

9-12 SCIENCE

PERFORMANCE TASK

STUDENT INSTRUCTIONS



TASK TITLE

Beyond the Human Tipping Point

INTRODUCTION¹

Through homeostasis, the human body is able to maintain relative stability when exposed to different environmental conditions. One common condition that affects the human body is exercise. Exercise causes many factors of homeostasis to kick in to maintain internal equilibrium. How exercise affects some of these factors can be determined by measuring and observing certain conditions of the human body. Some of these conditions are: change in skin color on arms and face, perspiration level external body temperature, breathing rate, and heart rate. For this task, you will conduct an experiment to investigate how a specific variable within the human body is altered when we exercise. You and your group will choose the variable you wish to investigate and determine which form of exercise someone in your group will perform. Your data will be used to create a model demonstrating how feedback loops regulate your chosen variable. Finally, you and your group will present your findings to the class.

¹ After administering the task to students, the design team revised the Introduction to provide more clarity. Here is the revised text:

Through homeostasis, the human body is able to maintain relative stability when exposed to different environmental conditions. One common condition that affects the human body is exercise. Exercise causes many factors of homeostasis to work to maintain balance. How exercise affects some of these factors can be determined by measuring and observing certain conditions of the human body. Some of these conditions are: change in skin color on arms and face, perspiration level, external body temperature, breathing rate, and heart rate.

For this task, you will **conduct an experiment** to investigate how a specific variable within the human body is altered when we exercise. You and your group will choose the variable you wish to investigate and determine which form of exercise someone in your group will perform. You will **create a lab report** and use your data to **develop a model** that explains how feedback loops regulate your chosen variable. Finally, you and your group will **present** your findings to the class.

SCORING CRITERIA²

PERFORMANCE INDICATOR	BEGINNING	DEVELOPING	PROFICIENT	EXPANDING
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<p>#3 Life Sciences-Structure, Function, and Information Processing: B</p> <p>Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.</p>	<p>Identify the components of the model.</p> <p>Identify systems in multicellular organisms.</p>	<p>Describe the relationships between components of the model.</p> <p>Explain the function(s) of the systems in multicellular organisms.</p>	<p>Develop and use a model to explain the relationship among its components.</p> <p>Illustrate how the hierarchical organization of systems interact to provide specific functions in multicellular organisms.</p>	<p>Distinguish between the accuracy of the model and the actual body system/function it represents by identifying limitations of the model.</p>
<p>#3 Life Sciences-Structure, Function, and Information Processing: C</p> <p>Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.</p>	<p>Plan an investigation to collect data about how feedback mechanisms maintain homeostasis.</p>	<p>Plan and conduct an investigation to collect data that demonstrates that feedback mechanisms maintain homeostasis.</p>	<p>Plan and conduct an investigation that identifies and measures internal and external environmental conditions and explain why the evidence demonstrates that feedback maintains homeostasis.</p>	<p>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.</p>
<p>Communication: 4</p> <p>Demonstrate organized communication through varied modes (oral, written, visual and/or performance).</p>	<p>Restate information using a mode of communication (oral, written, visual, and/or performance, including technology</p>	<p>Organize information to communicate ideas and responses when using any mode of communication (oral, written, visual, and/or</p>	<p>Present information and ideas coherently, with logical sequence when using any mode of communication (oral, written, visual, and/or performance, including technology</p>	<p>Enhance communication through the sequence and presentation of ideas when using any mode of communication.</p>

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	when applicable).	performance, including technology when applicable).	when applicable).	
<p>Problem Solving and Critical Thinking: 2</p> <p>Identify, collect and analyze relevant information.</p>	<p>Find information in sources provided and describe the information/data gathered.</p>	<p>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 more is needed.</p>	<p>Identify relevant information/data from resources and analyze patterns and trends to identify relationships.</p>	<p>Identify information/data crucial to the problem and identify and prioritize patterns and trends in information/data most relevant to the problem.</p>
<p>Problem Solving and Critical Thinking: 3</p> <p>Generate options and provide reasoning for a plan or approach to solve a problem.</p>	<p>Identify and choose a potential plan or process of approach from a list of possibilities.</p>	<p>Identify opportunities for new thinking or creative problem-solving.</p> <p>Generate a plan or process of approach.</p>	<p>Describe opportunities for new thinking or creative problem-solving using resources and design procedures.</p> <p>Generate a range of plans or processes of approach, select one and support the chosen plan or approach with information/data.</p>	<p>Analyze opportunities for new thinking or creative problem-solving using resources and design procedures needed for collecting, managing, and analyzing information.</p> <p>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.</p>

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.

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STUDENT DIRECTIONS AND MATERIALS

TASK DIRECTIONS³

Part I: Lab Investigation (Group)

1. After choosing your lab groups, determine which variable your group would like to investigate. You are free to choose any of the variables listed in the introduction section.
2. Determine which group member will perform the exercise and which type of exercise will be used to investigate the variable.
3. Write your hypothesis, as an “if, then” statement, to predict how exercise will affect your variable over time. Check with your teacher to make sure that your hypothesis is correctly formatted before moving on to the next step.
4. Once your hypothesis has been approved, your group will begin working on your procedure and materials. Your group will write a detailed procedure describing how you will perform the lab. It should be detailed enough that another group can follow your directions. Check in with your teacher before moving on to the next step.
 - a. Remember to consider how many trials you should perform in order to collect enough data.
 - b. Also, remember your variables! Which variable should be changing over time and which variables should stay the same?
5. Once your procedure has been approved, create data table(s) to organize the data you will be collecting from your lab. Clearly label the rows and columns of your table and include a title. Remember to include units!
6. Gather your materials and conduct your experiment. Remember to document all of your data!
7. Once your data has been collected, create a line graph to illustrate the trends that you noticed over time. Clearly label your axes with titles and units. Give your graph an appropriate title.
8. Analyze your data. What are you noticing about your variable? Is it increasing or decreasing over time? What happens once you are at rest? Which type of feedback mechanism is at work to keep your variable balanced?

Part II: Model Design (Individual)

Now that you have investigated your variable and have an understanding of how it changes when the human body is exercising, you will create a model to explain the feedback loop responsible for maintaining homeostasis. You may use previous feedback loop examples discussed in class as a guide while creating your model. You will incorporate your group’s background knowledge and research to create your model.

1. Based on your graph, determine if your variable is maintained by positive or negative feedback. Review your notes and examples from class if you are having difficulty.
2. Once you have determined the type of feedback loop that is maintaining homeostasis, research which organs are involved in this process. Take notes on how these organs communicate with one another. You should be able to identify the sensors, integrators, and effectors within the feedback loop. Remember to cite

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your sources!

3. Once your research is complete, begin designing your model. It **MUST** have the following information:
 - a. Title: Clearly label your feedback loop at the top. Which variable is described in this model?
 - b. Components: All organs, hormones, etc. are clearly labelled. The body systems that each organ belong to are labelled as well.
 - c. Directional Arrows: Arrows must be used to show how information is moving throughout the body. The feedback loop should be the correct shape depending on the type of feedback.
 - d. Images: Include drawings of relevant body parts, with labels next to each drawing.

Part III: Lab Report (Individual)

Lab reports will be individually typed and submitted. Your organized lab reports should include each step of the scientific method and reflect how your group designed your experiment, analyzed data, and formed a conclusion about your investigation.

Part IV: Presentation (Group)

As a group, you will present your findings to the class. Your group will determine how you wish to present your data. You may choose any of the following formats: poster, powerpoint, video or Prezi. If your group would like to use a different format, please ask your teacher for approval.

Presentation Checklist

- Presentation should discuss the Research Question, Hypothesis, Procedure & Materials, Data, Feedback Loop Model and Conclusion.
- All members of the group present 1-2 sections individually.
- All group members maintain eye contact with the audience and do not read off of the slides, poster, etc.
- Presentation tool (slides, poster, Prezi, etc.) is neat, error-free, and organized with section headings.
- Bibliography of external sources use for the lab report and/or feedback loop model are included and properly cited.

3 The team decided to include an introductory paragraph to the Student Directions and Materials section. It reads as follows:

For this task, you will conduct an experiment to investigate how a specific variable within the human body is altered when we exercise. You and your group will choose the variable you wish to investigate and determine which form of exercise someone in your group will perform. Your data will be used to create a model demonstrating how feedback loops regulate your chosen variable. Finally, you and your group will present your findings to the class.

MATERIALS

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- Sphygmomanometers
- Thermometers
- Timers (phones, clocks)
- Computers

NOTE

CHECKLIST

Your product must include:

- Lab Report
- Group Presentation
- Feedback Loop Model

STUDENT REFLECTION AND/OR GOAL SETTING

1. How effectively did you work with your group members? How could you improve your collaboration skills the next time you are working in a group?
2. What are some strengths of your feedback loop model?
3. How could you improve upon your feedback loop model?
4. How could you improve upon your experimental design? If other words, if you could do this lab again, what would you do differently?
5. How could you improve upon your presentation skills in the future? What is one goal that you have for the next time you present to the class?
6. What did you learn from other group presentations?