9-12 SCIENCE
PERFORMANCE TASK
TEACHER INSTRUCTIONS

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TASK OVERVIEW

TITLE	GRADE LEVEL	SUBJECT AREA	INSTRUCTIONAL UNIT	TIME FRAME: HOW LONG TO ADMINISTER THE TASK?
Beyond the Human Tipping Point	9-10	Biology	Homeostasis	3-5 Days?

CONTENT AREA
PROFICIENCIES AND PERFORMANCE INDICATORS

GRADUATION PROFICIENCY	GRADUATION PROFICIENCY DESCRIPTION	PERFORMANCE INDICATOR	PERFORMANCE INDICATOR DESCRIPTION
#3 Life Sciences-Structure, Function, and Information Processing	Students will demonstrate an understanding of how organisms live, grow, respond to their environment, and reproduce using molecular, structural, and chemical biology (LS1) through the integration of scientific and engineering practices and crosscutting concepts.	B	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
#3 Life Sciences-Structure, Function, and Information Processing	Students will demonstrate an understanding of how organisms live, grow, respond to their environment, and reproduce using molecular, structural, and chemical biology (LS1) through the integration of scientific and engineering practices and crosscutting concepts.	C	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

CROSS-CURRICULAR[1]
PROFICIENCIES AND PERFORMANCE INDICATORS

GRADUATION	GRADUATION PROFICIENCY	PERFORMANCE	PERFORMANCE INDICATOR

PROFICIENCY	DESCRIPTION	INDICATOR	DESCRIPTION
Communication	Students will demonstrate communication through using a variety of modes to convey meaning to and seek understanding from others.	4	Demonstrate organized communication through varied modes (oral, written, visual and/or performance).
Problem Solving and Critical Thinking	Students will demonstrate problem solving and critical thinking by applying processes to define problems, evaluating possible outcomes, and persevering in solving complex problems.	2	Identify, collect and analyze relevant information.
Problem Solving and Critical Thinking	Students will demonstrate problem solving and critical thinking by applying processes to define problems, evaluating possible outcomes, and persevering in solving complex problems.	3	Generate options and provide reasoning for a plan or approach to solve a problem.

[1] After administering the task to students, the design team decided to delete the Performance Indicator *Problem Solving and Critical Thinking: 3* as an assessment indicator for the task.

NEXT GENERATION SCIENCE STANDARDS

Disciplinary Core Ideas

LS1.A: Structure and Function

- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.
- 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.

Cross-Cutting Concepts

Stability and Change

- Feedback (negative or positive) can stabilize or destabilize a system.

Systems and System Models

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

Science and Engineering Practices

Developing and Using Models:
Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.

Planning and Carrying Out Investigations:
Planning and carrying out in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible variables or effects and evaluate the confounding investigation's design to ensure variables are controlled.

SCORING CRITERIA[2]

PERFORMANCE INDICATOR	BEGINNING	DEVELOPING	PROFICIENT	EXPANDING
#3 Life Sciences-Structure, Function, and Information Processing: B Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within	**Identify** the components of the model. **Identify** systems in multicellular organisms.	**Describe** the relationships between components of the model. **Explain** the function(s) of the systems in multicellular organisms.	**Develop and use a model** to explain the relationship among its components. **Illustrate** how the hierarchical organization of systems interact to provide specific functions in multicellular organisms.	**Distinguish** between the accuracy of the model and the actual body system/function it represents by identifying limitations of the model.

multicellular organisms.				
#3 Life Sciences-Structure, Function, and Information Processing: C Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.	**Plan** an investigation to collect data about how feedback mechanisms maintain homeostasis.	**Plan** and **conduct** an investigation to collect data that demonstrates that feedback mechanisms maintain homeostasis.	**Plan** and **conduct** an investigation that identifies and measures internal and external environmental conditions and **explain** why the evidence demonstrates that feedback maintains homeostasis.	**Plan** another investigation that identifies and measures internal and external environmental conditions to collect evidence of how feedback maintains homeostasis in a different living system in a real-world scenario.
Communication: 4 Demonstrate organized communication through varied modes (oral, written, visual and/or performance).	**Restate** information using a mode of communication (oral, written, visual, and/or performance, including technology when applicable).	**Organize** information to communicate ideas and responses when using any mode of communication (oral, written, visual, and/or performance, including technology when applicable).	**Present** information and ideas coherently, with logical sequence when using any mode of communication (oral, written, visual, and/or performance, including technology when applicable).	**Enhance** communication through the sequence and presentation of ideas when using any mode of communication.
Problem Solving and Critical Thinking: 2 Identify, collect and analyze relevant information.	**Find information** in sources provided and **describe** the information/data gathered.	**List** resources relevant to the plan or process of approach, **identify** simple patterns and trends in information/data, and **determine** whether information is sufficient or if	**Identify** relevant information/data from resources and **analyze** patterns and trends to identify relationships.	**Identify** information/data crucial to the problem and **identify** and **prioritize** patterns and trends in information/data most relevant to the problem.

		more is needed.		
Problem Solving and Critical Thinking: 3 Generate options and provide reasoning for a plan or approach to solve a problem.	**Identify** and **choose** a potential plan or process of approach from a list of possibilities.	**Identify** opportunities for new thinking or creative problem-solving. **Generate** a plan or process of approach.	**Describe** opportunities for new thinking or creative problem-solving using resources and design procedures. **Generate** a range of plans or processes of approach, select one and **support the** chosen plan or approach with information/data.	**Analyze** opportunities for new thinking or creative problem-solving using resources and design procedures needed for collecting, managing, and analyzing information. **Generate** a range of possible solutions that do not simply borrow from past examples and **select** and **justify** a chosen solution using evidence from an analysis of the options.

[2] After administering the task to students, the design team decided to delete the Performance Indicator *Problem Solving and Critical Thinking: 3* and the associated Scoring Criteria as an assessment indicator for the task.

CONNECTIONS TO INSTRUCTIONAL UNIT

UNIT SUMMARY
May include big ideas, authentic context, enduring understandings, essential questions.

In this unit, students will be introduced to the topic of homeostasis, particularly how all living organisms must maintain stability with changing external environments. Students will learn how feedback loops help maintain homeostasis and examine how positive and negative feedback loops operate differently in organisms. Students will become familiar with the parts of a feedback, including the sensors, integrators, and effectors. Finally, students will examine scenarios where homeostasis is not maintained and how these situations can lead to disorders of the body.

Anchoring Phenomenon:

- The anchoring phenomenon that will be used throughout the unit is how humans adapt to changes in water balance. They will watch a video clip about a high school football player who died after drinking too much

water and Gatorade after football practice. This phenomena will be used to discuss how humans maintains proper water balance, especially when undergoing stressors like exercise. Students will generate questions about how water, a vital component to life, can cause death when in excess.
Source: https://www.youtube.com/watch?v=jeiHmGTn_X8&list=WL&index=21&t=0s

Essential Questions:

- How do organisms maintain a balance between their internal and external environments?
- How is the human body affected by exercise?

What will students know as a result of instruction in this unit in order to complete the task?	What will students be able to do as a result of instruction in this unit in order to complete the task?
• Students will know that homeostasis allows for living things to maintain stable internal conditions. • Students will know the parts of a feedback loop: sensor, effector, control center/integrator. • Students will know examples of positive and negative feedback loops. • Students will know how to distinguish between positive and negative feedback loops.	• Students will be able to identify a variable (blood pressure, pulse, temperature, perspiration level, breathing rate) that is affected by exercise. • Students will be able to identify a hypothesis to investigate. • Students will be to identify materials needed to conduct their experiment. • Students will be able to plan an investigation to determine how exercise affects their variable. • Students will be able to organize their data into tables and graphs. • Students will be able to analyze their data and make comparisons with different groups. • Students will be able to present their results in a variety of formats (lab report, oral presentation, poster, etc). • Students will be able to draw a model of the feedback loops responsible for regulating their variable.

How will teachers know what students know and can do prior to the task? Which relevant concepts and skills have students struggled with, had misconceptions about or missed entirely?	What background knowledge do students need (cultural, language, etc)? Have both content goals and language demands for ELL students been considered? Have the needs of diverse learners been considered?

Formative Assessments: ● Vocabulary assessment: positive feedback, negative feedback, integrator, sensor, effector, independent variable, dependent variable ● Blood Pressure Assessment: Can they use the sphygmomanometer? Can they hear the pulse? ● Pulse Assessment: How do we measure a pulse? Where can we measure our pulse? ● Data Analysis Assessment: How do we set up our graphs and tables? ● Positive vs. Negative Feedback Assessment: Can students identify if a scenario is positive or negative feedback? Misconceptions: ● Students believe positive feedback is “good” and negative feedback is “bad”. ● Students confuse independent and dependent variables.	● Access to native language materials for ELL students ● Consult with literacy specialists for students with ILPs ● Consult with special educators for students with IEPs ○ Provide organizers to break task down into smaller chunks

CULMINATING TASK

TASK SUMMARY
Students will design their own experiment to examine how a particular variable (blood pressure, heart rate, breathing rate, perspiration level, etc.) is affected by exercise. Then, students will write a lab report that includes their research question, hypothesis, procedure, materials, data, analysis, and conclusion. Next, students will create a model to demonstrate how a feedback loop regulates their variable during exercise. This model will incorporate prior knowledge of homeostasis and independent research of body systems relating to their variable. Finally, students will present their findings to the class using a medium of their choosing (powerpoint, video, Prezi, poster, etc.). **Anchoring Phenomenon:** The anchoring phenomenon that will be used throughout the unit is how humans adapt to changes in water balance. They will watch a video clip about a high school football player who died after drinking too much water and Gatorade after football practice. This phenomena will be used to discuss how humans maintains proper water balance, especially when undergoing stressors like exercise.

Source: https://www.youtube.com/watch?v=jeiHmGTn_X8&list=WL&index=21&t=0s

STUDENT ACTIVITY

Investigation Question: How is the human body affected by exercise?

Part I: Lab Investigation
In this activity, students will work in small groups to design an experiment that answers the research question. First, students will identify their independent and dependent variables. They will identify a variable (blood pressure, heart rate, body temperature, perspiration level, breathing rate, etc.) that is affected by exercise. Students will also determine which type of exercise (jogging, jumping jacks, etc.) they want to perform.

Then, students will record their hypothesis and determine how they will conduct their experiment. They will write/ type formal materials and procedure for their investigation. It will require enough detail that another student group could follow their directions.

Students will create data tables to organize their information.

When procedures are approved by the teacher, students will conduct their experiments. They can use classroom materials and additional materials (teacher approved).

Students will fill in their data tables and create graphs to organize their data. Students will conclude if their variable is maintained by positive or negative feedback.

Part II: Model Design
Students will use prior knowledge and internet research to create a model (2D or 3D) that demonstrates how positive or negative feedback mechanisms regulate their specific variable. Their models must include all components of a feedback loop (sensors, integrators, effectors) and use directional arrows to show the flow of information. They will label these components and identify which body systems are involved in the feedback loop.

Part III: Lab Report
Students will individually create a formal lab report to document their investigation. They will follow the lab report protocol given to them and include the following sections: Research Question, Hypothesis, Materials, Procedure, Data, Analysis/Conclusion.

Part IV: Presentation
Student lab groups will determine how they wish to present their findings to the class. Whichever format they choose, students will present the following information to the class:

- Research Question

- Hypothesis
- Methods: Materials, Procedure, Variables
- Data: Graphs & Data Tables
- Conclusions: What effect did exercise have on your variable? Which type of feedback mechanism maintains your variable? How do you know? What could you have done differently?

CONSIDERATIONS FOR DIFFERENTIATION AND ACCESSIBILITY

Part I: Lab Investigation

- Flexible grouping for students who struggle with mathematical/problem solving skills. Also, groups should accommodate for students with medical concerns (disabilities, asthma, concussions, etc) that may impact their ability to exercise. Students who cannot exercise should instead record data, be timekeeper, etc. Students who can comfortably exercise for extended periods of time without injuring themselves should be used to collect data.
- Brainstorm worksheet/organizer for students with 504s and IEPs.
- Organizers can also include key vocabulary terms for ELL students or students with IEPs.
- Data table templates/organizers can be provided for students who struggle with organization.
- Template with numbered steps/flowchart boxes can be used to help students organize their procedure steps.
- Shared Google Drive data can be used for students who struggle with organizing/recording their data.

Part II: Model Design

- Model design flowchart can be given to students to break the task down into smaller chunks.
- Use audio/visual supports for resources given to students.

Part IV: Presentation

- Choice of group presentation format to accommodate for all student abilities.
- Powerpoint, poster, Prezi samples/templates can be given to students to fill in so that they can organize their information effectively and/or model how to complete the task.

ADMINISTRATION NOTES AND DIRECTIONS

Teacher will ask students “What variables in the human body are changed when we exercise?”. Students will brainstorm different variables that they could investigate.

Teacher will ask student groups:

- What is your research question?
- What are your independent and dependent variables?
- What is your hypothesis?

Teacher will facilitate this process for groups that are struggling to identify which variables to investigate.

Teacher will review student procedures and materials list to determine if students are ready to conduct their experiments. Teacher will scaffold the process for students who are having trouble creating an appropriate procedure.

Teacher will examine student data tables to determine if they are properly organized.

Teacher will prompt students if they are struggling with analysing their data. Some suggestions include:

- What does the shape of your graph show you about how exercise affects this variable? Is the variable increasing or decreasing?
- Which type of feedback mechanism is shown in this graph? How does resting after exercise change the variable?

Teacher will help students brainstorm which resources to use for their research. He/she may want to review how to determine if resources are reliable and how to cite resources.

Teacher can review the components of a feedback loop if students are struggling with identifying these parts.

Teacher can scaffold the creation of the model if student cannot determine how the parts fit together.

Teacher will distribute and review the lab report protocol/template. Teacher may consider assigning certain sections to be completed in-class or for homework depending on time and student needs.

Teacher will hand out presentation guides for student groups. Teacher may suggest that each student focus on particular sections of the presentation. Teacher may consider brainstorming qualities of an effective presentation with students.

MATERIALS AND RESOURCES

Lab Materials

- Sphygmomanometers

- Thermometers
- Timers (phones, clocks)
- Computers

Instructional Materials

- NSTA, Human Homeostasis:
- NSTA Homeostasis Unit:

Suggested Supplemental Aids

- Lab Report Template
- Presentation Protocol Worksheet
- Graphic Organizers