Objectives:
Identify the contributions of the endocrine system to **homeostasis**
Discuss the chemical composition of hormones and the mechanisms of hormone action
Summarize the site of production, regulation, and effects of the hormones of the pituitary, thyroid, parathyroid, adrenal, and pineal glands
Discuss several common diseases associated with endocrine system dysfunction
Describe the components of the Endocrine system and their function.
Explain how steroid and non-steroid hormones affect target cells.
Do Now

We will complete incomplete work after notes on the Endocrine system

10 minutes
Name and describe the locations of the major endocrine glands, and list the hormones they secrete.
What is the system?

1. Made up of glands that produce and secrete hormones, chemical messengers
2. Regulation of growth, metabolism, sexual development
3. Responses to stress and injury
4. Maintains homeostasis

Glands are found in different areas of the body.
BIG IDEA:
HORMONES are chemical MESSENGERS that act on target cells
<table>
<thead>
<tr>
<th>Major Structures of the Endocrine System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pineal gland</td>
</tr>
<tr>
<td>Hypothalamus</td>
</tr>
<tr>
<td>Pituitary gland</td>
</tr>
<tr>
<td>Parathyroid glands (on dorsal aspect of thyroid gland)</td>
</tr>
<tr>
<td>Thyroid gland</td>
</tr>
<tr>
<td>Parathyroid</td>
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<tr>
<td>Thymus</td>
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<tr>
<td>Thymus gland</td>
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<tr>
<td>Adrenal glands</td>
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<tr>
<td>Pancreas</td>
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<tr>
<td>Pancreas</td>
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<tr>
<td>Ovary / Teste</td>
</tr>
<tr>
<td>(female)</td>
</tr>
<tr>
<td>Testis (male)</td>
</tr>
</tbody>
</table>
Endocrine – secretions inside the body
Exocrine – secretions outside the body (sweat)

(a) Merocrine secretion
- Secretion
- Secretory vesicle
- Golgi complex
- Nucleus

(b) Apocrine secretion
- Pinched off portion of cell is the secretion

(c) Holocrine secretion
- Mature cell dies and becomes secretory product

Saliva
Breast Milk
Sweat
Control of Hormones

Negative feedback system

When the levels go above or below a SET POINT, the endocrine system secretes hormones to lower or raise the level.

Think of it like the thermostat of your house.
Example of Negative Feedback:

Calcium regulation by the thyroid parathyroid

1. If calcium level rises above set point
2. Thyroid gland releases calcitonin
3. Blood calcium level falls
4. If calcium level falls below set point
5. Parathyroid glands release parathyroid hormone (PTH)
6. Blood calcium level rises

Homeostasis: Blood calcium level
Example of Negative Feedback

Glucose levels rise - insulin is produced to cause sugar to be taken up by the cells (and out of the blood)
Positive Feedback System

Nerve impulses from cervix transmitted to brain

Brain stimulates pituitary gland to secrete oxytocin

Head of baby pushes against cervix

Oxytocin carried in bloodstream to uterus

Oxytocin stimulates uterine contractions and pushes baby towards cervix
11.5 Pituitary Gland
Hormone Control

The pituitary is often called the “master gland” because it controls all of the other glands.

Its actions are controlled by the hypothalamus in the brain.
Anterior Pituitary Hormones

**Prolactin or PRL** - PRL stimulates milk production from a woman's breasts after childbirth and can affect sex hormone levels from the ovaries in women and the testes in men.

Risperdal (ADHD drug) can increase production of a hormone called prolactin, which stimulates breast growth, or **gynecomastia**

http://www.banderasnews.com/0905/hb-risperdal.htm
Growth hormone or GH - GH stimulates growth in childhood and is important for maintaining a healthy body composition. In adults it is also important for maintaining muscle mass and bone mass.

It can affect fat distribution in the body.
That’s a bull of the Belgian Blue breed, which has a genetic anomaly that suppresses the production of a hormone called myostatin that inhibits muscle growth – hence the ‘double muscling’ seen above.

Myostatin inhibitor drugs are being developed with the intent of treating muscle-wasting diseases like muscular dystrophy in humans.
Problems with the pituitary gland can result in Dwarfism

Primordial Dwarfism
Or a person can grow too much. These are pictures of the man known as “The Alton Giant”, Robert Wadlow. Robert was 8’11”
Endocrine Research Rubric

Name and describe the locations of your endocrine glands, and list the hormones they secrete.

If you have a hormone, what gland does it come from?

Drawing of the gland you are reporting on, or that the hormone comes from.

What is the hormone targeting or its purpose? What is its action?

Describe each hormones action and correlate how each hormone effects the overall health.

<table>
<thead>
<tr>
<th>Category</th>
<th>25 pts</th>
<th>20 pts</th>
<th>15 pts</th>
<th>10 pts</th>
<th>5 pts</th>
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</thead>
<tbody>
<tr>
<td>Presentation</td>
<td>A presentation was given to the class with a thorough explanation</td>
<td>A presentation was given to the class with most of the information</td>
<td>A presentation was given to the class with some of the information</td>
<td>A presentation was given to the class with almost no information</td>
<td>No presentation given</td>
</tr>
<tr>
<td>Write up</td>
<td>All bullet points from above are included</td>
<td>Most of the bullet points from above are included</td>
<td>Some of the bullet points from above are included</td>
<td>Few of the bullet points from above are included</td>
<td>Almost no bullet points from above are included</td>
</tr>
<tr>
<td>Drawing</td>
<td>A neat illustration using color and labels</td>
<td>An illustration missing one of neatness, color or labels</td>
<td>An illustration missing two of neatness, color or labels</td>
<td>An illustration missing all: neatness, color and labels</td>
<td>No illustration</td>
</tr>
<tr>
<td>Notes for class</td>
<td>Notes are provided for your presentation and printed</td>
<td>Hand written notes are provided</td>
<td>Some notes are provided</td>
<td>Not all notes are provided</td>
<td>No notes were written for presentation</td>
</tr>
</tbody>
</table>
Adrenocorticotropin or ACTH - ACTH stimulates production of cortisol by the adrenal glands.

Cortisol, a so-called "stress hormone," is vital to survival. It helps maintain blood pressure and blood glucose levels.

Many diet aids claim that they block cortisol levels. Cortisol from stress may lead to fat deposits in the belly.
Thyroid-stimulating hormone or TSH - TSH stimulates the thyroid gland to make thyroid hormones, which, in turn, control (regulate) the body's metabolism, energy, growth and development, and nervous system activity.
Luteinizing hormone or LH - LH regulates testosterone in men and estrogen in women. (gonadotropin)
Follicle-stimulating hormone or FSH - FSH promotes sperm production in men and stimulates the ovaries to release eggs (ovulate) in women. LH and FSH work together to allow normal function of the ovaries or testes. (gonadotropin)
Posterior Pituitary Hormones

**Oxytocin** - Oxytocin causes milk letdown in nursing mothers and contractions during childbirth.
Oxytocin is known as the "cuddle hormone," but that simplistic moniker glosses over the complex role this hormone plays in social interactions and bonding.

Credit: wavebreakmedia | Shutterstock
Pitocin is another very controversial topic in childbearing today.

Oxytocin is a natural hormone produced by a woman's body that cause uterine contractions. Pitocin is the synthetic form of oxytocin.

Pitocin is generally used in two ways:
1) to induce labor, and 2) to augment (speed up) labor.
Antidiuretic hormone or ADH - ADH, also called vasopressin, is stored in the back part of the pituitary gland and regulates water balance.

Too much urination can lead to dehydration. When the body is dehydrated, ADH will cause the kidneys to conserve water.
Why do you feel thirsty?

Is this positive or negative feedback?
Diuretics – increase urine production

Many common foods and drinks contain chemicals that are diuretics (alcohol)

Midol relieves symptoms of bloating because it contains a diuretic that will make you urinate more

**Active Ingredients:** (in each caplet): Acetaminophen (500 mg) (Pain Reliever), Caffeine (60mg) (Diuretic, Stimulant), Pyrilamine Maleate (15 mg) (Diuretic)

**Inactive Ingredients:** Carnauba Wax, Croscarmellose Sodium, FD&C Blue 2, Hypromellose, Magnesium Stearate, Microcrystalline Cellulose, Pregelatinized Starch, Propylene Glycol, Shellac, Titanium Dioxide, Triacetin
THYROID GLAND

The thyroid hormones control your metabolism, which is the body's ability to break down food and store it as energy and release of energy.

TED-Ed Video on the Thyroid
THYROID HORMONES

Thyroxin (T4) & Tri-iodothyronine (T3) - both increase the rate at which cells release energy from carbohydrates

Calcitonin – regulates the blood concentration of calcium

BMR – basal metabolic rate: how many calories the body must consume to maintain life

BMR Calculator
Problems with the Thyroid

**Iodine** is essential for the formation of thyroxine.

Lack of iodine causes a swelling of the thyroid → **GOITER**.

Iodine is only found in seafood, so if salt wasn’t iodized, a lot of people wouldn’t get enough iodine, and there would be a lot of goiters.
Goiter
Hypothyroidism
Before and After Treatment
Cretinism (hypothyroidism in infants)
Hyperthyroidism ( Grave’s Disease )

Graves’ disease is a common cause of hyperthyroidism, an over-production of thyroid hormone, which causes enlargement of the thyroid and other symptoms such as exophthalmos, heat intolerance and anxiety.

- Normal thyroid
- Enlarged thyroid
- Diffuse goiter
- Exophthalmos (bulging eyes)
Exposure to radioactive iodine in childhood is also believed to be associated with thyroid cancer. Following the Chernobyl nuclear power plant explosion, there was an increase in thyroid cancer in children.
Parathyroid Glands

Located behind the thyroid, four tiny glands

Parathyroid Hormone (PTH) - takes calcium from the bones to make it available in the blood
Removal of a mass and thyroid gland:

https://www.youtube.com/watch?v=zLaalYtSXnk
Adrenal Glands

Located at the top of the kidneys

Adrenal Cortex - outer area

Adrenal Medulla - inner area

Adrenal Glands produce adrenaline
Adrenal Medulla

Epinephrine & Norepinephrine – increased heart rate, breathing rate, elevated blood pressure (fight or flight, response to stress)

People with severe life threatening allergies often carry injectors
EpiPen, an epinephine auto-injector used to treat allergy reactions that has seen its price rise from $57 in 2007 to about $500.

The cost to manufacture the drug is about $1.00 (estimated).

Should the government enact laws to control the prices of drugs?
Adrenal Cortex

**Aldosterone** – helps kidneys conserve sodium and excrete potassium, maintaining blood pressure

**Cortisol** – keeps blood glucose levels stable, response to stress

**Adrenal Sex Hormones** - androgens (male) and estrogens (female)
Adrenal Gland Disorders

Cushing’s Disease
Hyperadrenocorticism

Increased thirst and urination
Increased hunger
Increased panting
Pot-bellied abdomen
Obesity
Loss of hair

Cushing's syndrome happens when the adrenal glands makes too much cortisol.

https://www.vetdepot.com/article-images/cushings-disease.gif
This is Suki

In 2015, she was diagnosed with Cushing’s Disease

One month later, she was diagnosed with diabetes.

While her condition is managed with medication, she is now permanently blind.
Addison’s disease

- Hyposecretion of cortisol
- Low blood pressure results
- Increased pigmentation
Pancreas

The pancreas is a large gland behind the stomach that helps the body to maintain healthy blood sugar (glucose) levels.

Contains islands of cells called the Islets of Langerhans which secrete glucagon and insulin.
Glucagon – stimulates the liver to break down glycogen, raises **blood sugar**

**Insulin** – decreases blood sugar concentrations, affects the **uptake** of glucose by cells

*Both hormones work together to maintain a balance in the blood sugar*
Diabetes Mellitus – results from an insulin deficiency, blood sugar rises (hyperglycemia) and excess is excreted in the urine.

**Type I** - insulin dependent diabetes mellitus or juvenile onset diabetes, often caused by inherited immune disorder that destroys pancreatic cells
Type II – mature onset diabetes (usually after the age of 40), often individuals are overweight, can be controlled with diet and exercise.

Blood sugar test, device pricks the finger and measures the amount of sugar in the blood.
Injection of insulin will lower the blood sugar levels

Hypoglycemia can occur if levels become too low, can be cured with direct injection of glucose or with eating something high in sugar. This is why diabetics often have candy.
Diabetes Insipidus

Diabetes insipidus (DI) is an uncommon condition that occurs when the kidneys are unable to conserve water as they perform their function of filtering blood.

The amount of water conserved is controlled by antidiuretic hormone (ADH), also called vasopressin.

ADH is a hormone produced in a region of the brain called the hypothalamus.

Symptoms

Excessive thirst

--- May be intense or uncontrollable

---- May involve a craving for ice water

Excessive urine volume
Gestational Diabetes

Pregnancy hormones can block insulin from doing its job. When this happens, glucose levels may increase in a pregnant woman's blood.

Gestational diabetes usually starts halfway through the pregnancy. All pregnant women should receive an oral glucose tolerance test between the 24th and 28th week of pregnancy to screen for the condition.
Diabetic neuropathies are a family of nerve disorders caused by diabetes. People with diabetes can develop nerve damage throughout the body. Symptoms include pain, tingling, or numbness-loss of feeling-in the hands, arms, feet, and legs. This can result in wounds that are slow to heal.
Other Endocrine Glands

Pineal Gland – located between the cerebral hemispheres,
- secretes **melatonin**, maintains **Circadian rhythms** (light and dark activity)
Can you find the hypothalamus? Pituitary?
Thymus Gland – large in young children, gradually shrinks with age, secretes thymosins, important to immune function
Reproductive Glands – testes and ovaries – testosterone, progesterone, estrogen

GONADOTROPINS - include any hormone that affect the gonads
Anabolic steroids are artificially produced hormones that are the same as, or similar to, androgens, the male-type sex hormones in the body. There are more than 100 variations of anabolic steroids. The most powerful androgen is testosterone.
THE ENDOCRINE SYSTEM

HYPOTHALAMUS
Regulates hunger, thirst, sleep and wakefulness plus most of your involuntary mechanisms including body temperature.

PITUITARY GLAND
Controls all other endocrine glands; influences growth, metabolism and regeneration.

THYROID GLANDS
Regulates your energy and your metabolism.

PARATHYROID
Secretes the hormones necessary for calcium absorption.

THYMIC GLANDS
Helps build resistance to disease.

PANCREAS
Aids in the digestion of protein, fats and carbohydrates. Produces insulin which controls blood sugar levels.

ADRENAL GLANDS
Secretes hundreds of compounds including cortisone & adrenaline which helps you react to emergencies. Regulates your metabolic processes in the cells, water balance, blood pressure, etc.

OVARIES
Influences how your blood circulates and determines your mental vigor and your sex drive. (Testes in males.)

METABOLISM - The conversion of nutrients into energy and building materials to meet your body’s needs.