



The Endocrine System

Endocrine Glands

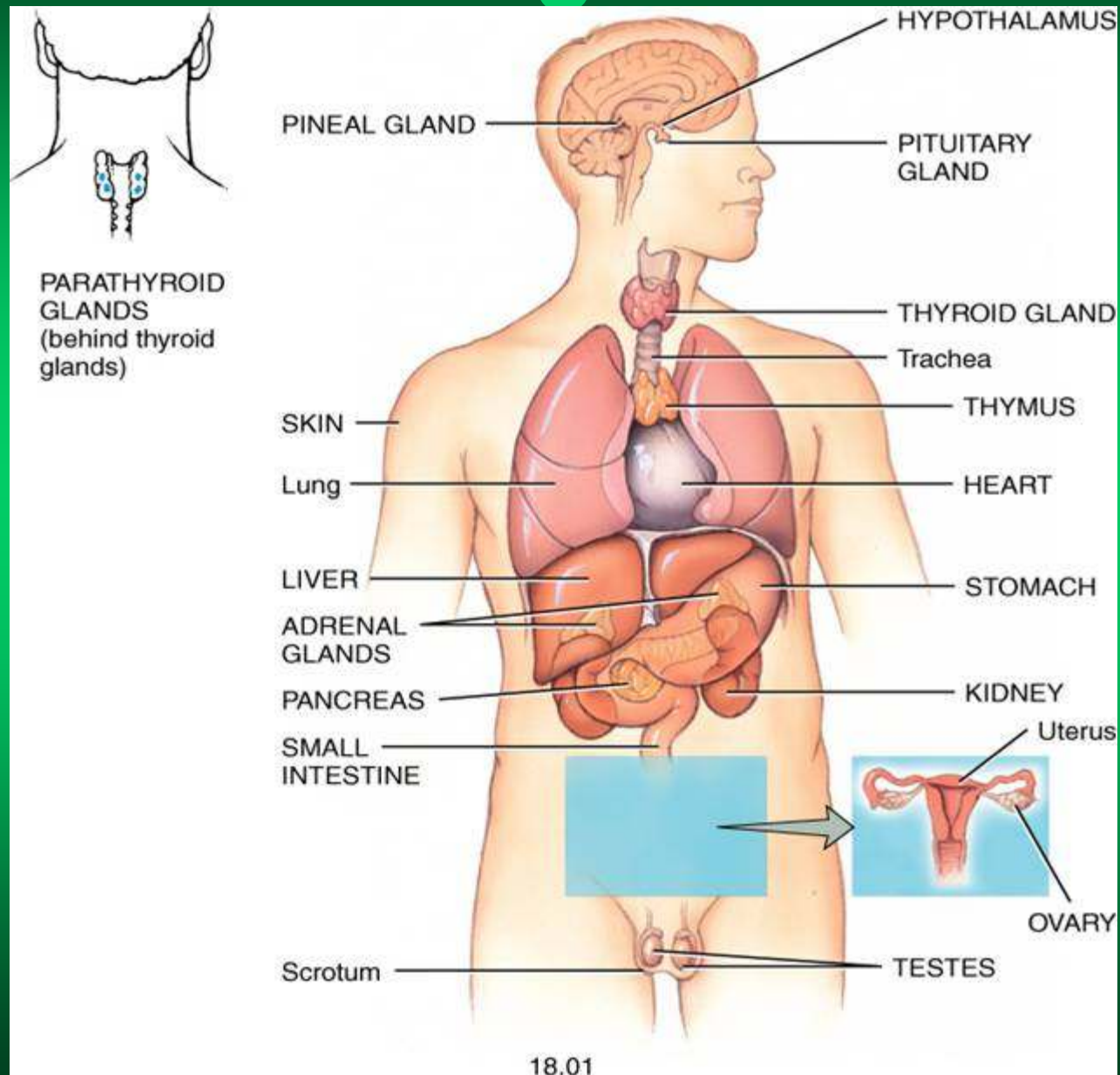


- Glands that secrete their products (HORMONES) into extracellular spaces around cells. The hormones then enter into the bloodstream by diffusing into the capillaries located next to the glands.

Glands and Organs of the Endocrine System

- Hypothalamus
- Pituitary
- Thyroid
- Parathyroid
- Thymus
- Pancreas
- Adrenal
- Gonads
 - Testes
 - Ovaries
- Pineal
- Thalamus
- Kidneys
- Liver
- Stomach
- Lungs
- Heart
- Small Intestine
- Skin
- Placenta

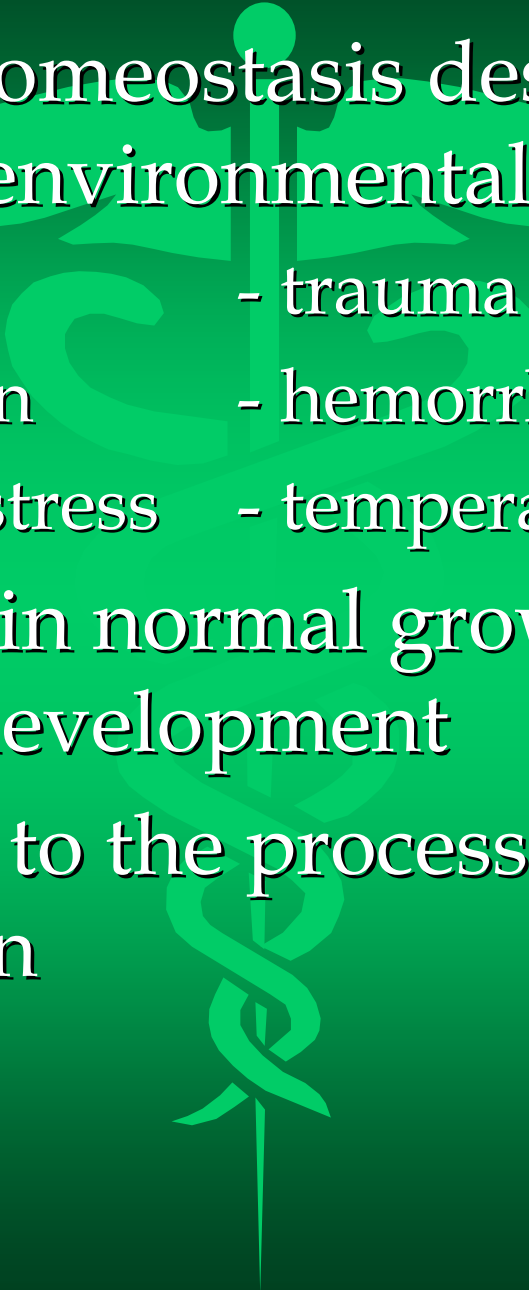
Endocrine Glands



Hormone Function



- Regulates chemical and volume of the body's internal environment
- Regulates metabolism and energy balance
- Regulates contraction of cardiac and smooth muscle
- Regulates certain activities of the immune system

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- Maintains homeostasis despite emergency environmental interruptions
 - infection – trauma – starvation
 - dehydration – hemorrhage
 - emotional stress – temperature extremes
 - Plays a role in normal growth and sequential development
 - Contributes to the process of reproduction

Hormones



- Secretions of the endocrine glands
- Enter the bloodstream and have an effect on a target cell, tissue, or organ
- Over 50 different hormones
- Most only affect a few, specific types of cells

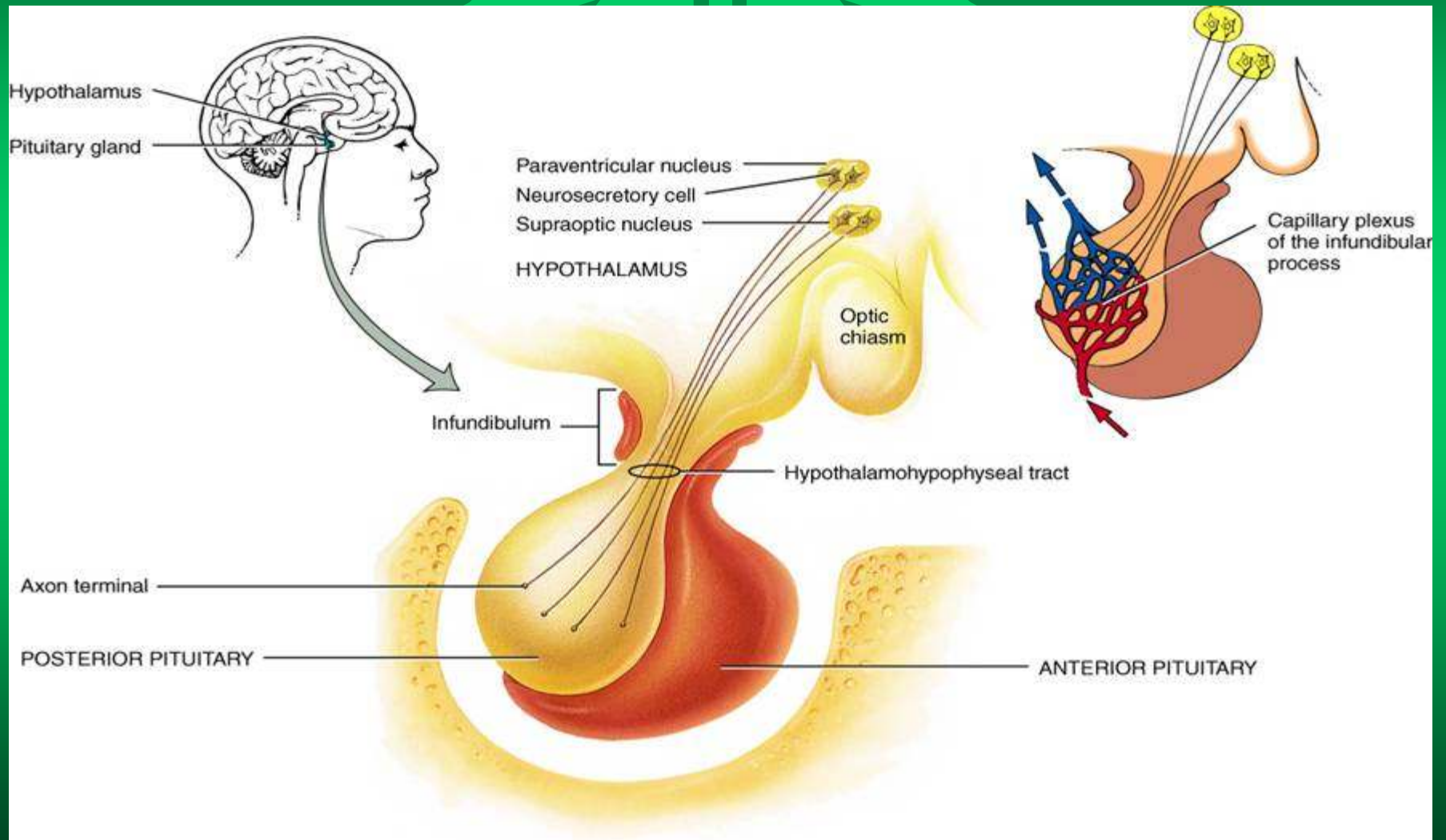


Endocrine Glands and The Hormones They Secrete

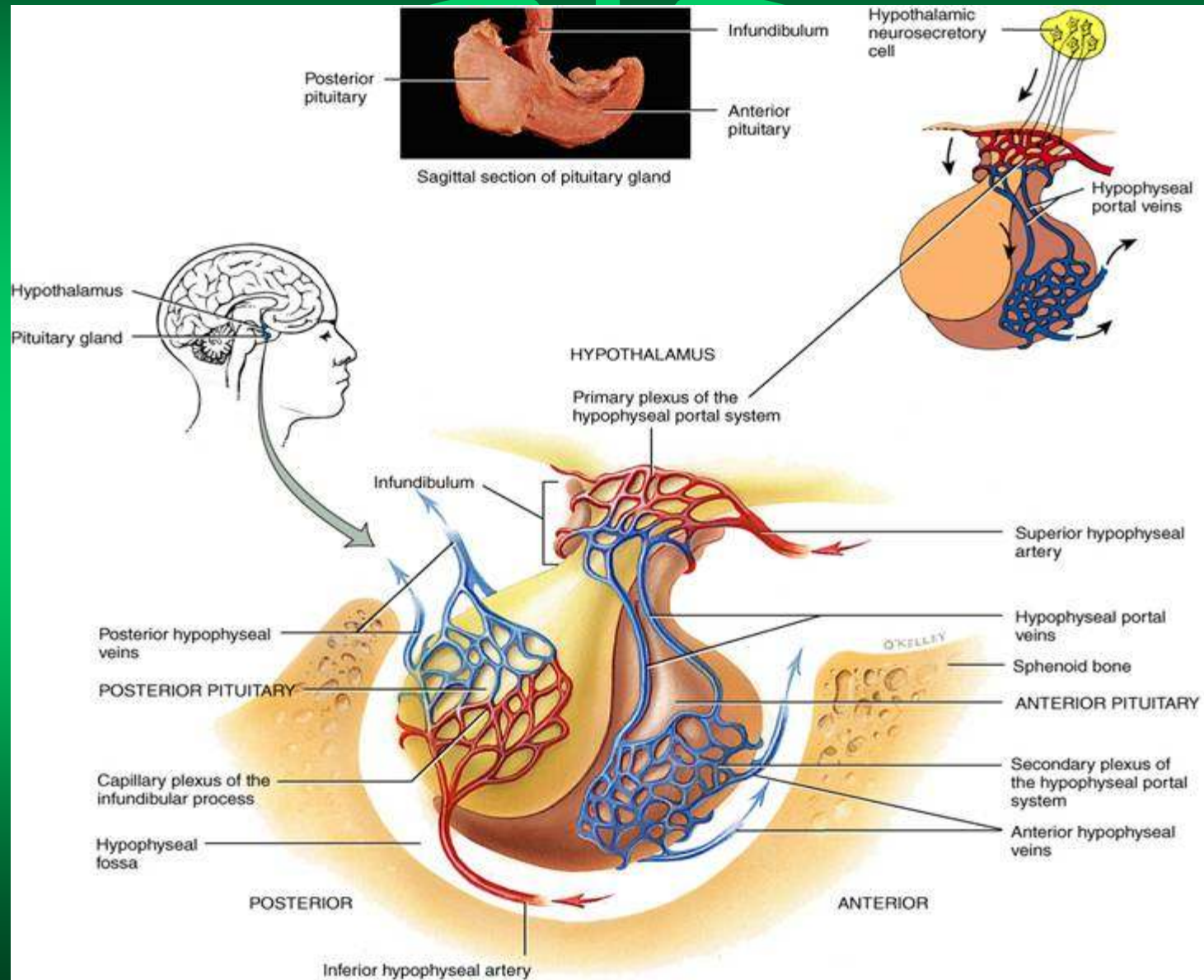
Pituitary Gland (Hypophysis)

- Often called the master gland because it secretes hormones that control other endocrine glands
- Structurally divided into two parts:
- Anterior Pituitary Gland
(Adenohypophysis)
- Posterior Pituitary Gland
(Neurohypophysis)

Pituitary Gland



Pituitary Gland



Human Growth Hormone (hGH) or Somatotropin

- The most abundant anterior pituitary hormone
- Stimulates growth of body cells
- Stimulates protein synthesis
- Inhibits protein breakdown
- Stimulates lipolysis (fat breakdown)
- Inhibits the use of glucose as a fuel for metabolism

Thyroid Stimulating Hormone (TSH)

- Also called Thyrotropin
- Influences the body's metabolic rate
- Stimulates the secretion of:
 - T3 - Triiodothyronine
 - T4 - Thyroxine

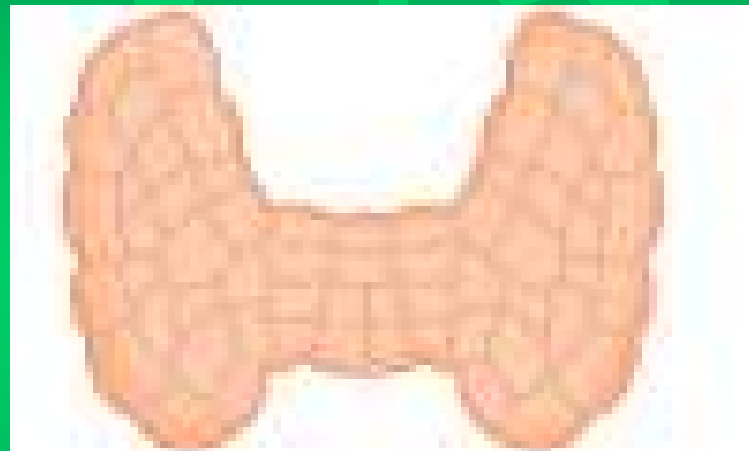
Adrenocorticotrophic Hormone (ACTH)

- Controls the production and secretion of glucocorticoids by the cortex of the adrenal glands

Thyroid Gland Hormones

- The thyroid gland is located just below the larynx with its lobes lying on either side of the trachea
- The right and left lobes are connected to each other by the *isthmus*
- The only gland that can store its secretory product in large quantities
 - normally about a 100 day supply

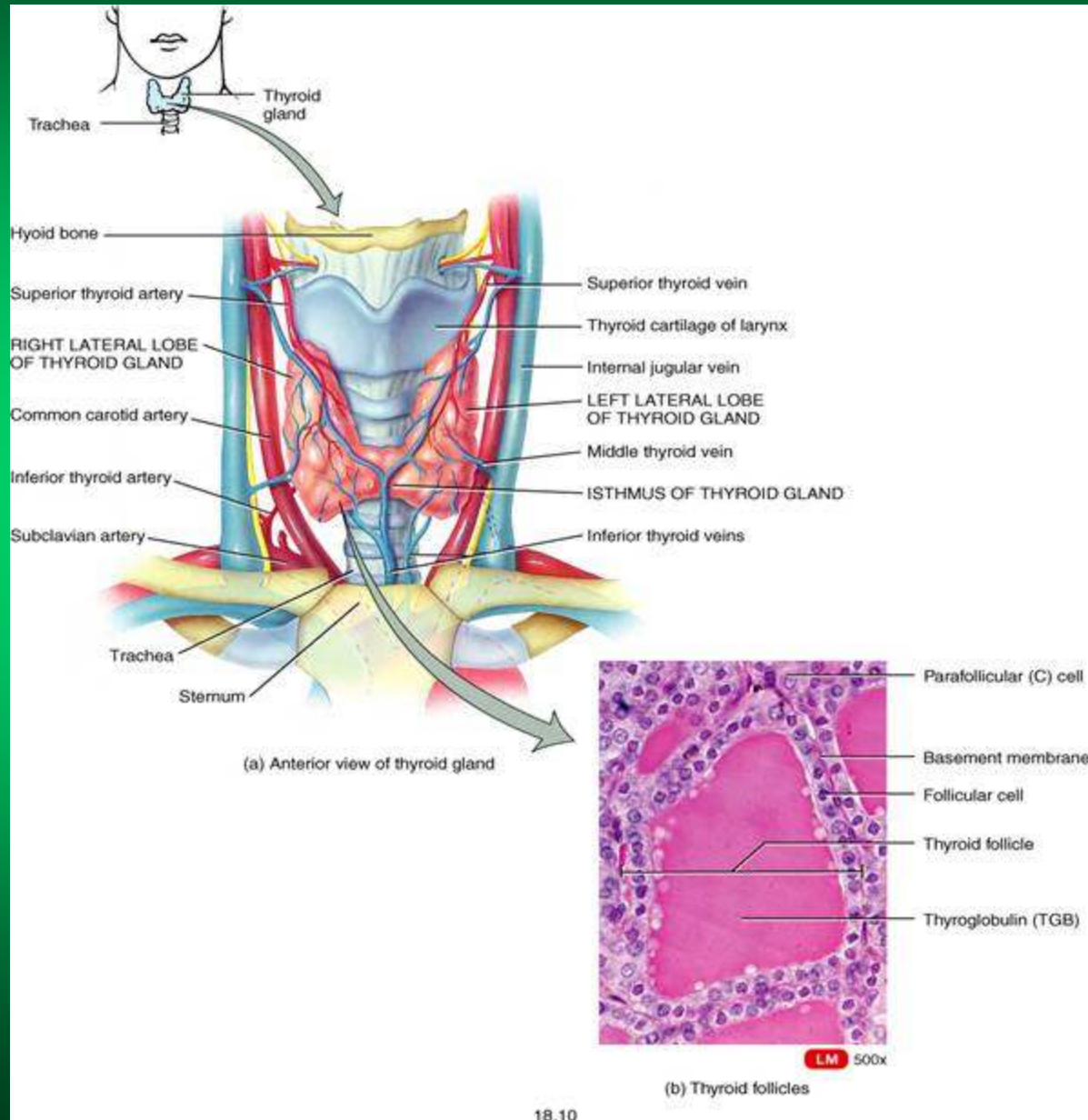
Thyroid Gland



Thyroid gland

18.T04b

Thyroid Gland



Thyroid Hormones



- Thyroxine (T4)
 - Contains 4 iodine atoms
 - Normally secreted in greater quantity
 - Most is converted to T3 by the removal of an iodine atom

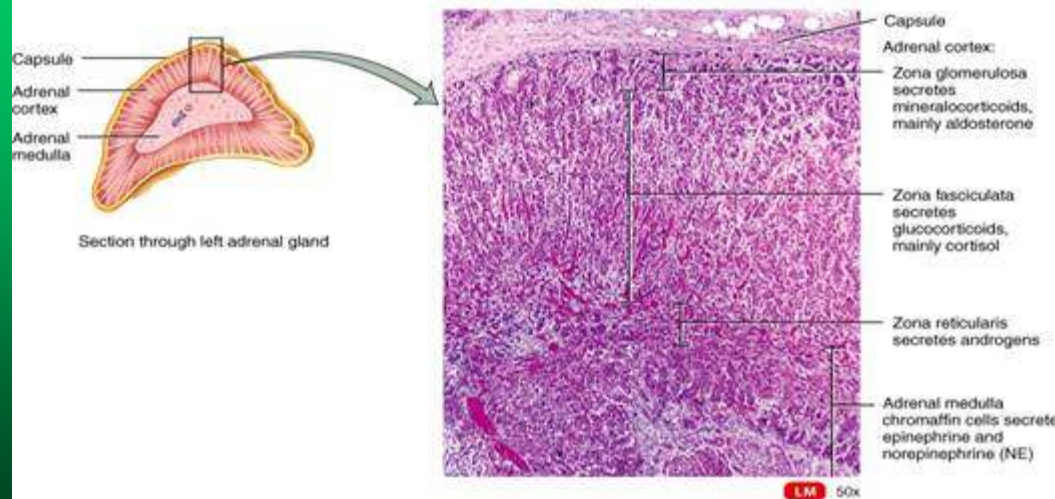
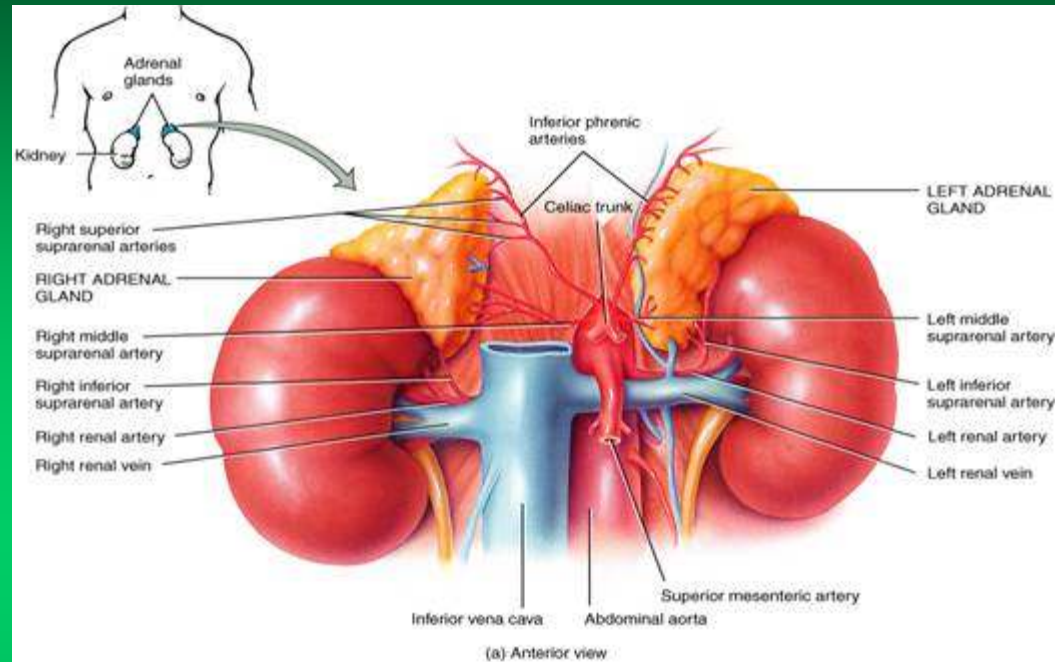
Actions of the Thyroid Hormones (T3 and T4)

- Regulates oxygen utilization and basal metabolic rate
- Regulates cellular metabolism
 - Increases protein synthesis
 - Increases lipolysis
 - Increases glucose use in ATP production
- Works in conjunction with hGH to regulate growth and development catecholamines
- Enhances the actions of

Adrenal (Suprarenal) Glands and Hormones

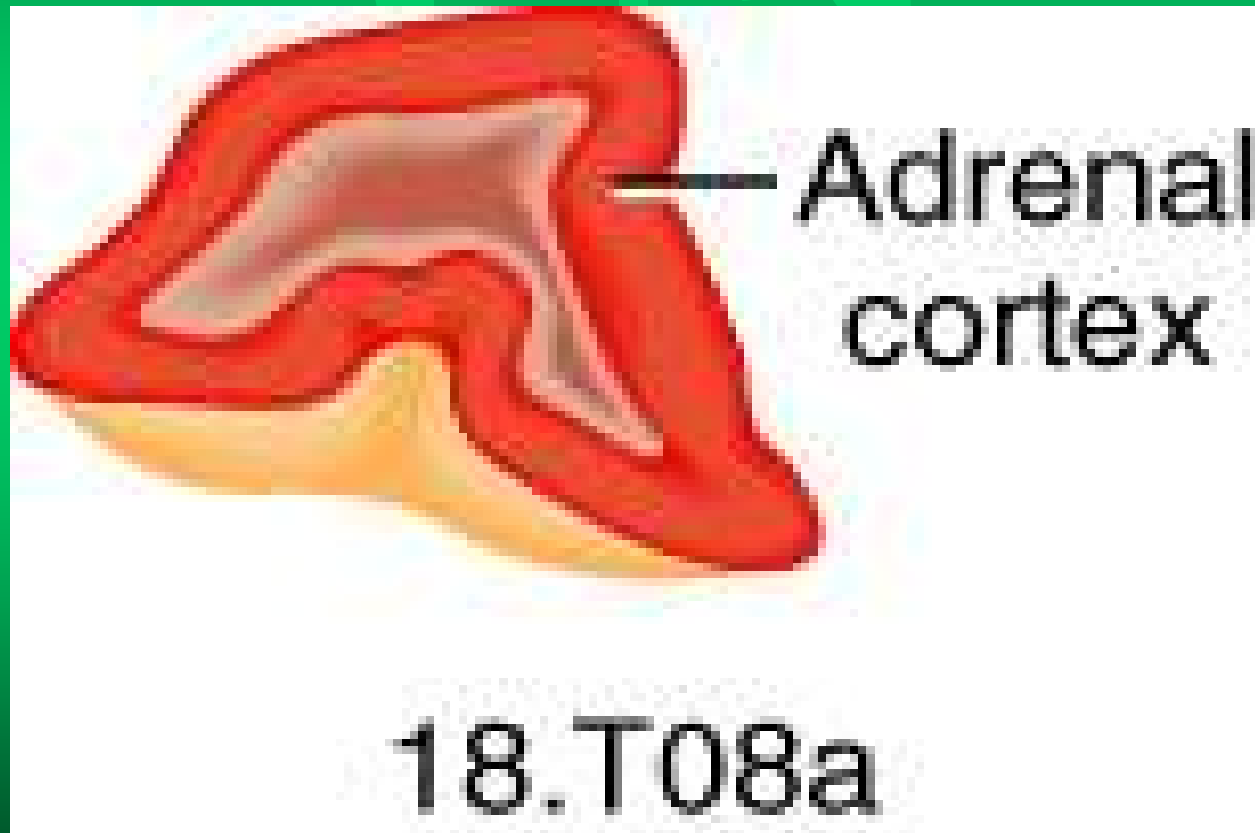
- Glands located superior to each kidney
- Structurally divided into two regions
- Adrenal Cortex
 - Outer region
 - Makes up the majority of the gland
- Adrenal Medulla
 - The inner portion of the gland

Adrenal Glands



(c) Subdivisions of the adrenal gland

Adrenal Cortex



Glucocorticoids

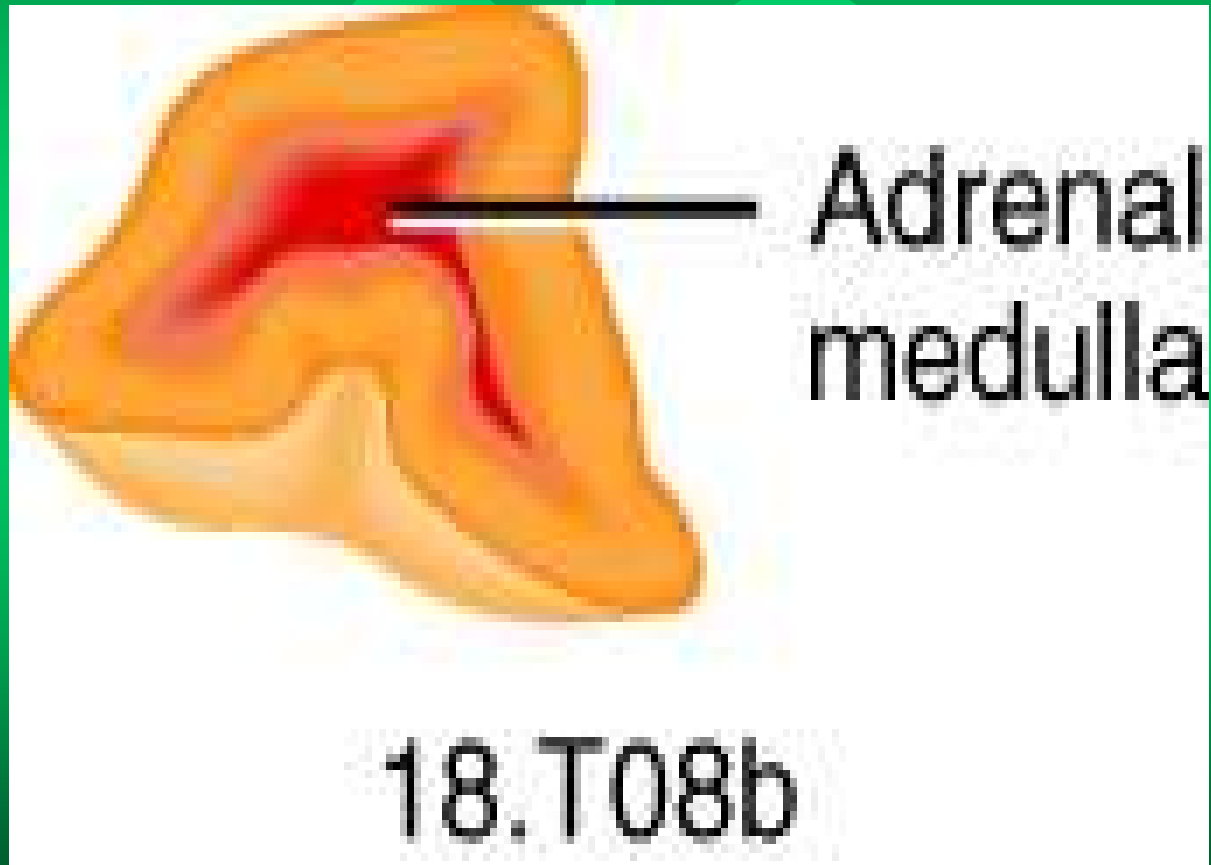
- regulates metabolism
- influences resistance to stress
- Cortisol (Hydrocortisone)
 - makes up 95% of glucocorticoids
 - primary role is that of gluconeogenesis
 - synthesis of glucose and glycogen in the liver
 - promotes normal metabolism
 - provides resistance to stress
 - acts as anti-inflammatory compounds
- regulated by the secretion of ACTH

Adrenal Medulla



- Inner region of the adrenal glands
- Contains two sets of hormone producing cells
- Under the direct control of the Autonomic Nervous System (ANS)
 - Hormone production and release can occur almost immediately

Adrenal Medulla



Hormones of the Adrenal Medulla

- Epinephrine and Norepinephrine
(Adrenaline and Noradrenaline)
 - Makes up over 80% of the secretions from the adrenal medulla
 - Responsible for the *“Fight or Flight”* response
 - Helps the body cope with stress

Actions of Epinephrine and Norepinephrine

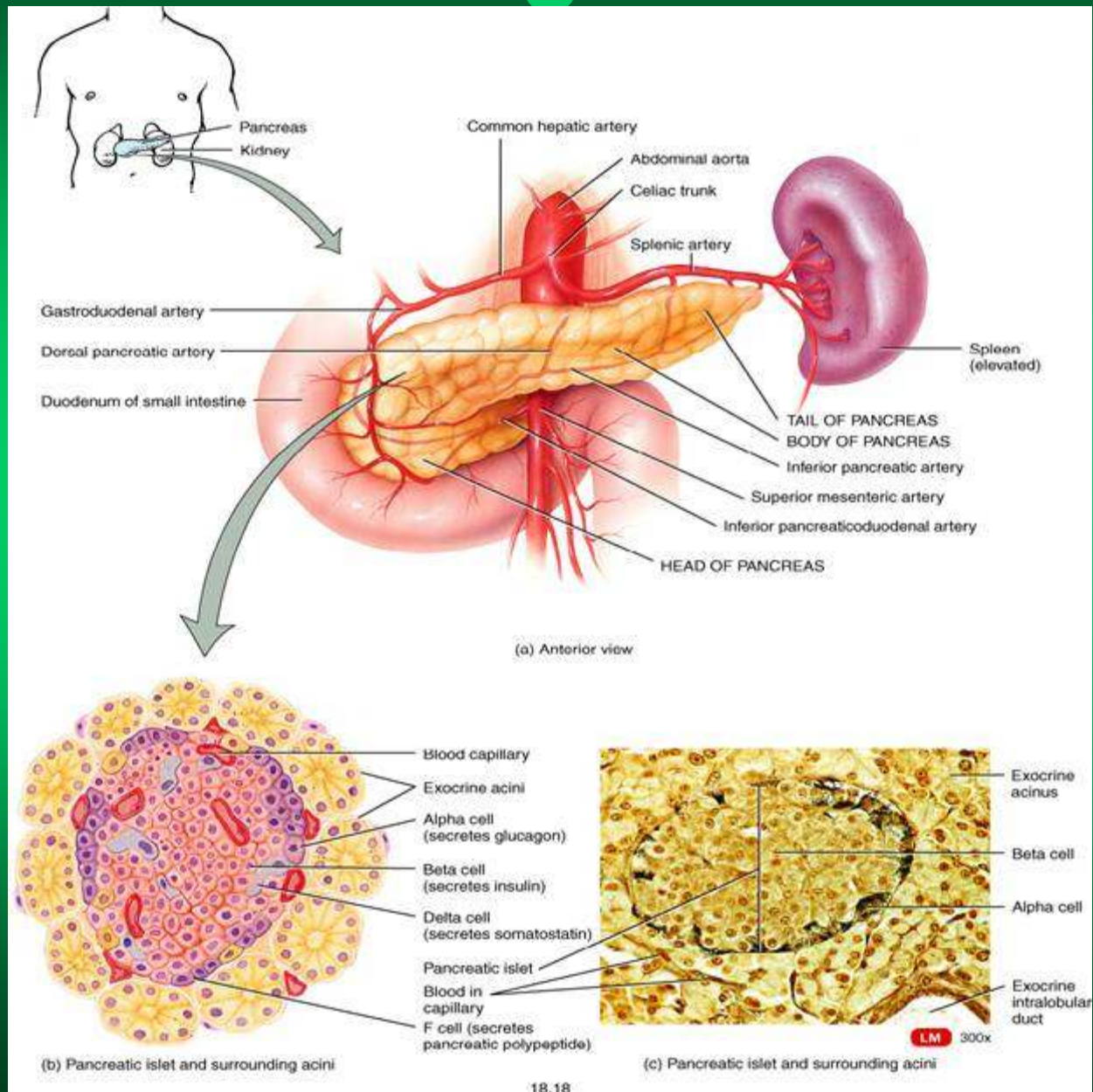
- increases heart rate
- increases blood pressure
- increases heart contractility
- constricts blood vessels
- increases respiratory rate
- dilates respiratory passageways
- increases blood sugar levels
- stimulates cellular metabolism
- increases efficiency of muscular contractions

Pancreas



- A flattened oblong organ located just posterior and slightly inferior to the stomach
- Is both an endocrine and exocrine gland
- The endocrine tissue of the pancreas is called the *Pancreatic Islets* or *Islets of Langerhans*

Pancreas

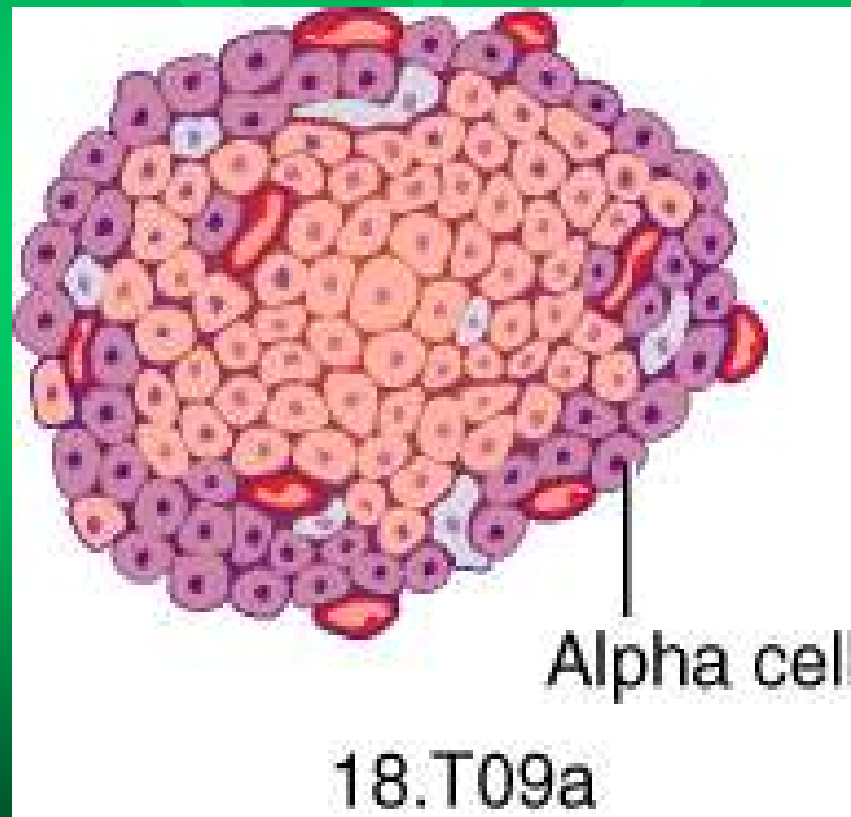


Cell Types of the Islets of Langerhans

- Alpha Cells - secrete Glucagon
 - raises blood sugar
- Beta Cells - secrete Insulin
 - lowers blood sugar

Alpha Cells

-Secretes Glucagon-



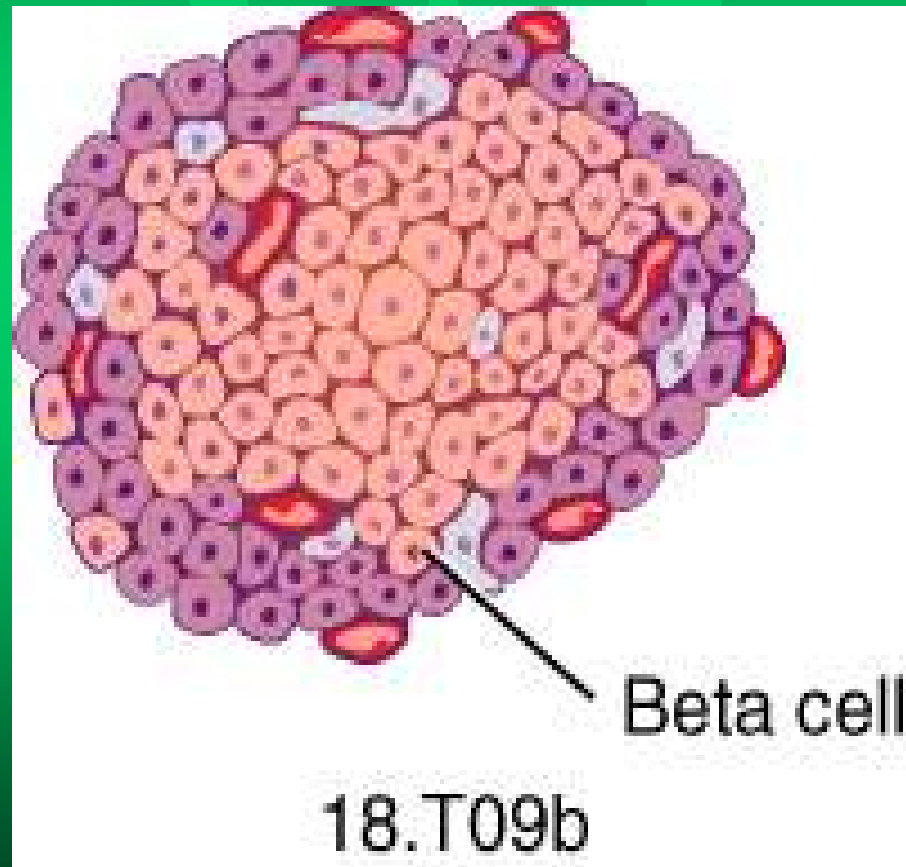
Glucagon



- Increases blood sugar when it falls below normal ranges
- Main target tissue is the liver
- Accelerates the conversion of glycogen into glucose (glycogenolysis)
- Promotes the formation of glucose from lactic acid (lactate) and certain amino acids (gluconeogenesis)
- Suppresses appetite

Beta Cells

-Secretes Insulin-



Insulin

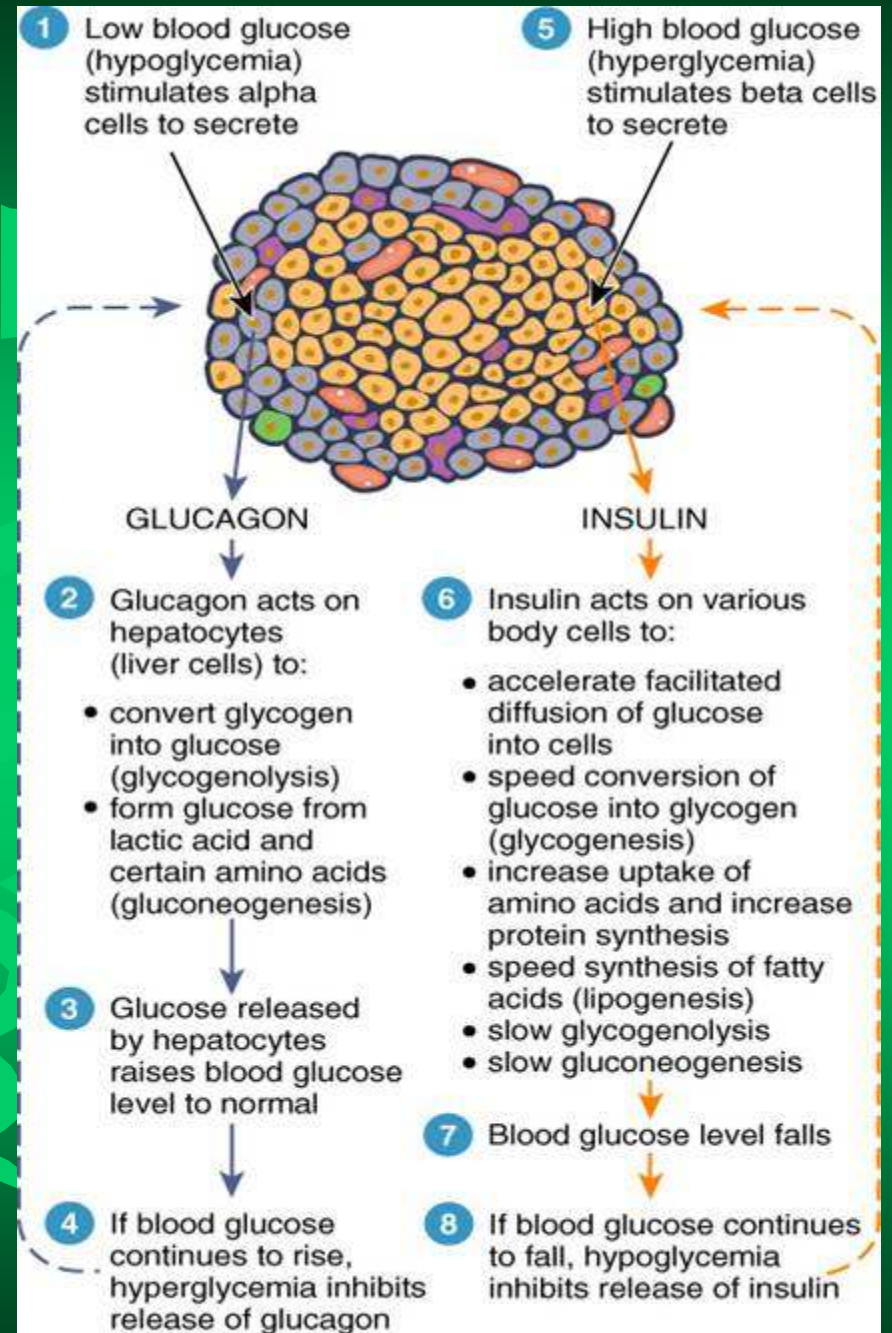


- Decreases blood glucose levels if it gets too high
- Accelerates the transfer of glucose from the blood into the body's cells
- Accelerates the conversion of glucose to glycogen (glycogenesis)
- Accelerates the entry of amino acids into cells and the synthesis of proteins

- Accelerates the conversion of glucose or other nutrients into fatty acids (lipogenesis)
- Inhibits glycogenolysis
- Inhibits gluconeogenesis
- Primarily influenced by blood glucose levels
- Also influenced by increased levels of certain amino acids and hormones
 - hGH and ACTH stimulate Insulin release

Blood Glucose Regulation

- Insulin
 - Decreases Blood Glucose
- Glucagon
 - Increases Blood Glucose





Metabolic Diseases and Disorders of the Endocrine System

Dwarfism



- Caused by a hyposecretion of hGH during the growth years
 - Slow bone growth
 - Epiphyseal plates close before normal height is reached
 - Other organs of the body may also fail to grow and develop
- Treatment requires administration of hGH during childhood

Dwarfism

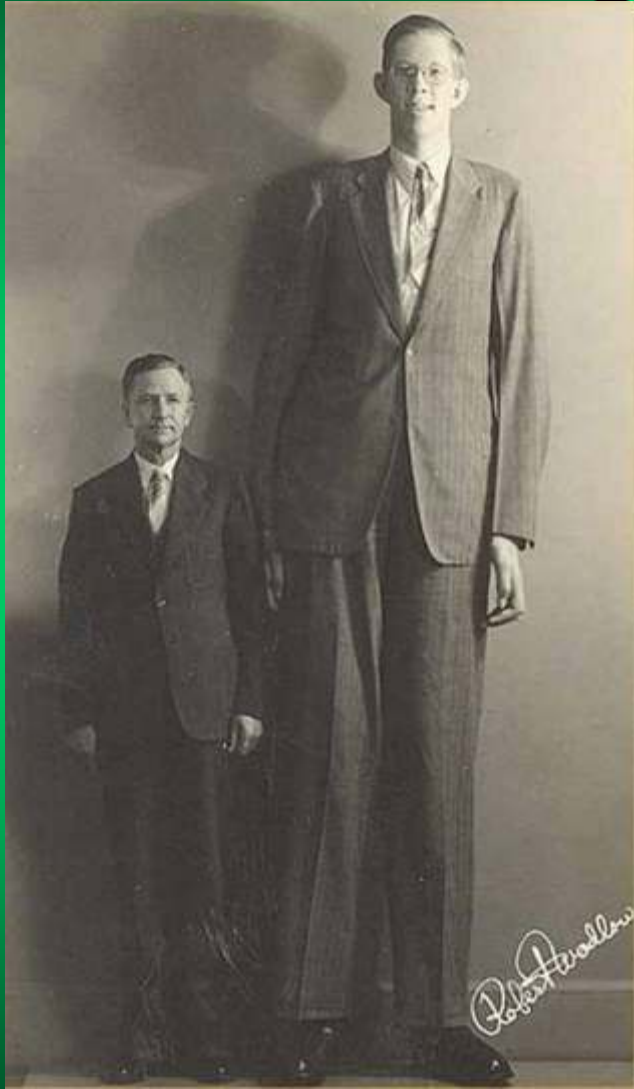


Gigantism



- Caused by the hypersecretion of hGH during childhood
 - Abnormal increase in bone length and size of other organs
- The person is very tall with normal body proportions

Gigantism



Robert Wadlow 8' 3"



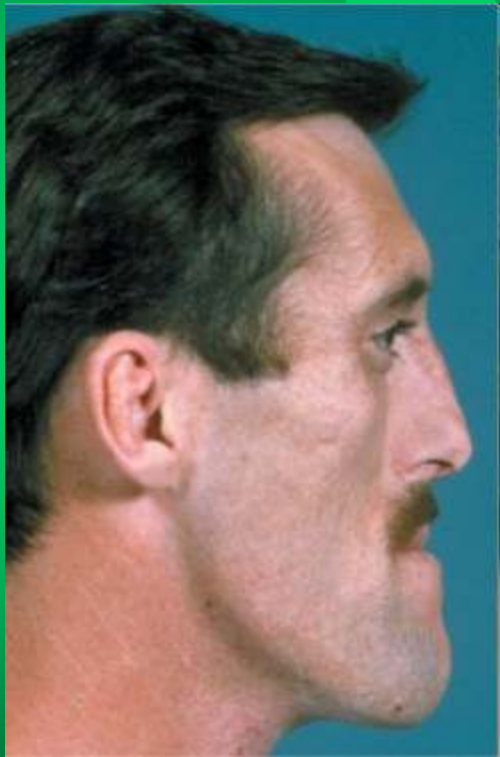
De-Fen Yao 7' 9"

Acromegaly



- Caused by the hypersecretion of hGH during adulthood
- May be caused by steroid and hGH use
 - Bones of hands, feet, and skull thicken
 - Eyelids, lips, and tongue enlarge
 - Skin thickens and develops furrows

Acromegaly



Cretinism



- Caused by hyposecretion of thyroid hormones during fetal development
 - Exhibits dwarfism because the skeleton fails to grow
 - Individuals are usually severely mentally retarded
 - Retarded sexual development
 - Usually have a yellowish skin color

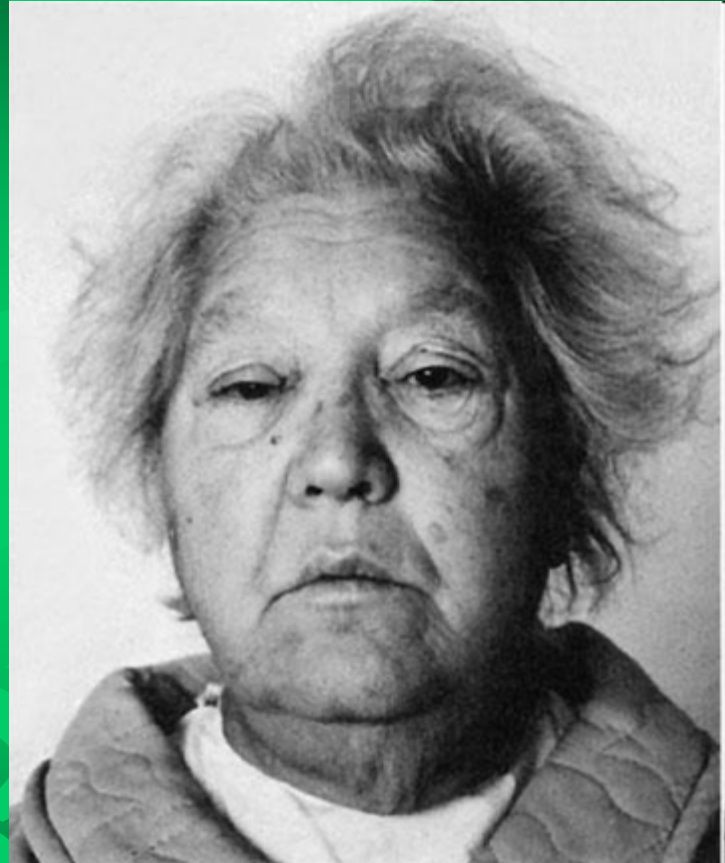
Cretinism



Myxedema

- Caused by hypothyroidism during the adult years
- Causes facial tissue to swell and look puffy
- About 5 times more common in females
- Other symptoms include:
 - bradycardia
 - low body temperature
 - lethargy
 - muscle weakness
 - dry skin and hair
 - easily gains weight
 - sensitivity to cold
 - hypersensitive to drugs

Myxedema



Graves' Disease

- Caused by hyperthyroidism
- An autoimmune disorder
 - increased metabolism - heat intolerance
 - increased sweating - insomnia
 - weight loss - nervousness
 - tremors of hands
- May have a slightly enlarged thyroid gland (goiter)
- Causes the eyes to protrude (exophthalmos)

Graves' Disease



Diabetes mellitus

Metabolic malfunction that arises from a lack of insulin or the inability for cells to recognize it.

Insulin stimulates the liver to form glycogen from glucose and inhibits conversion of non-carbohydrates into glucose. It also assists glucose in crossing some cell membranes (cardiac muscle, adipose tissue, and resting skeletal muscle)

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Diabetes mellitus

- Blood sugar concentration rises and the excess is dumped by the kidneys.
- Glucose-starved cells use proteins for energy causing tissues to waste away.
 - Drop in weight, hunger increases, slow healing, growth stops in children, exhaustion.
 - Changes in fat metabolism cause fatty acids and ketones to accumulate in the blood, lowering the pH.
 - Dehydration and acidosis can harm brain cells, cause disorientation, coma, and eventually death.

Diabetes mellitus

- Type I (insulin-dependent or juvenile)
 - Usually before age 20.
 - Immune system destroys the beta cells of the pancreas.
 - Insulin injections several times per day.
- Type II (non-insulin-dependent or maturity-onset)
 - Insulin is produced, but the body cannot recognize it.
 - Usually after age 40.
 - Can be controlled with diet.
- Blood-glucose levels must be monitored daily.
- ¹¹⁻⁵² Non-treatment causes coronary heart disease, peripheral nerve damage, and retinal damage..

Diabetes Mellitus

- A group of disorders that leads to an elevation of blood glucose (hyperglycemia)
- Symptoms include:
 - polyuria
 - polydipsia
 - polyphagia
 - glucosuria
- Two Types or Categories of Diabetes
 - Type I Diabetes - Insulin Dependent Diabetes Mellitus (IDDM)
 - Type II Diabetes - Non Insulin Dependent Diabetes Mellitus (NIDDM)

Type I Diabetes (IDDM)

- Pancreas does not produce insulin due to the destruction of beta cells in the Islets of Langerhans
- Requires regular injections of insulin to prevent death
- Most commonly develops in individuals younger than 20 years old (*Juvenile Onset Diabetes Mellitus*)
- Appears to be an autoimmune disorder

Type II Diabetes (NIDDM)

- Also called *Maturity Onset Diabetes*
- Much more common type of Diabetes (over 90% of Diabetes cases)
- Most often occurs in individuals over 40, but seeing more often now in children
- Most individuals are overweight or clinically obese
- Blood glucose levels can usually be controlled by medications, diet, exercise, and weight loss and control

Complications from Diabetes



- atherosclerosis
- heart disease
- peripheral vascular disease
- severe kidney damage
- Glaucoma and/or blindness
- gangrene
- ketoacidosis
- weight loss
- neuropathy

Treatments for Diabetes

- Regular insulin injections
- Artificial pancreas
- Transplantation of the pancreas
- transplantation of clusters of islet cells
- Injection of fetal islet cells