Grade 8: Reproductive and Endocrine Systems

Lesson 1: The Endocrine System

Objectives:

1. Students will define the Endocrine System.
2. Students will explain how the Endocrine System works.
3. Students will explore seven glands of the Endocrine System and their functions.
4. Students will explore the connection between the Endocrine System and puberty; stress.
5. Students will define Type 1 and Type 2 diabetes and the connection to the Endocrine System.

Materials:

- Endocrine System Chart **(See Figure 1)**

Activity Summary:

In this lesson students will explore the endocrine system, its connection to puberty and the physical changes they are experiencing. Seven major endocrine glands and their hormone functions will be examined. Finally, the connection of the Endocrine System to the stress response and to diabetes will be explored.

Background Information for the Teacher:

Endocrine System

The Endocrine System is a different type of body system from the ones we most typically study. Most body systems have a clearly identified primary organ and recognizable pathways for movement of material (ex: blood through the arteries for the Circulatory System) and communication (ex: motor and sensory messages along the nerves for the Nervous System).

The Endocrine System, however, consists of seven separate glands. There is no central system organ and no easily identifiable connecting pathways among the glands. In fact, the job of the endocrine glands is more to interact with the body as a whole and to regulate body-wide functions than it is for the glands to interact with or coordinate any kind of predominant endocrine activity with each other. This is different from the activity of the urinary, nervous, respiratory or circulatory system organs and functions.

The Endocrine System operates as a **chemical communication system**. The endocrine glands play a key role in growth and development throughout adolescence. Glands and hormones are the two key components of the system.

The hormones are the chemical messengers secreted by the glands. They have specific effects on cells or organs. The hormones are carried through the blood-stream to the tissue and cells targeted to receive the message.

Endocrine glands are placed throughout the body. The major endocrine glands, their location and functions are:

Gland	Location	Function
Pituitary	Base of the brain	Sometimes referred to as the **Master Gland.** Hormones secreted: a) **Growth hormones** regulate body growth (height and weight) and development; b**) Endorphins** that act on the nervous system and modulate pain sensation, c) **Hormones** regulate the thyroid gland, the adrenals, and how the kidneys retain water. Hormones also cause the uterus to contract in childbirth, and stimulate milk production in the breasts.
Pineal	In the middle of the brain	Hormones secreted: **Melatonin**. Regulates sleep
Thyroid	Throat near the trachea	Hormones secreted that **regulate body growth and metabolism** through the chemical reaction of nutrients in the cells. The rate at which cells burn fuels from food producing energy is called the body's metabolism.
Pancreas	Behind the stomach	Hormones secreted: **Insulin**. Controls blood sugar levels. Sends digestive enzymes to the small intestine, and is also considered part of the Digestive System.
Adrenals	On top of the kidneys	Hormones secreted: **Epinephrine**, also called adrenaline. Key in regulating body's stress response. Regulates salt and water balances in the body and aids in digestion.
Ovaries	On both sides of the uterus	Female reproductive glands. Hormones secreted: **Estrogen** and p**rogesterone**. Controls female sexual development and maturing of eggs.
Testes	In scrotum sacs behind the penis	Male reproductive glands. Hormones secreted: Testosterone. Controls male sexual development and sperm production.

How the Endocrine System Works

The glands produce and secrete hormones into the bloodstream. Blood circulation carries the hormones to the cells appropriate for the message. These cells, called **target cells**, have receptors that bind only to certain hormones. Each hormone has its own receptor, so hormone/target cell communication is very specific. When the hormones find and attach to the proper cells the chemical activity of the hormone is released into the cell. The Endocrine System regulates the correct level of each hormone in the body for proper functioning. This is done through a mechanism of the pituitary gland that regulates the correct amount of each hormone in the body.

Adolescent Changes

The Endocrine System is responsible for initiating and controlling the significant series of physical and emotional changes that begin somewhere between 11 and 15 years of age. Growth patterns and spurts are different for boys and girls, and certainly differ from one adolescent to the next, but females typically enter puberty earlier than boys. Girls can begin changing as early as age eight, and most are undergoing puberty by age 13. While some boys begin the process at age 10,others begin as late as age 15.

Female Changes in Puberty	Male Changes in Puberty
• Female hormone production starts • Sudden and rapid growth occurs • Permanent teeth come in • Acne may occur • Hair begins growing in the underarm and pubic area • External genitals enlarge • Breasts develop • Hips widen • Body fat increases • Perspiration increases • Ovulation begins • Menstruation begins • Uterus and ovaries enlarge	• Male hormone production starts • Sudden and rapid growth occurs • Permanent teeth come in • Acne may occur • Hair begins growing, particularly in the underarm and pubic area • Facial hair increases • External genitals enlarge • Breasts may enlarge • Muscles develop • Perspiration increases • Sperm production begins • Larynx enlarges and voice deepens

NOTE: During puberty significant **mental and emotional developments** occur as well. Information about these will be discussed in more detail in Lesson 6 of this unit.

Care of Endocrine System

The Endocrine System is a body-wide system since there is no central organ. Consequently, care of the Endocrine System requires a health-conscious attention to the *entire* body. Given the way our physical body is affected by our emotions and our minds, having a healthy Endocrine System means being healthy physically, mentally, and emotionally.

Endocrine System health can be enhanced by attending to healthy **stress management.** All the things that manage and discharge stress will help to keep the entire body healthy. If stress is effectively managed (thus keeping the entire body healthy) the Endocrine System will operate more efficiently and stay in balance. Healthy stress management activities, behaviors and habits promote a healthy, energetic body, a clear mind, and balanced emotions--no small feat for anyone, much less an adolescent at the mercy of hormones.

Nevertheless, this may be a very good time to reinforce the message of the benefits of stress management by encouraging each student to commit to their own physical, mental, and emotional health in the following ways:

- Getting **good balanced nutrition** throughout the day is key.
- Engaging in **healthy and regular physical activity** has a positive impact on thyroid glands, essential for growth and development.
- Getting **plenty of restful sleep every night** helps regulate the pineal gland, influencing the adrenals and promoting a healthy stress response.
- **Learn what is important and what is not.** Develop perspective on what's happening in your life by practicing effective mental and emotional stress techniques. Doing this will significantly improve how your physical body feels by influencing the adrenal glands to recover from any stress-induced adrenaline "rush." This calms the body and helps lessen the impact of stress.)

Endocrine System Problems

Diabetes Mellitus

One of the most significant endocrine problems is diabetes, a chronic condition in which insulin production and use is affected. Juvenile diabetes (or Type 1 diabetes) occurs when the pancreas doesn't produce enough insulin. When it occurs in the In teens and younger children it may be the result of an autoimmune disorder in which the person's immune system attacks pancreatic cells that make insulin, causing less insulin to be produced. The symptoms of Type 1 diabetes include weight loss, fatigue, frequent urination, and extreme thirst. Type 2 diabetes, however, occurs when the body no longer responds to insulin normally.

Growth Hormone Dysfunctions

Growth hormones that fail to release in the proper quantities at the proper time can cause bone growth abnormalities, resulting in stunted growth or growth that is excessive for their age. Gigantism and dwarfism are extreme forms of growth hormone dysfunction.

Vocabulary:

Endocrine System
Glands
Hormones
Target cells
Pituitary gland
Pineal gland
Thyroid
Pancreas
Adrenals
Ovaries
Testes
Insulin
Melatonin
Adrenaline
Epinephrine
Estrogen
Progesterone
Testosterone
Endorphins
Growth hormones
Diabetes: Type 1 and Type 2
Puberty

Engage:

1. Have students create a question and answer advice newspaper column (such as, "Ask Emma"). Assign students the task of formulating any questions they have regarding any of the topics relating to the Endocrine System and puberty. Have students write their names at the very top corner of their paper. (Students may be graded on the quality of their topic questions.) *NOTE: Make this an assignment before you begin the lesson so students have a few nights to come up with a thought-provoking question.* Possible topics:
   - Myths and misunderstandings about puberty
   - When will puberty begin?
   - When does puberty end?
   - What's healthy/ what's not healthy?

2. After you have collected the students' questions and have checked to be sure that all students have handed theirs in, cut the names off the tops of

the papers so that the questions remain anonymous. (This activity will be continued in the Extend portion of the lesson.)

3. Begin by writing the word **"PUBERTY"** on the board. Ask students to free-write on the topic for three minutes, including the **definition** of puberty as well as any words and phrases they can think of that relate to puberty.

4. In random fashion, call for answers from every student. Clarify the definition by noting the information on the board in a web or some other "mind map" format. Organize the information into categories such as:

   - physical changes
   - mental and emotional development
   - social and family impact
   - impact on body systems, thoughts and feelings about puberty

Explore:

1. Group Research: Divide the class into seven groups. Assign each group one of the endocrine glands to study.

2. Have students thoroughly research information about:
   - the gland
   - the hormones it produces,
   - how the hormone is used in the body
   - what happens when the hormone is out of balance or the gland malfunctions

3. Ask students to explore the following questions:
   - What Endocrine System problems are associated with that hormone and gland?
   - How do those problems affect short- and long-term health?
   - What can be done to prevent and/or treat those problems?
   - What happens to the gland when the body is under acute stress? Chronic stress?

4. Have students research answers to the same group of core questions and topics so they can compare and contrast information about **all** the glands. If the groups also want to look into information about an endocrine gland not assigned they may also do that in addition to their topic.

5. Have each group prepare a "test" and an answer key for **five** questions, based on the information they have found for their presentation. (Save for the Evaluation portion of the lesson.)

6. Have each group present their findings. Encourage them to incorporate visual elements into their presentations.

7. Upon conclusion of the presentations, ask students to:
   - Draw conclusions and compare what is similar and different about the seven glands,
   - Develop their own recommendations about how to care for and maintain a healthy Endocrine System.

8. Have students refer to the Endocrine System Chart (at the end of the lesson (**See Figure 1**). Ask students to review this information and compare their findings.

Explain:

1. Ask: ***"What causes the changes of puberty to begin?"*** *(The Endocrine System is responsible. The endocrine glands play a key role in growth and development through adolescence.)*

2. Ask: ***"When does puberty begin? How long does it last?"*** *(Growth patterns and spurts are different for boys and girls, and certainly different from one adolescent to the next. Females usually enter puberty earlier than boys and girls can begin changing as early as age eight. Most girls typically begin puberty by 13, while some boys begin at 10 while others begin as late as age 15.)*

3. *Ask:* ***"What is the Endocrine System?"*** *(The Endocrine System operates as a chemical communication system. Glands and hormones are the two key components of the system.)*

4. Ask: ***"What are glands? What are hormones?"*** *(**Glands** are groups of specialized cells which produce and secrete hormones into the bloodstream. **Hormones** are the chemical messengers secreted by the glands. They have specific effects on cells or organs. The hormones are carried through the bloodstream to the tissue and cells targeted to receive the message.)*

5. Have students review and discuss the Endocrine System Chart (at the end of the lesson **See Figure 1**).

6. Ask: ***"Hormone communication with cells is similar to nerve cell communication. How do you think hormones deliver their messages accurately?"***
   - *Blood circulation carries the hormones to target cells.*
   - *Target cells have receptors that only bind to certain hormones. Each hormone has its own receptor.*
   - *Hormone-target cell communication is very specific.*
   - *Hormones find and attach to the cell that has its receptor.*

- *The chemical activity of the hormone is released into the cell. The Endocrine System regulates the correct level of each hormone in the body for proper functioning.*
- *The mechanism of the pituitary gland regulates the correct amount of each hormone is in the body.*

7. Ask: ***"How is the Endocrine System different from our other body systems?"*** *(The Endocrine System consists of seven separate glands with no central system organ and no easily identifiable connecting pathways among the glands.)*

8. Ask: ***"How can the endocrine glands be considered a system?"*** *(Each gland has a similar function: to produce and secrete hormones; hormones have a similar purpose in regulating body-wide functions.)*

Extend:
Randomly hand out the questions that the students wrote in the engage portion of the lesson. Remind the students that the purpose of the Newspaper Column is to give accurate, user-friendly, and age-appropriate information to other teens their own age and younger who are going through puberty.

Students will receive a question that someone else wrote and will pretend they are writing an answer to a question that someone has submitted to a newspaper column.

Have students share the question they received as well as the answer they've given.

Evaluate:

- **Option 1**: As an overall assessment you may choose to use the five-question test that each group prepared in the Explore portion of the lesson. Combine all the questions and give students the test.

- **Option 2**: Have each student develop an assessment tool and answer sheet about the Endocrine System--how it works, the glands and hormones, what the hormones do, and two dysfunctions of the Endocrine System. Have students create a quiz, a puzzle, a mix & match, a fill-in chart, etc., along with an answer sheet for their quiz or puzzle.

Have student work in pairs, with each student completing the assessment tool created by their partner. Students should use their answer sheet to review and score the completed assessment. Have each student submit the assessment and answer sheet they created *and* the one they completed.

Optional Enrichment Activity:

1. Assign students the task of researching diabetes. Students must search online, look at health magazines, or do research in a library to find an article relating to diabetes. Have them summarize the article and explain how diabetes relates to the Endocrine System.

2. Arrange students in groups of five to share what they've discovered to the entire class.

Additional Web Resources

- TeenHealth.org
- www.kidshealth.org
  Search: Puberty, Endocrine System

Missouri Standards:

Health and Physical Education Frameworks

I. Functions and Interrelationships of Systems

A. Body Systems

What All Students Should Know:

1. The Endocrine System is a system of ductless glands that secrete hormones into the blood. These hormones regulate many vital body functions, including growth (pituitary), reproduction (ovaries and testes), fight or flight responses (adrenal), and energy metabolism (thyroid).

What All Students Should Be Able To Do:

a. Describe the physical changes that occur during puberty and the interrelationship among systems that cause these changes

Figure 1

ENDOCRINE SYSTEM CHART

Gland	Location	Function
Pituitary	Base of the brain	Sometimes referred to as the **Master Gland**. Hormones secreted: • **Growth hormones** regulate body growth (height and weight) and development; • **Endorphins** act on the nervous system and modulate pain sensation, • **Hormones** regulate the thyroid gland, adrenals, and how the kidneys retain water. Hormones also cause the uterus to contract in childbirth, and stimulate milk production in the breasts.
Pineal	In the middle of the brain	Hormones secreted: **Melatonin**. Regulates sleep
Thyroid	Throat near the trachea	Regulate body growth and metabolism through a chemical reaction of nutrients in the cells. The rate at which cells burn fuels from food producing energy is called the body's **metabolism**.
Pancreas	Behind the stomach	Hormones secreted: **Insulin**. Controls blood sugar levels. Sends digestive enzymes to the small intestine, and is also considered part of the digestive system.
Adrenals	On top of the kidneys	Hormones secreted: **Epinephrine** (also called adrenaline). Key in regulating body's stress response. Regulates salt and water balances in the body. Aids in digestion.
Ovaries	On both sides of the uterus	Female reproductive glands. Hormones secreted: **Estrogen** and **progesterone**. Control female sexual development and maturing of eggs.
Testes	In scrotum sacs behind the penis	Male reproductive glands. Hormones secreted: **Testosterone**. Controls male sexual development and sperm production.