobes that wrap around the trachea connected by an isthmus.
- Consists of two lobes, a left and right which take on the shape of a butterfly.



Thyroid Gland

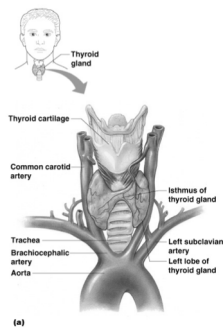


Figure 9.6

Thyroid Hormone

- Two active iodine containing hormones are produced by the thyroid gland.
- Thyroxine (T_4)
- Triiodothyronine (T_3)

Function of Thyroid Hormones

- Controls the rate at which your body burns calories (metabolism)
- Slow or speed up heart rate
- Raise or lower body temperature
- Regulate the speed at which food moves through the digestive tract
- Affect muscle strength
- Regulate the speed at which body replaces dying cells

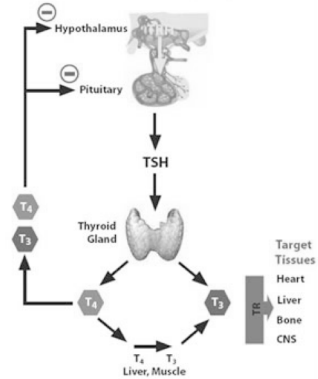
Pituitary and your Thyroid

- The pituitary and the thyroid work together.
- The pituitary gland produces TSH (thyroid stimulating hormone). This in turn causes the thyroid to release more T_3 and T_4 .
- Blood tests can reveal if levels of TSH are adequate.

Levels of TSH

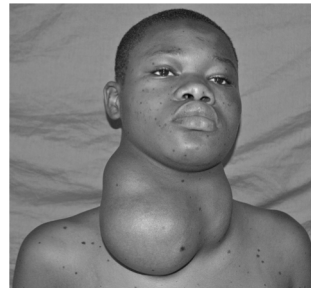
- If blood tests reveal the TSH levels are too high, that means the thyroid is not producing enough T₃ or T₄. That is bad because the pituitary can become overworked and fail.
- This can be prevented by taking medications like Levothyroxine. This medication increases levels of T₃ and T₄ when the thyroid is not producing enough on its own.

Hypothalamic-Pituitary-Thyroid Axis



Disorders of the Thyroid

- Goiters-Enlargement of the thyroid gland due to a lack of iodine. Iodine is necessary because T₃ and T₄ are iodine containing hormones. Iodine can be found in the soil in most areas of the world. However, some areas of the world have soil low in iodine. This led to many people developing goiters. We have an area right here in the USA near the Great Lakes. To combat this problem, iodine is added to salt (iodized salt)



Parathyroid Gland

- Located in the neck located behind the thyroid gland.
- Humans have 4 of them, roughly the size of a grain of rice.
- They regulate the levels of calcium in the blood constantly using a hormone called PTH (parathormone).
- Regulation is done using PSH (parathyroid stimulating hormone)

Parathyroid Stimulating Hormone

- If blood calcium is too low, PTH is released and calcium is removed from the bones to increase calcium levels in the blood.
- If blood calcium is too high, the parathyroid shuts down and stops making PTH. A hormone called calcitonin also helps reduce blood calcium.

Importance of Calcium

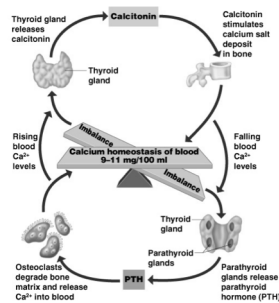
- Provides electrical energy for our nervous systems by helping the impulse travel along the nerve cells.
- Provide energy for muscle cells to contract.
- Helps provide strength to the skeletal system.

Disorders of the Parathyroid

- Hyperparathyroidism-Too much PSH is present and blood calcium levels rise. This can cause kidney stones and/or osteoporosis.
- Hypoparathyroidism-You will not have enough blood calcium and too much phosphorous. This is rare, but can cause damage to other endocrine glands.

Calcitonin

- Decreases blood calcium levels by causing its deposition on bone
- Antagonistic to parathyroid hormone



Adrenal Glands

- Sits on top of the kidneys
- Two glands
 - Cortex – outer glandular region in three layers
 - Medulla – inner neural tissue region

Hormones of the Adrenal Cortex

- Mineralocorticoids (mainly aldosterone)
 - Produced in outer adrenal cortex
 - Regulate mineral content in blood, water, and electrolyte balance
 - Target organ is the kidney by controlling the absorption of sodium and potassium.

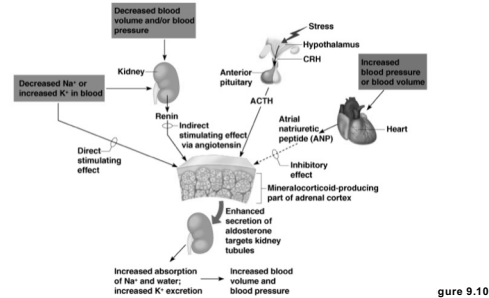
Hormones of the Adrenal Cortex

- Glucocorticoids (including cortisone and cortisol)
 - Produced in the middle layer of the adrenal cortex
 - Released in times of stress or low blood sugar.
 - Promote normal cell metabolism
 - Help resist long-term stressors

Hormones of the Adrenal Cortex

- Sex hormones
 - Produced in the inner layer of the adrenal cortex
 - Androgens (male) and some estrogen (female)

Hormones of the Adrenal Cortex



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

Adrenaline/Epinephrine

- A stress hormone released by the adrenal glands that quickens heart beat, strengthens heart contractions and opens the bronchioles of the lungs.
- Released in times of fear, panic or stress.
- Causes a "fight or flight" response.

Fight or Flight

- An interaction between your nervous system and your endocrine system.
- The hypothalamus tells the sympathetic nervous system to kick into gear and become alert.
- The adrenal glands release adrenaline (epinephrine) and your body prepares itself to fight the fear or to run away to safety.

Road Rage

- When someone cuts you off or drives crazy it causes several reactions to occur in your body.
- Many people will speed up and try to engage the individual in a fight by flashing lights or actually getting out of the car and bashing on the other guys car.
- If you find someone driving crazy, slow down and take a breath. It is not worth potentially hurting someone or you yourself getting hurt.
- The feeling will pass and you can go about your day.

Norepinephrine/ Noradrenaline

- A neurotransmitter that influences reflexive changes in cardiovascular tone.
- Part of the sympathetic nervous system.

Roles of the Hypothalamus and Adrenal Glands in the Stress Response

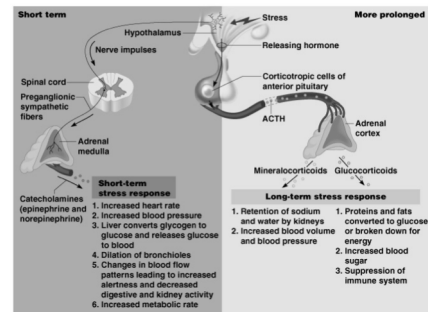
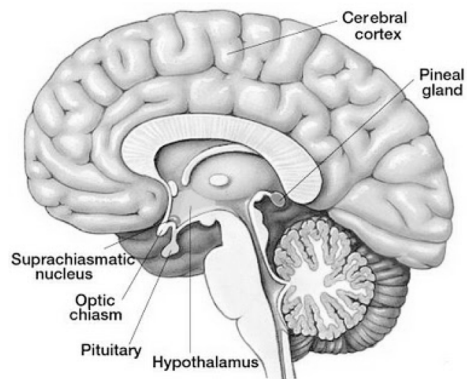


Figure 9.12

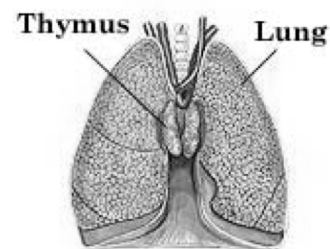
Pineal Gland

- Found on the third ventricle of the brain
- Secretes melatonin
 - Helps establish the body's wake and sleep cycles
- May have other as-yet-unsubstantiated functions



Thymus

- 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



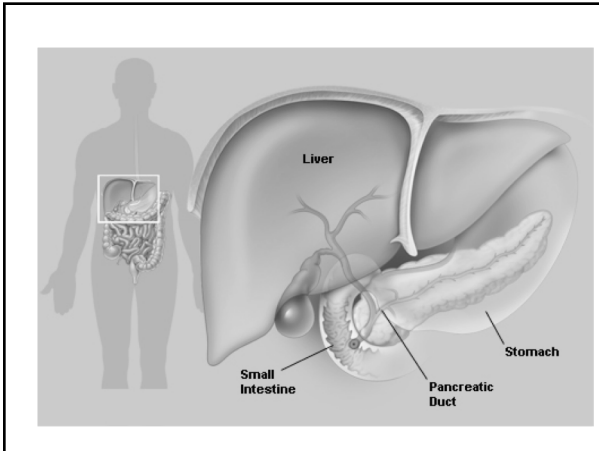
The Pancreas

- It is a six inch long gland that sits across the back of the abdomen just behind the stomach.
- For its digestive function, it is connected via a duct to the duodenum and provides enzymes needed to break down food on its way to be absorbed by the small intestines.
- As an endocrine gland, it regulates blood sugar with the production of insulin and glucagon.

Islets

The islets of the pancreas produce hormones

- Insulin– allows glucose to cross plasma membranes into cells from beta cells
- Glucagon – allows glucose to enter the blood from alpha cells



Insulin

- Produced by cells in the pancreas called Islets of Langerhans but are commonly called "Islets"
- A healthy adult has about 1 million Islet cells which help regulate blood sugar.
- One type of cell is called the Beta cell, and when it senses too much sugar in the blood, insulin is released to lower blood sugar.

Glucagon

- Produced by the alpha cells of the pancreas when blood sugar is too low.
- When glucagon is released, the liver will release some of its stored glucose. The glucose is stored in a molecule called glycogen.
- This will help increase blood sugar levels.

Normal Blood Sugar Levels

- Blood glucose is normally between 70 mg/dl and 110 mg/dl.
- When levels drop below 70 you are considered hypoglycemic.
- When levels are above 180 you are considered hyperglycemic.

Blood Sugar Test Kits

Diabetic Meter Bag



Malfunction of the Pancreas-Diabetes

- Type I diabetes-The body's immune system destroys insulin producing cells. Lifelong insulin injections are needed to maintain blood sugar levels.
- Type II diabetes-The body makes insulin its just not enough or the body cannot use it well enough. Some people can control type II diabetes with diet and exercise.

Pancreatic Islets

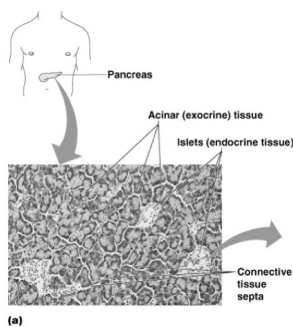


Figure 9.13

Pancreatic Hormones and Blood Sugar

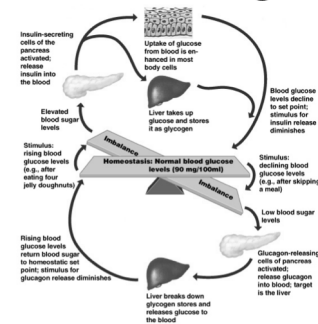


Figure 9.14

Hormones of the Ovaries

- Estrogens
 - Stimulates the development of secondary female characteristics
 - Matures female reproductive organs
 - Helps prepare the uterus to receive a fertilized egg
 - Helps maintain pregnancy
 - Prepares the breasts to produce milk

Hormones of the Ovaries

- Progesterone
 - Produced by the corpus luteum
 - Acts with estrogen to bring about the menstrual cycle
 - Helps in the implantation of an embryo in the uterus

Hormones of the Testes

- Interstitial cells of testes are hormone-producing
- 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

Endocrine Function of the Placenta

- Produces hormones that maintain the pregnancy
- Some hormones play a part in the delivery of the baby
- Produces 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