NCHSE

National Consortium for
Health Science Education

NCHSE
National Consortium for Health Science Education

The Endocrine System

- **Foundation Standard 1: Academic Foundation**

  Understand human anatomy, physiology, common diseases and disorders, and medical math principles.

1.13 Analyze basic structures and functions of human body systems

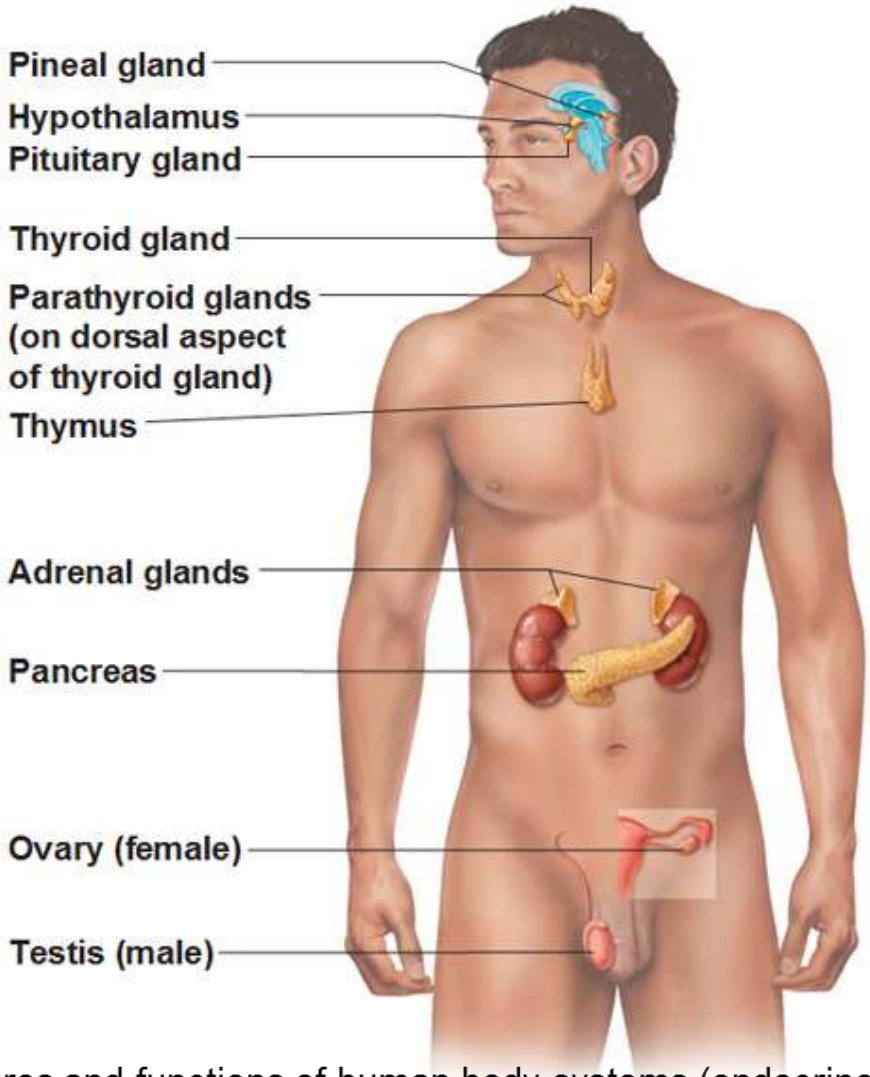
- Endocrine versus exocrine
- Structures of endocrine system
- Functions of endocrine system
- Hormones
- Regulation of hormones

1.21 Describe common diseases and disorders of each body system

- Etiology
- Pathology
- Diagnosis
- Treatment
- Prevention

NCHSE
National Consortium for Health Science Education

The Major Endocrine Organs



1.13 Analyze basic structures and functions of human body systems (endocrine).
i. Endocrine (structures of endocrine system)

NCHSE
National Consortium for Health Science Education

Endocrine vs Exocrine

Endocrine

- Ductless
- Secretions empty into the blood
- Secrete hormones
- Have long term control of target organs

Exocrine

- May or may not have ducts
- Secretions go directly to the target cells
- Secrete enzymes
- Have short term control

1.13 Analyze basic structures and functions of human body systems endocrine).
i. Endocrine (endocrine versus exocrine, functions of endocrine system)

NCHSE
National Consortium for Health Science Education

The Endocrine System

DUCTLESS GLANDS

- Secrete chemical messengers (***hormones***)
  - Diffuse directly into the bloodstream
  - Interact with receptors inside/outside ***target cells***
  - Involve growth, maturation, reproduction, metabolism, and human behavior

1.13 Analyze basic structures and functions of human body systems endocrine).
i. Endocrine (endocrine versus exocrine, structures and functions of endocrine system)

NCHSE
National Consortium for Health Science Education

The Endocrine System
Major Glands and Organs

- Hypothalamus
- Pituitary
- Thyroid
- Parathyroid
- Pineal
- Adrenal
- Gonads
  - Testes
  - Ovaries
- Pancreas
- Thymus

1.13 Analyze basic structures and functions of human body systems (endocrine).
i. Endocrine (structures of endocrine system)

NCHSE
National Consortium for Health Science Education

The Endocrine System

Biofeedback mechanisms controls hormone levels

Negative feedback (minimizes change)

- If the hormone is high, the gland will stop producing it.
- If the hormone is low, the gland will produce more.

Positive feedback (the change**)**

- Stimulus is promoted until the hormone is no longer needed.
  - childbirth, labor stimulates the production of oxytocin until the baby is delivered. Oxytocin is no longer needed.

1.13 Analyze basic structures and functions of human body systems endocrine).
i. Endocrine (regulation of hormones)

NCHSE
National Consortium for Health Science Education

Hypothalamus

"Commander in Chief"

- Link between endocrine and nervous system
- Direct control of posterior pituitary gland
  - ADH and oxytocin
- Indirect control through release of regulatory factors
  - Target-anterior pituitary gland

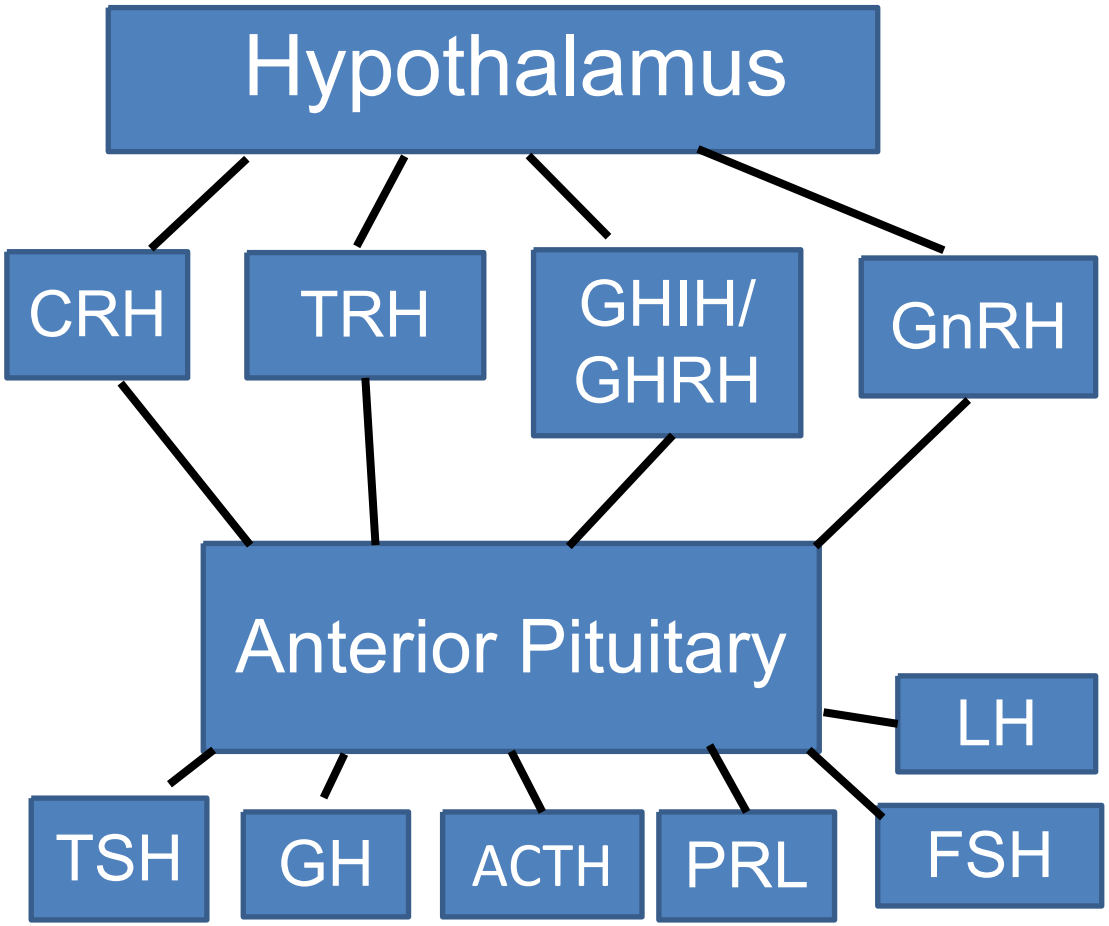
Hormones

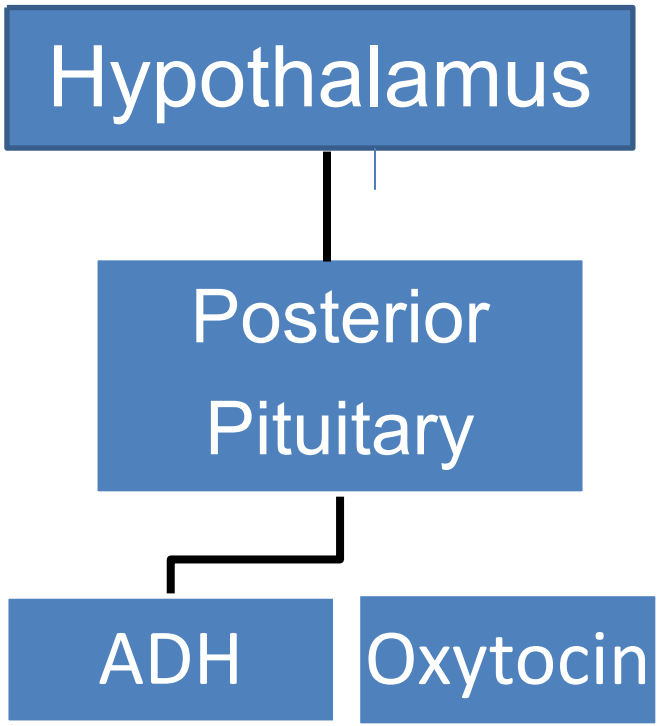
- ✓ CRH - Corticotropin- releasing hormone
- ✓ TRH - Thyrotropin-releasing hormone
- ✓ GH - Growth hormone
  - GHIH - Growth hormone inhibiting hormone
  - GHRH - Growth hormone releasing hormone
- ✓ PH - Prolactin-inhibiting hormone
- ✓ GnRH - Gonadotropin releasing hormones

1.13 Analyze basic structures and functions of human body systems endocrine).
i. Endocrine, structures and functions of endocrine system, hormones)

NCHSE
National Consortium for Health Science Education

Hypothalamus





1.13 Analyze basic structures and functions of human body systems endocrine).
i. Endocrine, structures and functions of endocrine system, hormones

NCHSE
National Consortium for Health Science Education

Pituitary

"Master Gland"

- Secretes hormones that control other endocrine glands
- Structurally divided into two parts:
  - ***Posterior*** pituitary gland
  - ***Anterior*** pituitary gland

1.13 Analyze basic structures and functions of human body systems endocrine).
i. Endocrine (structures and functions of endocrine system)

NCHSE
National Consortium for Health Science Education

Pituitary

Posterior Pituitary Gland

- **Oxytocin**
- **ADH –** Antidiuretic hormone (Vasopressin)

Anterior Pituitary Gland

- **GH** - Growth hormone (Somatotropin)
- **TSH** - Thyroid stimulating hormone (Thyrotropin)
- **ACTH** - Adrenocorticotropic hormone
- **LH** - Luteinizing hormone (female)
- **FSH** - Follicle stimulating hormone
- **Prolactin** - Lactogenic

1.13 Analyze basic structures and functions of human body systems endocrine). i. Endocrine (hormones)

NCHSE
National Consortium for Health Science Education

Posterior Pituitary

ADH (antidiuretic hormone) = vasopressin

- ⬇ urination → ⬆ blood volume

  Water is reabsorbed in the tubules of the nephron

- Large amounts of **ADH**

  ⬇⬇ urination → ⬆ blood pressure

- Insufficient **ADH** → diabetes insipidus

  Causing excessive urination → ⬇ fluids and electrolytes

1.13 Analyze basic structures and functions of human body systems endocrine).
i. Endocrine (functions of endocrine system, hormones, regulation of hormones)
1.21 Describe common diseases and disorders of each body system a. Etiology b. Pathology c. Diagnosis d. Treatment e. Prevention

NCHSE
National Consortium for Health Science Education

Posterior Pituitary

Oxytocin - positive feedback- increase the magnitude of change

- Stimulates the contraction of the smooth muscle of the uterus
- Stimulates the mammary glands forcing milk into the ducts

Indications for administration:

- Given to induce labor
- Given after delivery to constrict uterine blood vessels to minimize bleeding

1.13 Analyze basic structures and functions of human body systems (endocrine).
i. Endocrine (functions of endocrine system, hormones)

NCHSE
National Consortium for Health Science Education

Anterior Pituitary Gland

Growth Hormone (GH) Somatotropin

Stimulates growth of body cells

- **Pituitary Dwarfism**
  - Too little growth hormone (hGH)
  - Proportions are normal
- **Gigantism**
  - Excessive secretion of growth hormone (hGH)
- **Acromegaly**
  - Excess secretion of growth hormone (GH) after childhood

1.21 Describe common diseases and disorders of each body system a. Etiology b. Pathology c. Diagnosis d. Treatment e. Prevention

NCHSE
National Consortium for Health Science Education

Thyroid Gland

- Located in front of the trachea
- Secretes three hormones
  - **T3 Triiodothyronine**
    - ✓ Controls cell metabolism and growth
    - ✓ Contains 3 iodine atoms
  - **T4 Thyroxine**
    - ✓ Controls cell metabolism and growth
    - ✓ Contains 4 iodine atoms
  - **Calcitonin**
    - ✓ Decreases blood calcium
    - ✓ Stimulates bone development

1.13 Analyze basic structures and functions of human body systems endocrine).
i. Endocrine (functions of endocrine system, hormones)

NCHSE
National Consortium for Health Science Education

Thyroid

- **Hypothyroidism**
  - **Hashimoto's thyroiditis**
    - ✓ Most common cause
    - ✓ Women 30-50 years
    - ✓ Autoimmune
    - ✓ Low T4 and high TSH
    - ✓ Swelling of thyroid
    - ✓ Treated with synthetic thyroid hormones
    - ✓ May lead to goiters

1.21 Describe common diseases and disorders of each body system a. Etiology b. Pathology c. Diagnosis d. Treatment e. Prevention

NCHSE
National Consortium for Health Science Education

Thyroid

- **Hyposecretion** of thyroid hormones during fetal development
  - **Cretinism**
    - ✓ Skeleton fails to grow
    - ✓ Usually severely mentally retarded
    - ✓ Retarded sexual development
    - ✓ Usually have a yellowish skin color
    - ✓ Hormone therapy must begin before 2 months to alleviate symptoms

NCHSE
National Consortium for Health Science Education

Thyroid

- **Hypersecretion** of thyroid hormone
  - **Grave's Disease**
    - ✓ Symptoms
      - hot
      - tremors
      - sweating
      - muscle weakness
      - nervousness
      - irritability
      - bulging eyes

1.21 Describe common diseases and disorders of each body system a. Etiology b. Pathology c. Diagnosis d. Treatment e. Prevention

NCHSE
National Consortium for Health Science Education

Parathyroid Glands

- Two small pairs of glands embedded in the ***posterior side*** of the thyroid
- Produces PTH (***Parathyroid Hormone***)
- ***Increases*** level of ***calcium*** in the blood:
  - stimulating bone-dissolving cells
  - kidneys to reabsorb calcium
  - intestines absorb calcium from food
- Calcium is important:
  - bone growth
  - blood clotting
  - muscle tone and contraction (including the heart)

1.13 Analyze basic structures and functions of human body systems endocrine).
i. Endocrine (functions of endocrine system, hormones)

NCHSE
National Consortium for Health Science Education

Parathyroid Glands

Hyperparathyroidism

- Hypercalcemia
  - leading to renal calculi
  - bone weakness
- Often caused by a tumor (adenoma)
- Treatment: surgical removal of the tumor

Hypoparathyroidism

- Hypocalcemia and elevated phosphorous
  - can lead to ***tetany***
  - hyperirritability of the nervous system
  - seizures
  - death

1.21 Describe common diseases and disorders of each body system a. Etiology b. Pathology c. Diagnosis d. Treatment e. Prevention

NCHSE
National Consortium for Health Science Education

Adrenal Cortex

Outer layer of the adrenal gland

- Under the direction of the anterior pituitary [***(Adrenocorticotropic Hormone (ACTH)***]
  - Mineralocorticoids
  - Glucocortocoids
  - Gonadocorticoids

1.13 Analyze basic structures and functions of human body systems endocrine).
i. Endocrine (functions of endocrine system, hormones)

NCHSE
National Consortium for Health Science Education

Adrenal Cortex

Mineralocorticoids

- ***Aldosterone***

Acts on the Kidneys:

- Regulates sodium reabsorption
- Regulates potassium excretion
- Increases water reabsorption

1.13 Analyze basic structures and functions of human body systems endocrine).
i. Endocrine (functions of endocrine system, hormones)

NCHSE
National Consortium for Health Science Education

Adrenal Cortex

Glucocortocoids

- ***Cortisol-hydrocortisone***
- ***Cortisone***
- ***Actions:***
  - metabolism
  - increase blood glucose
  - help resist stress
  - anti-inflammatory to reduce immune responses

1.13 Analyze basic structures and functions of human body systems endocrine).
i. Endocrine (functions of endocrine system, hormones)

NCHSE
National Consortium for Health Science Education

Adrenal Cortex

Gonadocorticoids (sex hormones)

- **Estrogens**
  - Stimulate the development of female sexual characteristics
- **Androgens**
  - Stimulate the development of male sexual characteristics
  - Stimulate the female sex drive

1.13 Analyze basic structures and functions of human body systems endocrine).
i. Endocrine (functions of endocrine system, hormones)

NCHSE
National Consortium for Health Science Education

Adrenal Medulla

Epinephrine (*Adrenaline*)

Norepinephrine

- Actions:
  - Responsible for the ***"Fight or Flight"*** response
  - Helps the body cope with stress
    - ✓ ⇧ heart rate
    - ✓ ⇧ blood pressure
    - ✓ ⇧ respirations
  - Sweaty palms
  - Dry mouth

1.13 Analyze basic structures and functions of human body systems endocrine).
i. Endocrine (functions of endocrine system, hormones)

NCHSE
National Consortium for Health Science Education

Addison's Disease

Insufficient Adrenocorticosteriods

- **Cortisol**
- **Aldosterone**

Causes:

- autoimmune
- infection
- cancer

Treatment:

- hormone replacement

Symptoms:

- weight loss
- muscle weakness
- fatigue
- low blood pressure
- hypoglycemia
- irritability
- depression
- skin pigmentation

NCHSE
National Consortium for Health Science Education

Cushing's Syndrome

Over-secretion of Cortisol

Causes:

- Medical steroid use (Prednisone)
- Pituitary (ACTH) or adrenal tumors
- Genetic

1.21 Describe common diseases and disorders of each body system a. Etiology b. Pathology c. Diagnosis d. Treatment e. Prevention

NCHSE
National Consortium for Health Science Education

Cushing's Syndrome
Symptoms

- upper body obesity
- round face
- bruising
- osteoporosis
- fatigue
- depression
- hypertension
- high blood sugar
- female-facial hair
- male –decreased fertility
- retention of sodium
  - causes tissue fluid build up (puffiness)

Treatment:

- if tumor, remove
- drugs to decrease cortisol level

1.21 Describe common diseases and disorders of each body system a. Etiology b. Pathology c. Diagnosis d. Treatment e. Prevention

NCHSE
National Consortium for Health Science Education

Pancreas

A flat oblong organ located just posterior and slightly inferior to the stomach

- Both an **exocrine** and **endocrine** gland
  - **Exocrine tissue** of the pancreas
    - ✓ The bulk of the pancreas produces digestive enzymes
    - ✓ Pancreatic duct connects to the duodenum
  - **Endocrine tissue** of the pancreas
    - ✓ ***Islets of Langerhans*** release insulin and glucagon into the blood stream
    - ✓ Regulate blood glucose levels

1.13 Analyze basic structures and functions of human body systems (endocrine).
i. Endocrine (endocrine versus exocrine, structures and functions of endocrine system, hormones)

NCHSE
National Consortium for Health Science Education

Pancreas

Types of Cells of the Islets of Langerhans

- **Alpha Cells -** secrete ***glucagon***
  - raises blood sugar
- **Beta Cells -** secrete ***insulin***
  - lowers blood sugar

1.13 Analyze basic structures and functions of human body systems endocrine).
i. Endocrine (functions of endocrine system, hormones)

NCHSE
National Consortium for Health Science Education

Diabetes Mellitus

- Disorder related to abnormal pancreatic hormones
- Diabetes from Greek “siphon” and mellitus for honey
- Symptoms include:
  - ***Polyuria*** **-** excess urination
  - ***Hyperglycemia → glycosuria***
    - ✓ glucose in the urine
  - ***Polydipsia*** **-** excessive thirst
  - ***Polyphagia*** **-** excessive eating

1.21 Describe common diseases and disorders of each body system a. Etiology b. Pathology c. Diagnosis d. Treatment e. Prevention

NCHSE
National Consortium for Health Science Education

Type I Diabetes

- **Insulin Dependent Diabetes Mellitus (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

1.21 Describe common diseases and disorders of each body system a. Etiology b. Pathology c. Diagnosis d. Treatment e. Prevention

NCHSE
National Consortium for Health Science Education

Type II Diabetes

Non-Insulin Dependent Diabetes Mellitus (*NIDDM*)

- Also called **maturity onset diabetes**
- Most often occurs in individuals over 40
  - being seen more in a younger age group
- Affects the way the body processes glucose
- Most individuals are ***overweight*** or ***clinically obese***

Treatment:

- Medications
- Diet
- Exercise
- Weight loss and control

1.21 Describe common diseases and disorders of each body system a. Etiology b. Pathology c. Diagnosis d. Treatment e. Prevention

NCHSE
National Consortium for Health Science Education

Complications from Diabetes

- Atherosclerosis
- Heart disease
- Peripheral vascular disease
- Severe kidney damage
- Glaucoma and/or blindness
- Gangrene
- Ketoacidosis
- Weight loss
- Neuropathy

1.21 Describe common diseases and disorders of each body system a. Etiology b. Pathology c. Diagnosis d. Treatment e. Prevention

NCHSE
National Consortium for Health Science Education

Other Glands

Thymus Gland

- Functions in the ***endocrine*** and ***lymphatic*** systems
  - Produces a hormone called ***thymosin***
  - Hormone that supports function of WBCs
- Begins to ***atrophy*** at puberty

Pineal Gland

- Produces ***melatonin***
- Regulates sleep patterns

1.13 Analyze basic structures and functions of human body systems endocrine).
i. Endocrine (functions of endocrine system, hormones)