***5E Lesson Plan***



|  |  |  |  |
| --- | --- | --- | --- |
| **Grade**: 9-12 High School Living Env | **Topic:** Making Connections Lab - Pulse Rate and Exercise  | 3 periods | ***Comments/notes*** |
| **Brief Lesson Description**: Explore how organisms regulate body conditions to a changing environment by designing and carrying out all steps required for a controlled experiment and presenting their findings. |
| **Performance Expectation(s): Living Environment Standards** * **Key Idea 1**: The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing and creative process. (Includes all major understandings)
* **Key Idea 2**: Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity. (Includes all major understandings)
* **Key Idea 3**: The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into natural phenomena. (Includes all major understandings)
* **1.2c**: The components of the human body, from organ systems to cell organelles, interact to maintain a balanced internal environment. To successfully accomplish this, organisms possess a diversity of control mechanisms that detect deviations and make corrective actions.
* **1.2d**: If there is a disruption in any human system, there may be a corresponding imbalance in homeostasis.

**Common Core ELA/Writing/Math Standards*** WHST.9-12.7: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3)
* WHST.11-12.8: Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and over-reliance on any one source and following a standard format for citation. (HS-LS1-3)
 | *Would include standards that cover the scientific method as well as some regarding homeostasis**Include CCLS*  |
| **Specific Learning Outcomes:** Students learn to apply the steps of the scientific method and present their findings to the whole class for peer evaluation. Students apply knowledge of homeostasis to describe the physiological changes that occur pre- and post-exercise and other activities.Students collect digital pulse rate data using the Arduino microcomputer with pulse sensors attached to it.  |  |
| **Narrative / Background Information**

|  |  |  |
| --- | --- | --- |
| **Background for teachers:**More technology-based spin on the Living Environment mandated state lab *Making Connections* that allows students to use Arduino to measure their pulse rates before/after certain activities instead of measuring with fingers on pulse points/ Adapt for students with disabilities: Students with physical disabilities may not be asked to take their own pulse if they are unable. You may also ask a friend to take their pulse for them. Students with learning disabilities should be sat in front and refocused throughout the lesson. You may also want to do more than one test trial. | **Teacher preparation**: (Plan for 32-34 students) - 8 groups* Clothespins for each pair
* Copies of lab handout
* Arduino uno with pulse sensor and digital screen added on
	+ [Link for sensor](https://pulsesensor.com/products/pulse-sensor-amped)
	+ Sensor and code and all instructions [here](https://www.electronicshub.org/heartbeat-sensor-using-arduino-heart-rate-monitor/)
	+ Also any software/code that needs to be run
	+ [Code 1](https://github.com/bmbergh/cheerios) ← click for code
* Area where students can do exercise (stairwell, empty part of the room, hallway, etc.) - *let students know to be respectful of other classes in progress!*
* **Google Doc** for collecting data on pulse rates for the whole class - prepare ahead of time, make clear for students to navigate through
	+ Manual measurements vs digital
	+ Count of each category
	+ Designed lab data
* Timer for activity portion
 | **Prior Student Knowledge:** * Understanding of applying the scientific method and all of its steps (emphasis on making a scientifically-sound hypothesis, identifying constants and variables in the first part; making conclusions and analyzing data after the experiment)
* **Homeostasis and feedback mechanisms**: Understanding why the body reacts to certain changes in the environment as it does, as with thermoregulation
 |

 |
| **Science & Engineering Practices:** * Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.]
* HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. [
 | **Disciplinary Core Ideas:** LS1.A: Structure and Function* Feedback mechanisms maintain a living system’s internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.
 | **Crosscutting Concepts:** Cause and Effect* Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS2-8), (HS-LS4-6)

Scale, Proportion, and Quantity* The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-LS2-1)
* Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. (HS-LS2-2)

Stability and Change* Much of science deals with constructing explanations of how things change and how they remain stable. (HS-LS2-6)
 |
| **Possible Preconceptions/Misconceptions:** * Students may need assistance with Arduino equipment - make sure to demonstrate ahead of time
* Understanding why pulse rate is higher after exercise in terms of what is happening with the circulatory system
* Check student scales to make sure they start from zero (or have a break) and are scaled in equal multiples/line
* Identifying a good number a constants for a lab experiment - push students to think of as many parameters to keep the same as they can
 | *Misconceptions about the equipment, experiment, concepts, or vocabulary* |
| **LESSON PLAN – 5-E Model**  |
| **ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:** *Students pick up Making Connections lab packet as they enter the room.**Show picture of a pregnant woman with a cigarette.* Do Now: 5 min talk, 4 min review (9 min total)Write down your partner’s response to the following questions:1. What may happen to a baby if the mother started smoking?
2. Are smoking and low-birth weight babies directly related? How would you confirm your response?

*Discuss as a class, ensuring that students are sharing only their partner’s responses (not their own).*  | Are there any videos/interactive resources that students could explore first? |
| **EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:**Pre-lab Protocol* Read through *Discovering Connections* and *Safety* sections of the lab with students (5 mins)
	+ Find out if anyone is excused from physical activity due to health reasons
* Show students how to normally do pulse rate, just so they know (2 mins)
	+ Tell students that we will be using a device for calculating the pulse rates for the three trails on page 2
* Introduce Arduino pulse rate sensor to students and demonstrate use (8 min)
	+ YouTube video showing its use (not sure which to use yet)
		- <https://www.youtube.com/watch?v=nUtFfaG-SJ0>
		- <https://www.youtube.com/watch?v=_J7pyL_3-AI> ← this one seems more student-friendly w/instructions
		- Go over any precautions to ensure Arduino is not damaged
	+ Page 2 of Making Connections Lab (5 mins)
		- Students take three trials of their pulse rate (1 min) and record into packet
		- Students calculate average and input into Google Doc
	+ Page 3 of Lab Packet (<10 min)
		- Students complete data table from displayed data
		- Students generate a histogram using appropriate scales and the data provided
		- Review one or two if time allows
		- Address any common misconceptions regarding the histogram (display an example on the board if needed -- do not show if students are generating well on their own)
	+ Page 4 of Packet (Students skip the first three questions, complete for DN next day; do activity part first - last 5 min of day 1)
		- Students perform activity for a minute - partner times them
			* Take pulse on Arduino and record results into packet
			* Students ask four other partners if they got similar results
			* Answer last question on page 4 and discuss as a class if time allows

**SECOND PERIOD**DN: Page 4 of Making Connections Packet (5 min total)* Individually, students answer the first three questions
* For question 3, students write their partner’s question right under theirs after discussing responses

*Page 5+6: Students perform Part A2 and answer the questions on pages 5 and 6* (15 mins) * Do questions individually (10 mins)
* On bottom of page 5, in blank space: Discuss responses with partner and write down similarities/differences between your responses. (5 mins)
 | *Students input pulse data into a google doc for easier display of class results* |
| **EXPLAIN: Concepts Explained and Vocabulary Defined:** Student Presentations of final report (THIRD PERIOD)*Teacher** Provide presentation guidelines and an audience handout for them to follow along and evaluate their peers during a gallery walk

*Student** Prepare work around the room displaying their experiment (5 mins)
* Present findings in pairs with data gathered
* Participate in a gallery walk (20 mins)
* Students compare their findings to that of their peers and discuss as a class (10 mins)
	+ Discuss which experiments they though investigated the claims well and why (5 min)

**Vocabulary:** homeostasis/dynamic equilibrium, scientific method, controlled experiment, hypothesis, independent and dependent variables, constants aka controlled variables | *Might add more to this section* |
| **ELABORATE: Applications and Extensions:***Page 7-9*: Investigating Claims (~20-25 mins; rest of the second period)* Discuss briefly the difference between a claim and a fact.
* Read over summary, allow students to read through Conflicting Claims About the Effect of Exercise…
	+ Students answer questions in their pairs and design an experiment using the guidelines on page 8
	+ *Teacher*:
		- Ensure data tables are properly made
		- Make sure experiments are not all exactly the same
		- Provide ideas for experimental variables they can change
	+ Students show data tables to teacher before starting experiment
		- Students can create data table into google doc
	+ Students gather data using multiple trials (10 mins)
		- Student enter data into google doc

**HOMEWORK**: Allow students about 2-3 days (or time over a weekend if lab is done by Friday) to create a typed lab report and presentation for the class. Students share final reports with the teacher over Google Docs/by email directly.  | *This has activities from period 2; would come before explain*  |
| **EVALUATE:** **Formative Monitoring (Questioning / Discussion):** *Multiple checks during the lab setup, portion, pre- and post-experiment*1. Ask students how they are properly applying all of the necessary steps of the scientific method (see scientific method template that includes a checklist after every section)
2. Students will be inputting their own observations into their lab notebook
3. Peer evaluation of extension labs and setup

**Summative Assessment (Quiz / Project / Report):** 1. End-of-lab report with detailed analysis in conclusion and details about extension activities (Individually using collected group data) - students use template from before to write this
2. Whole class presentation by groups on their findings, and comparison to other groups’ findings
3. Scientific method/state lab regents questions quiz
 | *During experimentation, during presentations; individual versus group assessment techniques* |
| **EXTEND Further / Reflect: Enrichment: (Added extensions to lesson, if possible)** Time allowing or for hw* Explore other ways our bodies change with the environment, and relate them to disorders
* How does this disorder disrupt feedback mechanisms/homeostasis/dynamic equilibrium in an organism?
 | ***Optional*** *- could be done as HW, reviewed as a brief Do Now if time allows* *Could think of more* |