

## Title: Exercise and Homeostasis

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**Date and Time of Lesson:** February 28, 1:50 to 2:38 p.m.

**Grade Level:** 7<sup>th</sup> Grade (Pre AP)

**Lesson Source:** Various sources, Brain POP, Katie Donaldson, Region 4 TAKS Preparation Booklet

### Texas Essential Knowledge and Skills (Process and Concept TEKS):

**7.2 Scientific investigation and reasoning.** The student uses scientific inquiry methods during laboratory and field investigations. The student is expected to:

- (C) collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers;
- (D) construct tables and graphs, using repeated trials and means, to organize data and identify patterns; and
- (E) analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.

**7.4 Science investigation and reasoning.** The student knows how to use a variety of tools and safety equipment to conduct science inquiry. The student is expected to:

- (A) use appropriate tools to collect, record, and analyze information, including life science models, hand lens, stereoscopes, microscopes, beakers, Petri dishes, microscope slides, graduated cylinders, test tubes, meter sticks, metric rulers, metric tape measures, timing devices, hot plates, balances, thermometers, calculators, water test kits, computers, temperature and pH probes, collecting nets, insect traps, globes, digital cameras, journals/notebooks, and other equipment as needed to teach the curriculum;

**7.13 Organisms and environments.** The student knows that a living organism must be able to maintain balance in stable internal conditions in response to external and internal stimuli. The student is expected to:

- (A) investigate how organisms respond to external stimuli found in the environment such as phototropism and fight or flight; and
- (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.

**7.4 Patterns, relationships, and algebraic thinking.** The student represents a relationship in numerical, geometric, verbal, and symbolic form. The student is expected to:

- (B) graph data to demonstrate relationships in familiar concepts such as conversions, perimeter, area, circumference, volume, and scaling; and

- (C) use words and symbols to describe the relationship between the terms in an arithmetic sequence (with a constant rate of change) and their positions in the sequence.

**Concepts Statement:**

Balance is very important to all systems. Most systems maintain a dynamic balance called homeostasis by using feedback and restoring mechanisms to make small, balancing changes. Systems in balance are constantly making tiny changes to adjust to changes in their surroundings. Systems of the human body also fluctuate to maintain a balance of sugar in the blood, temperature, heart rate, water content, and blood flow. The brain is the major control center of the nervous system and responds to messages sent in from all areas of the body. The nervous system, circulatory system, respiratory system, endocrine system and integumentary system all work together to maintain this balance by using a system of positive and negative feedback controls so as to stabilize health and functioning, regardless of the outside changing conditions. It is also the ability of the body or a cell to seek and maintain a condition of equilibrium or stability within its internal environment when dealing with external changes. In humans, homeostasis happens when the body regulates body temperature in an effort to maintain an internal temperature around 98.6 degrees Fahrenheit. For example, we sweat to cool off during the hot summer days, and we shiver to produce heat during the cold winter season.

*Word origin:* from the Greek: *homeo*, meaning unchanging + *stasis*, meaning standing.

**Appropriateness of Lesson to the Grade Level:**

This lesson incorporates the Texas Essential Knowledge and Skills for 7th grade science and math.

**Objectives:**

Students will be able to:

1. define homeostasis, negative and positive feedback, circulatory system, respiratory system, recovery time and integumentary system;
2. construct a graph from data;
3. analyze collected data;
4. describe how body works to accommodate changes in energy needs with heart rate and temperature changes;
5. demonstrate how to use a heart rate monitor;
6. predict how organisms will respond to internal and external stimuli.

**Materials List:**

- 7 PASPORT Hand-Grip Heart Rate Sensors
- 7 SPARK Science Learning Systems
- 28 Homeostasis Heart Rate Lab sheets
- 28 sheets of graph paper
- 7 calculators

**Advanced Preparations:**

- Charge all SPARK units overnight.
- Layout materials on each station.
- Plug in sensors and turn on SPARK.
- Press “Open”.
- Scroll down to “Middle School Science” and select it.
- Scroll down to “Recovery Heart Rate – Hand Grip” and select it, then press okay and wait for program to load.
- At the top of the display, press the right arrow key until you get to page 11.
- Press the blue box that looks like a graph in the lower left corner.
- Press the blue graph box with expanding arrows near the top right.
- Press red graph box in lower left corner.
- Press the Sampling Options button (looks like a stop watch) to set sampling at every 10 seconds, then press okay.
- Now the students can collect data and view on screen.

**Safety:**

Instruct students to use caution while running in place. Since different people are conditioned for varying levels of physical exertion, be prepared to stop students from exercising if they become light headed or dizzy.

| ENGAGEMENT   |  | Time: 5 Minutes  |
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| What the Teacher Will Do   | Probing/Eliciting Questions  | Student Responses and Misconceptions                     |
| The teacher will say, “Today’s lesson is about homeostasis. To remain in balance, systems must be monitored and adjusted.” | Show of hands, who has heard about homeostasis before? (Teacher will count hands, make note and continue.) | Some will know, some will not know.                      |
| “If I told you that homeostasis had a Word origin: from the Greek: homeo, meaning  | What is homeostasis?<br>What is equilibrium?   | A balance, I don’t know, various.<br>Not a clue, dynamic |

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| unchanging + stasis, meaning standing, what would that mean to you?   |  | balance within a living organism, various. |
| Balance is very important to all systems. Most systems maintain a dynamic balance called homeostasis by using feedback and restoring mechanisms to make small, balancing changes. Systems in balance are constantly making tiny changes to adjust to changes in their surroundings. |  |  |
| The teacher will say, "Let's try an experiment that will demonstrate how homeostasis works. Let's get into groups of 3-4 people in each group. Let's move over to the stations."  |  |  |

| <b>EXPLORATION</b>   |                                    | <b>Time: 20 Minutes</b>                     |
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| <b>What the Teacher Will Do</b>  | <b>Probing/Eliciting Questions</b> | <b>Student Responses and Misconceptions</b> |
| "There are SPARK Science Learning systems at each station with heart rate sensors."  |                                    |   |
| <p>"Everyone look at the instructions for setting up our lab. Let's read through it together. &lt;Read&gt; Setup: Plug in sensors (This has already been done for you.) and turn on SPARK. Press "Open".</p> <p>Scroll down to "Middle School Science" and select it.</p> <p>Scroll down to "Recovery Heart Rate – Hand Grip" and select it, then press okay and wait for program to load.</p> <p>At the top of the display, press the right arrow key until you get to page 11.</p> <p>Press the blue box that looks like a graph in the lower left corner.</p> |                                    |   |

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| <p>Press the blue graph box with expanding arrows near the top right.</p> <p>Press red graph box in lower left corner.</p> <p>Press the Sampling Options button (looks like a stop watch) to set sampling at every 10 seconds, then press okay.</p> <p>Now the students can collect data and view on screen.</p> <p>Student data collection:</p> <p>This lab involves one person resting for one minute, running in place for one minute, and then standing very still and quiet for two minutes.</p> <p>Select one person to do the exercise.</p> <p>Student doing the exercise picks up both sensors and has metal completely covered by palm of hand and holds fairly tightly.</p> <p>The Pasport sensor will indicate when it registers the heart beat by blinking a red light. Do not start collecting data until there is a registered heart beat.</p> <p>Another team mate will begin the data collection.</p> <p>Press the green box with the white arrow to start collecting.</p> <p>Subject will rest for the first minute.</p> <p>Watch the timer and have the subject begin jogging in place for one minute.</p> <p>After one minute, have the subject stand still, not talking or moving for two minutes.</p> <p>When the timer reaches 4 minutes (displays 4:00:0) stop the data collection by pressing the red box with the white arrow.</p> <p>Record your data</p> |  |  |
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| <p>Press the blue box that looks like a graph in the lower left corner.</p> <p>Press the blue graph box with expanding arrows near the top right.</p> <p>Now, look for the blue box that has a graph in it. There are two side by side. Press the one that is on the right column.</p> <p>Some new red arrows appear above the graph. They show x and y values. You will use the red arrows to find the heart rate for a given time.</p> <p>Press red graph box in lower left corner.</p> <p>This will give you a graph that you can better see the points to record in your data table and on your graph paper.”</p> |   |                 |
| <p>“Set up the graph on your graph paper just like what is on the display.</p> <p>Label your x-axis as Time (in seconds) and your y-axis as Heart Rate (beats/Min).”</p>  | <p>Is everyone clear on graphing?</p>   | <p>Yes, no.</p> |
| <p>“You can complete the percent change after graphing.”</p>  |   |                 |
| <p>“Now that we all know what we are doing, let’s get started. Please let us know if you need any help setting up the lab. Once everyone’s SPARK is setup, please turn your papers face down on the table and wait before collecting data so we can all start together.”</p>  | <p>Are there any functions on your SPARK that are not working or do you need help setting up?</p> |                 |
| <p>“Let’s be clear on how to jog in place. Can I get a volunteer? Whomever volunteers will not need to jog for the experiment. Please jog in place for a couple seconds. Need to speed up or slow down? Let’s not get crazy with this. Just a nice pace to see what happens. No need to</p>   | <p>❖ Can I get a volunteer?</p>   |                 |

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| stomp on the floor.”  |   |   |
| “Now that everyone has the SPARK set up, Press the green box with the white arrow to start collecting. Be sure to watch the display and wait for the time to start jogging in place.”   |   |   |
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| <b>EXPLANATION</b>  |   | <b>Time: 10 Minutes</b>   |
| <b>What the Teacher Will Do</b>   | <b>Probing/Eliciting Questions</b>  | <b>Student Responses and Misconceptions</b>   |
| Teacher will say, “Let’s talk about our results from the lab. Was it fun? Did it make you feel tired? How about the graphs? Did everyone finish?”   | How does exercise affect your heart rate?   | Heart beats faster.   |
|   | Did your heart rate increase? Why?  | Yes, no, body is doing work, needs more blood to provide more oxygen and to supply muscles with energy.   |
| Because your body is so busily using energy, your organs need more blood at one time than they do when your body is at rest. Your heart is in charge of pumping your blood, so t has to work faster and harder to pump the necessary blood. | Did your body feel warmer after exercise? Why?  | Yes, no, sort of, because we are running, I don’t know; because all of your warm blood has to circulate more quickly to deliver oxygen to your body’s cells |
| The blood in your body is very warm, and when you exercise, increasing the rate at which it flows through your body, its heat causes your body temperature to rise  | Controlling body temperature is a large part of homeostasis. How does homeostasis work?                       | Keeps our bodies in balance.  |
| Our bodies control many pieces of homeostasis on their own, without us having to think about “hm, my heart should pump faster, I need to breathe more quickly, or, wow, I need a higher temperature!”                                       | How does your body regulate homeostasis? What is the major difference between positive and negative feedback? | Students will have little input, or perhaps suggest brain   |

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| <p><u>Negative feedback</u>- decreases desired effect, for example, contractions during pregnancy allow the baby to be delivered, eventually decreasing the pain of contractions and delivery</p> <p><u>Positive feedback</u>- increases a desired effect, for example, heart rate increasing, increasing oxygen delivered to your body</p> | <p>What organ in the body serves as the command center for all of the body's functions, including processes like positive and negative feedback?</p>  |  |
| <p>The hypothalamus is the part of the brain that receives messages from organs in the body and stimulates release of hormones that tell body to sweat; note that it is similar to the thermostat analogy given in the engage</p>   | <p>Why do you sometimes get thirsty or hungry?</p>  | <p>Because your organs, which need energy from food to operate, are sending messages to your hypothalamus that stimulates production of chemicals that cause sensations of hunger and thirst</p>   |
| <p>We now know that the hypothalamus plays a large role in homeostasis.</p>   | <p>What other body systems or processes might play a role in homeostasis? Maintaining body temperature?</p>   | <p>The integumentary system works with other body systems to maintain homeostasis. It allows vessels near the skin to dilate allowing hot, fast flowing blood to be cooled by air.</p>   |
| <p>During the lab, your heart rate, breath rate, and perspiration rate increased. This is partly due to thermoregulation.</p>   | <p>What does the prefix thermo- in thermoregulation tell you about the meaning of the word? thermoregulation tell you about How did your body know to increase the rate of these functions? How does temperature affect the rates of these functions?</p> | <p>Thermo- is a prefix meaning "heat" or "high temperature". Thermoregulation is the process by which your body regulates its temperature. Your body knows how to regulate its temperature because your organs send messages to your brain (specifically the hypothalamus). Temperature will cause the rate of most bodily functions (especially the ones mentioned in the lab) to increase.</p> |

| <b>ELABORATION</b>   |   | <b>Time: 5 Minutes</b>   |
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| <b>What the Teacher Will Do</b>  | <b>Probing/Eliciting Questions</b>  | <b>Student Responses and Misconceptions</b>  |
| Consider the last time you had the flu, a bad cold, or any other somewhat serious illness. | Why do you begin to run a fever? What is normal human body temperature? What can happen if your fever becomes too high? | It helps the body fight infection more efficiently. Some types of infections are killed or weakened by the heat; normal body temperature is about 37°C; if your fever is too high (above 41°C), brain tissue can start to break down and/or the person could start to suffer a heat stroke |
| Think about our snow days we just had. It was really cold and we wanted to stay warm.      | How does a body stay warm?  | Shivering is a function that helps us stay warm.   |
| In this manner, we use some energy to shiver and warm our bodies.                          | What about when it is hot outside?  | We sweat, and evaporation of sweat cools our bodies.   |

| <b>EVALUATION</b>  |   | <b>Time: 5 Minutes</b>   |
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| <b>What the Teacher Will Do</b>  | <b>Probing/Eliciting Questions</b>  | <b>Student Responses and Misconceptions</b>  |
| Teacher will pass out the Evaluation form and instruct students to fill out and then return to teacher upon exiting classroom. | Which of the following animals maintains a constant body temperature?   | Snake, lizard, dog, shark  |
|  | Endothermic creatures maintain a constant body temperature, while ectothermic creatures do not. What are the best synonyms for “endothermic” and “ectothermic”? | Warm blooded and cold blooded, land dwelling and water dwelling, mammalian and reptilian, vertebrate and invertebrate. |
|  | What can you infer about the prefix “thermo-“ from the word “thermoregulation”?   | It refers to the brain, temperature, feedback, nerves and hormones.  |
|  | What is the major difference between  | PF is controlled by the hypothalamus and NF is   |

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|  | positive and negative feedback?   | controlled by the endocrine system; PF causes bodily functions to continue, NF causes bodily processes to start or stop; etc.  |
|  | <p><b>TAKS April 2006 Gr 8 Science</b></p> <p>4. Which of the following processes helps the body maintain chemical balance?</p> | <p>F - Tears washing away dust from the eyes</p> <p>G - Rib bones protecting internal organs</p> <p>H - Hair growing faster in winter months</p> <p>J - Cells using sugar in the blood</p> |

Copies of one page evaluation and handouts included.