PEER One Health Curriculum	
Leader Guide	**Stress Case Study: Diabetes**

Summary:
The stress module covers the concepts of the nervous system, the endocrine system, homeostasis, and feedback mechanisms. Through the One Health in Action case study, students will have the opportunity to investigate the homeostatic mechanisms resulting in Types 1 & 2 Diabetes.

Keywords: effector, gland, homeostasis, hormone, negative feedback, positive feedback, set point, stimulus

Subject TEKS:
- 7.12 (B) identify the main functions of the systems of the human organism, including the circulatory, respiratory, skeletal, muscular, digestive, excretory, reproductive, integumentary, nervous, and endocrine systems
- 7.13 (B) describe and relate responses in organisms that may result from internal stimuli such as wilting in plants and fever or vomiting in animals that allow them to maintain balance.
- Biology 4 (B) investigate and explain cellular processes, including homeostasis
- Biology 10 (A) describe the interactions that occur among systems that perform the functions of regulation, nutrient absorption, reproduction, and defense from injury or illness in animals
- Biology 11 The student knows that biological systems work to achieve and maintain balance.

Grade Level: 6^{th} - 9^{th}

Learning Objectives:
1. Investigate how organisms respond to internal stimuli
2. Identify the structures of the endocrine system
3. Describe the main functions of the endocrine system
4. Describe how organisms maintain balance in stable internal conditions in response to internal stimuli.

Time Required: Two – three, 45-minute class periods

Materials:
- Computers or tablets with internet access
- Supplies for the modeling component of the “Diabetes Doctors” activity (Styrofoam balls, toothpicks, marshmallows, tape, and other materials easily available.)
- Nametags (or other fun identifying markers) for students involved in skit
- Optional: props for the skit
- Butcher paper or a large pad of paper

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- Markers

Background and Concepts for Teachers:

Endocrine System

The endocrine system assists in the regulation of many body functions including growth and development and reproduction. It does this by releasing chemical messengers called hormones produced in glands.

Eight glands make up the endocrine system. The hypothalamus receives signals from the receptors located on the target organs and stimulates the pituitary gland (often called the "master" gland) to release hormones. Although the hormones circulate throughout the body, each type of hormone is targeted toward certain organs and tissues. Additionally, the endocrine system receives help from organs such as the kidney, liver, heart and gonads, which have secondary endocrine functions.

Homeostasis and Feedback Mechanisms

Homeostasis is the steady, life-maintaining conditions inside an organism, despite changes in its environment. The nervous and endocrine systems are control centers that play a vital role in maintaining homeostasis. When balance is not maintained disease or death can occur.

The nervous and endocrine systems have specific mechanisms to regulate homeostatic variables (temperature, blood sugar, etc.) called feedback loops. Negative feedback opposes changes in variables from their target values, or set points. This system acts to return a variable to its set point. For instance, when the temperature rises because of a hot day we produce sweat which will cool us down; the response was to lower the temperature to balance out the deviation of a rising temperature. Positive feedback amplifies a starting signal. The best example of positive feedback is childbirth. When labor begins, a hormone called oxytocin is released, oxytocin causes more contractions which again releases more oxytocin. This culminates in stronger contractions closer and closer together that ultimately help deliver the baby.

Diabetes

Diabetes is a chronic health condition that occurs when your body doesn't make enough insulin or can't use it as well as it should. When functioning correctly, your body breaks down most of the food you eat into sugar (glucose) and releases it into your bloodstream. When your blood sugar goes up, it signals your pancreas to release insulin. Insulin acts like a key to let the blood sugar into your body's cells for use as energy. With diabetes, when there isn't enough insulin or cells stop responding to insulin, too much blood sugar stays in your bloodstream. Over time, that can cause serious health problems, such as heart disease, vision loss, and kidney disease.

In type 1 diabetes, the body makes little or no insulin. The immune system attacks and destroys the cells in the pancreas that make insulin. Type 1 diabetes is usually diagnosed in children and young adults, although it can appear at any age. People with type 1 diabetes need to take insulin every day to stay alive.

In type 2 diabetes, body cells don't use insulin properly. The pancreas may be making insulin but is not making enough insulin to keep blood glucose levels in the

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normal range. Type 2 diabetes is the most common type of diabetes. Risk factors, such as overweight or obesity, and a family history of the disease increase the likelihood of developing type 2 diabetes.

Vocabulary / Definitions:

- Effector: an organ or cell that acts in response to a stimulus.
- Gland: an organ which produces and releases hormones that perform a specific function in the body.
- Homeostasis: regulation of an organism's internal, life-maintaining conditions despite changes in its environment.
- Hormone: Two or more different types of tissue working together to perform a specific function
- Negative Feedback: processes that act to oppose the stimulus, or cue, that triggers the response
- Positive Feedback: processes that amplify the initiating stimuli; they move the system *away* from its starting state
- Set Point: the normal value of a physiological variable such as temperature, glucose level, blood pressure, etc.
- Stimulus: any internal or external change that brings about a response.

Lesson Introduction / Motivation:

Begin the lesson by illustrating the concept of One Health with this simple colored water activity:
https://drive.google.com/file/d/1GgyzUOp0dros2FL7PMeLrmTkAzG4mJMs/view?usp=sharing

Continue the theme of One Health and introduce the topic of diabetes by viewing the following TedEd video: https://youtu.be/k_3hbrqLZ5U. After watching, ask students to describe any interactions between human and animal health they observed.

Finally, ask students to do a quick-write answering the following questions: Do you know someone with diabetes? What is diabetes? What are its causes? Instruct students to write for 3 minutes and then share their thoughts with the class.

Exploration/Explanation: Day 1

Students should next examine the required concepts (standards) of homeostasis and the endocrine system through the Essential Knowledge – "Endocrine System" and "Homeostasis and Feedback Mechanisms" sections of the Stress module from the One Health online curriculum. This can be done as a whole group, small group, partner, or individual activity. Slides, videos, and stopping points are listed below.

- Endocrine System Essential Knowledge Slides 3 – 4: "Endocrine System" and "Hormones"
- Knowledge Check slide 5 – "Regulate Your Knowledge" (use as whole group activity, or create friendly competition – boys v. girls, etc.)

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- Slide 6: “Glands of the Endocrine System”
- Slide 12: “Pancreas” Alternatively, use this TED-Ed video about Pancreas function https://youtu.be/8dgoeYPoE-0
- Homeostasis & Feedback Mechanisms Essential Knowledge Slide 2 – Amoeba Sisters Homeostasis video clip https://youtu.be/Iz0Q9nTZCw4
- Slide 4: “Homeostasis is…”
- Slide 10: “Response to Internal Stimuli”
- Knowledge Check slide 11 – “Keep it in Balance” (use as whole group activity, or create friendly competition – boys v. girls, etc.)
- Slides 16 – 22: feedback mechanisms and examples
- Knowledge Check slide 23 – “Feedback Needed” (use as whole group activity, or create friendly competition – boys v. girls, etc.)
- Slide 24: “Homeostatic Imbalance”

Elaborate: Day 2

- In the “Why Can’t I Have Sugar – All About Diabetes” activity – students will apply concepts related to the endocrine system and homeostasis as they role-play doctors and patients during a diabetes diagnosis and develop models to demonstrate the difference between types 1 and 2 diabetes.
    - https://drive.google.com/file/d/1t_h6dLxMd582MLb6bF9ToUEQurByHR_K/view?usp=drive_link

Assessment/Evaluation:

The Stress Module includes a post-test, which can be used for an overall learning assessment. Other opportunities for assessment include student output for the “Elaborate” activity.

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