

# Annotated 9 - 12 (Biology) Science Work Samples

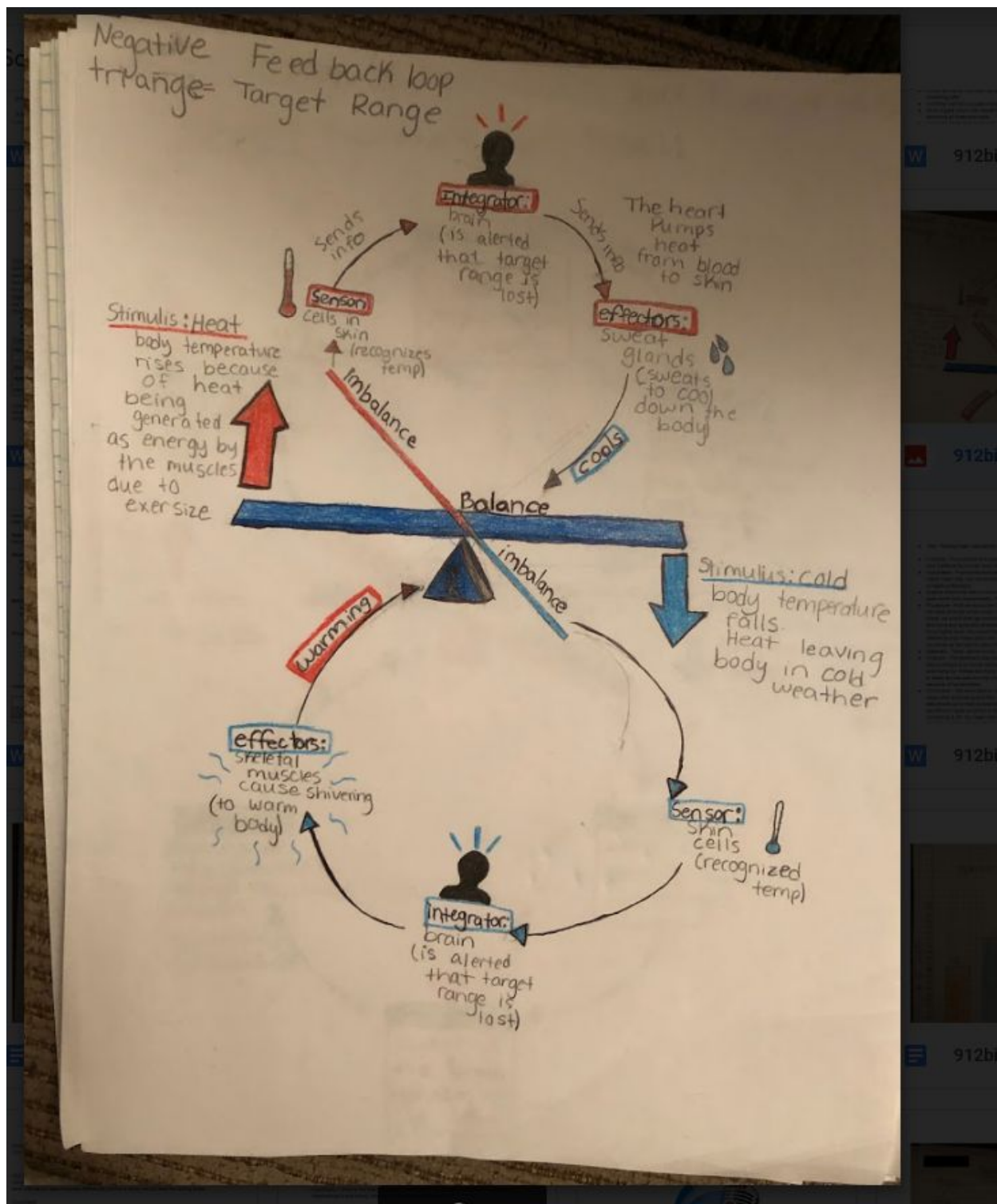
## Scoring Criteria<sup>1</sup>

PERFORMANCE INDICATOR	BEGINNING	DEVELOPING	PROFICIENT	EXPANDING
<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 when applicable).</p>	<p>Organize information to communicate ideas and responses when using any mode of communication (oral, written, visual, and/or performance, including technology when applicable).</p>	<p>Present information and ideas coherently, with logical sequence when using any mode of communication (oral, written, visual, and/or performance, including technology when applicable).</p>	<p>Enhance communication through the sequence and presentation of ideas when using any mode of communication.</p>

<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>

<sup>1</sup> As indicated in both the Teacher Instructions and Student Instructions, the team decided to remove *Problem Solving and Critical Thinking: 3* as an assessment indicator for this task. As such, there are no scores given for this indicator in the student work displayed below.

Student Work Sample #1 (page 1 of 5)



## Student Work Sample #1 (page 2 of 5)

### **Purpose**

Homeostasis is how the body maintains an equilibrium as a result to a change. When someone exercises the energy powering their muscles is lost as heat, this causes body temperature to rise. To regulate your body temperature your heart will pump the heat in your blood from your muscles to your skin. When the skin heats up the body releases sweat to cool off. The purpose of this project is to discover how much the body will heat directly after physical activity.

### **Hypothesis**

If you perform an exercise then your body temperature will increase because heat is being released from the muscles to your skin.

### **Research Question**

How does physical activity affect the process of homeostasis.

### **Variables**

**Independent:** Exercising/resting

**Dependent:** Body temperature

**Control:** 25 push ups

### **Procedure**

#### **Materials**

- Thermometer
- Timer
- Water (for personal benefit, optional)
- Computer/Notebook

#### **Steps**

1. Gather all the materials needed for the experiment
  2. Choose one member of the group to be a test subject. (The test subject should be capable of performing the type, amount, and duration of exercise)
  3. Depending on the test subject, choose a length of planks in which the person will start sweating so results can be seen
  4. Before you begin, take the temperature of the test subject's body to get their resting temp before exercise
  5. Make a chart or table in order to easily record data (we recommend performing 3 trials )
  6. The test subject should begin by doing 3 minutes of planks
  7. One group member should time the length of the planks (3 minutes)
  8. Immediately after the test subject finishes the plank take their body temperature again
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## Student Work Sample #1 (page 3 of 5)

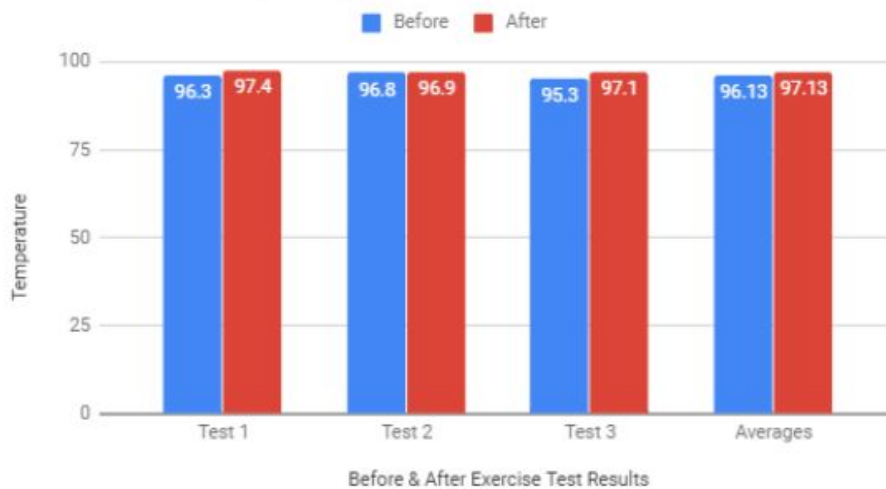
(temp after exercise) The test subject cannot perform the next set of planking until they cool back down to their resting temp)

9. When the test subject's temperature decreases back or close to normal the person can perform the next trial. Repeat steps 6-8 for two more trials so an average can be calculated
10. When you finish recording the data complete the rest of the given directions for the assignment.

### Data:

Temperature	Test 1	Test 2	Test 3	Averages
Before	96.3	96.8	95.3	96.13
After	97.4	96.9	97.1	97.13

### Homeostasis Body Temperature



### Observing Data

Maya's temperature rose immediately after the first set of a three minute plank, by about one degrees fahrenheit. Her temperature dropped before the next test, this is because body naturally cools itself down during physical activity by sweating to regulate the equilibrium which was Maya's average body temperature. Her temperature rose slightly in trial two and immediately

## Student Work Sample #1 (page 4 of 5)

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dropped afterwards before trial three. In trial three her temperature rose about two degree, this is because her muscles started to warm again from generating energy after she had cooled down.

### Analysis

Sensor: Temperature related cells in the skin and brain

Integrator: The brain

Effector: Sweat glands

A Feedback Loop shows how living organisms respond to stimuli. This experiment exhibits a negative feedback loop. A negative feedback loop causes reversed actions to occur in order to bring a variable back to its target range. In this demonstration, Maya's body temperature was dependent variable and her average resting temperature of 96.13 is the target range. Initially, when Maya completed the first set of planking for three minutes her body temperature rose. When doing physical activity the energy generated in the muscles is lost was heat. This caused her body temperature to rise from 96.3 degrees to 97.4 degrees. Between tests one and two Maya's body started to cool down slightly. This is because, the heart pumps the heat in your blood to the skin. When the skin heats up, skin cells which are sensors signal the brain which is the integrator because this body temperature is out of target range. The integrator, then contacts the skin glands or effectors and causes them to sweat in order to cool down the body. This resulted in her body temperature dropping from 97.4 degrees to 96.8 degrees. This process occurs again between tests two and three. Maya's body temperature then rises to 96.9 degrees after the planks in test two and drops two 95.3 degrees as a result of the negative feedback process. Finally, her body temperature will rise again to 97.1 degrees after the planks in test three. The negative feedback loop steadily occurs throughout the tests in order to maintains Maya's target range temperature, this is why the change in temperature is very low.

### Conclusion

The purpose of this experiment was to learn how body temperature (dependent variable) is affected when a person performs planks (independent variable). In my hypothesis I predicted that our test subject, Maya's body temperature will rise when performing planks. I predicted this because when exercising, heat is released from the muscles to the skin which should cause a raise in temperature. The data my group generated proved this hypothesis correct. Maya's body temperature did rise after doing three minutes of planking. Maya's average resting temperature is

## Student Work Sample #1 (page 5 of 5)

96.13 degrees fahrenheit and her average body temperature directly after physical activity was raised to 97.13 degrees fahrenheit. After planking her body temperature rose immediately but in between each of the three tests during a resting time Maya's body temperature was able to decrease and measure close to her average target range. This is a result of a negative feedback loop. I know this is a negative feedback loop because, when heat is generated from the muscles the heart pumps this heat from the blood to the skin. The skin is the sensor in this experiment and when it heats up, the brain which is the integrator is signalled and it causes sweat glands which are effectors to release sweat. The goal is to cool the body down and bring it back to the target range. Before doing this test my group tried the same experiment with twenty-five push ups as the independent variable. The data we originally collected barley represented a difference in temperature from before and after Maya did the push ups. We learned that 25 push ups did not require enough energy to be generated from Maya's muscles to cause her body to heat up and activate the negative feedback loop. The amount of physical activity needed to activate this process differs for everyone but when doing this experiment it is important to make sure the amount, duration, and type of exercise generates the right amount of data needed.

**#3 Life Sciences - Structure, Function, and Information Processing: B - Proficient** - This model received a Proficient score. The model clearly distinguishes the four parts of the feedback loop (Sensor-skin cells, Control Center-brain, Effector-sweat glands, and the stimulus). They are all clearly labelled and illustrated. Directional arrows correctly show the flow of information. The model was developed by the student and used to explain their lab data. The model shows how different body systems (integumentary, muscular, nervous, etc) work together to cool down the body following exercise.

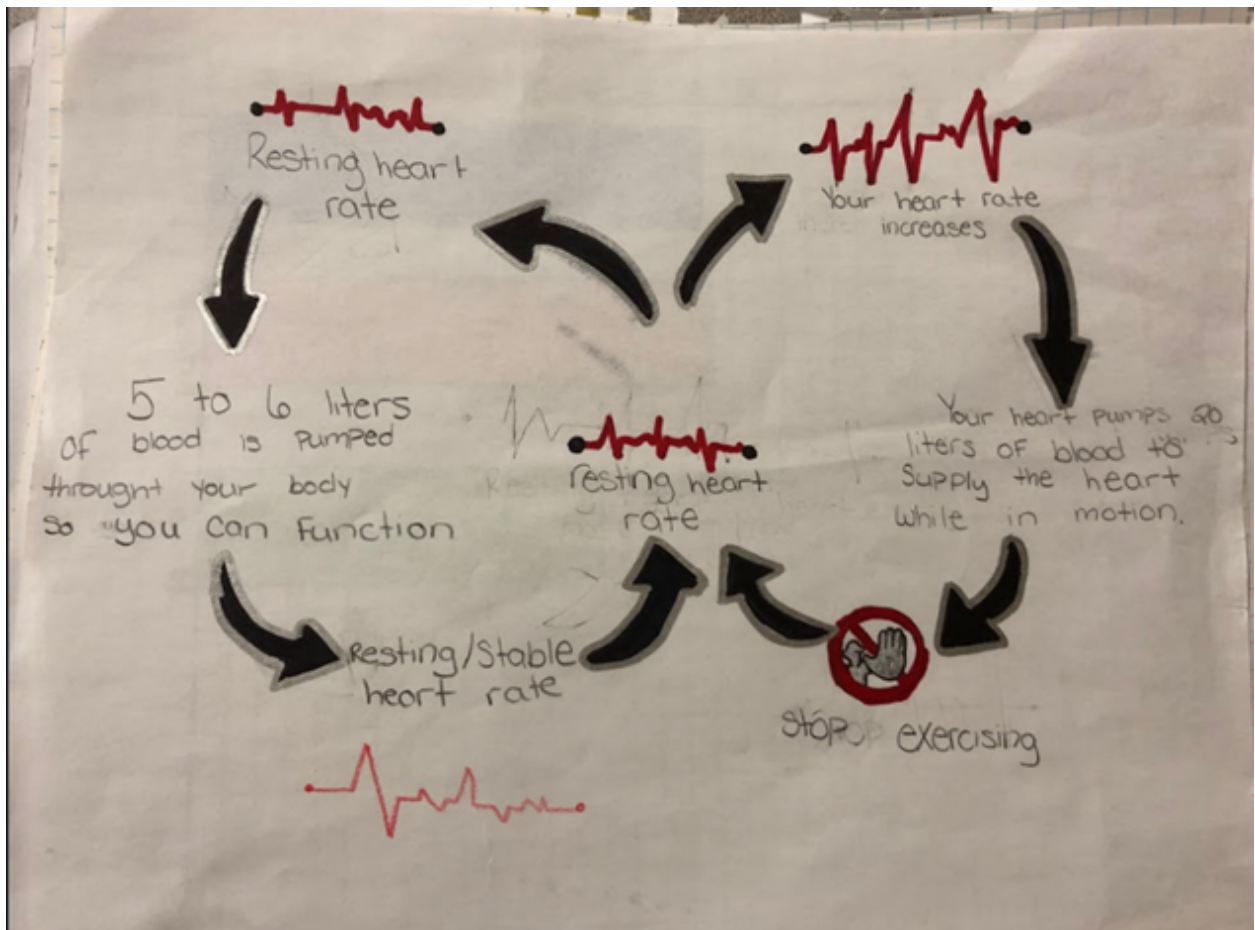
**#3 Life Sciences - Structure, Function, and Information Processing: C - Expanding** - The student plans and conducts an experiment to determine how planks affected the body temperature of a member of her lab group. Her Analysis section explains the trends that were observed during the lab. She identifies the negative feedback loop that is responsible for increasing her body temperature from 96.3 to 97.4 degrees Fahrenheit. She later notes that the temperature decreased to 97.1 degrees Fahrenheit, which illustrated a negative feedback loop. We determined that this task went above the proficient level and was exemplary because in the Conclusion section, the students reflected upon a prior failure while designing their procedure. Initially, the student's group attempted push up as their form of exercise, but it did not produce enough of a temperature difference to demonstrate a negative feedback loop.

Therefore, this student "planned another investigation" and applied their learning to a real-world scenario by giving advice to others who would attempt this lab in the future.

**Communication: 4 - Expanding** - The student received an exemplary for her communication and organizational skills. She used section headings for each section of the lab report. The sections are in the proper sequence which helps the reader understand the scientific method and the process by which her group completed the task. There are meticulous details that explain her conclusions.

**Problem Solving and Critical Thinking: 2 - Expanding** - The student received an exemplary on this indicator. Referring to her Analysis and Conclusion sections (see above), the student identifies and prioritizes patterns and trends in her group's data. She notes the increases and decreases in body temperature while completing the planks and following the completion of the planks. While her writing is meticulous, she highlights only relevant pieces of data rather than superfluous information.

Student Work Sample #2 (page 1 of 4)





## Student Work Sample #2 (page 2 of 4)

### ***Beyond the Human Tipping Point***

**Research Question:** How does your heart rate change from resting after you run?

**Purpose:** The purpose of this lab was to show how your heart rate is altered when we exercise. It was to further our understanding of homeostasis. Heart rate is a part of homeostasis so this helps us to learn more by seeing the effect exercise has on our heart rate. We wanted to learn how a specific exercise would affect one's heart rate.

**Hypothesis:** If you run then your heart rate will increase because your heart needs to work harder to pump more blood throughout your body causing it to be a negative feedback loop.

#### **Procedure/ Materials**

##### **Materials:**

- Stabilized runner which means you shouldn't have someone with asthma do this lab it may change the results (In air experiment it was Spencer)
- Sneakers
- **Large area that you could easily track where to start and stop**

##### **Procedure:**

1. Lace up your sneakers tight
2. Designate a starting point and ending point
3. Take your resting pulse before you run and record it
4. Run two laps (from starting point to ending point)
5. Take your pulse immediately after running and record it
6. Wait until your pulse returns to your resting heart rate
7. Repeat steps 4-6 two more times and record for accurate data

#### **Data/Observations**

Spencer was a runner	Resting heart rate (bpm)	Heart rate after running (bpm)
<b>Trial 1</b>	72 bpm	144 bpm
<b>Trial 2</b>	72 bpm	120 bpm
<b>Trial 3</b>	76 bpm	164 bpm

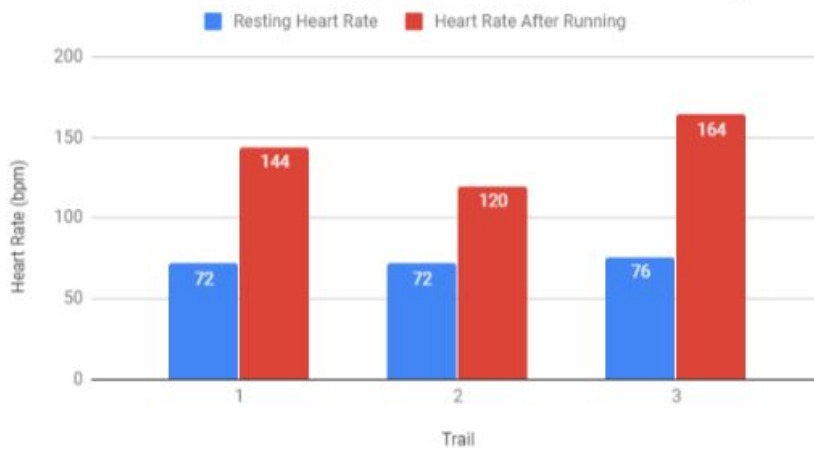
~Observations

## Student Work Sample #2 (page 3 of 4)

- It took a long time before we could get the runner's heart rate back down to the resting heart rate
- The resting heart rate was the same during trails two and three however the runners heart rate after running was different
- In the first trail the runners resting heart rate doubles
- We did the first trail one day and the two others the next day however the first trail was the only one where the resting heart was doubled

### Graph

How Your Heart Rate Changes Before And After Running



### Analysis:

It is a negative feedback loop. This is because with exercise, the heart rate will increase, but because of homeostasis the body will return the heart rate to its resting point when the exercise is finished. For example, at the end of trial 1, the heart rate went up from 72 to 144. Since it is a negative feedback loop, the heart rate after resting for roughly 15 minutes, the heart rate returned to its resting point of 72.

## Student Work Sample #2 (page 4 of 4)

### **Conclusion:**

In this experiment we learned that one's heart rate is affected by the exercises that you perform. We found that your running heart rate is either doubled or more than doubled. We found that your heart rate doesn't vary that much, in the first and second test his heart rate was 72 and in the last one it was 76. My hypothesis was proven by this experiment because the runner which was Spencer heart rate increased after he did he running. It also proved that your heart rate is a negative feedback loop because when your heart rate increases it has to decrease. A positive feedback loop doesn't come back down to normal. When running your heart rate will increase because you heart needs to work harder to pump more blood throughout your body. To improve this experiment we should time how long it takes for the runners heart beat to return to its resting rate. Also we could have done one more person to further are investigation, to show that your heart rate will increase. Overall are experiment worked and it showed that your heart has to work harder when doing exercise.

### **Powerpoint:**

[https://docs.google.com/presentation/d/1Xd3YjcAR0xRC0B0yjXCq6zcB8G1oD7W6Py2PwV7IYEQ/edit#slide=id.g49d7876f32\\_0\\_217](https://docs.google.com/presentation/d/1Xd3YjcAR0xRC0B0yjXCq6zcB8G1oD7W6Py2PwV7IYEQ/edit#slide=id.g49d7876f32_0_217)

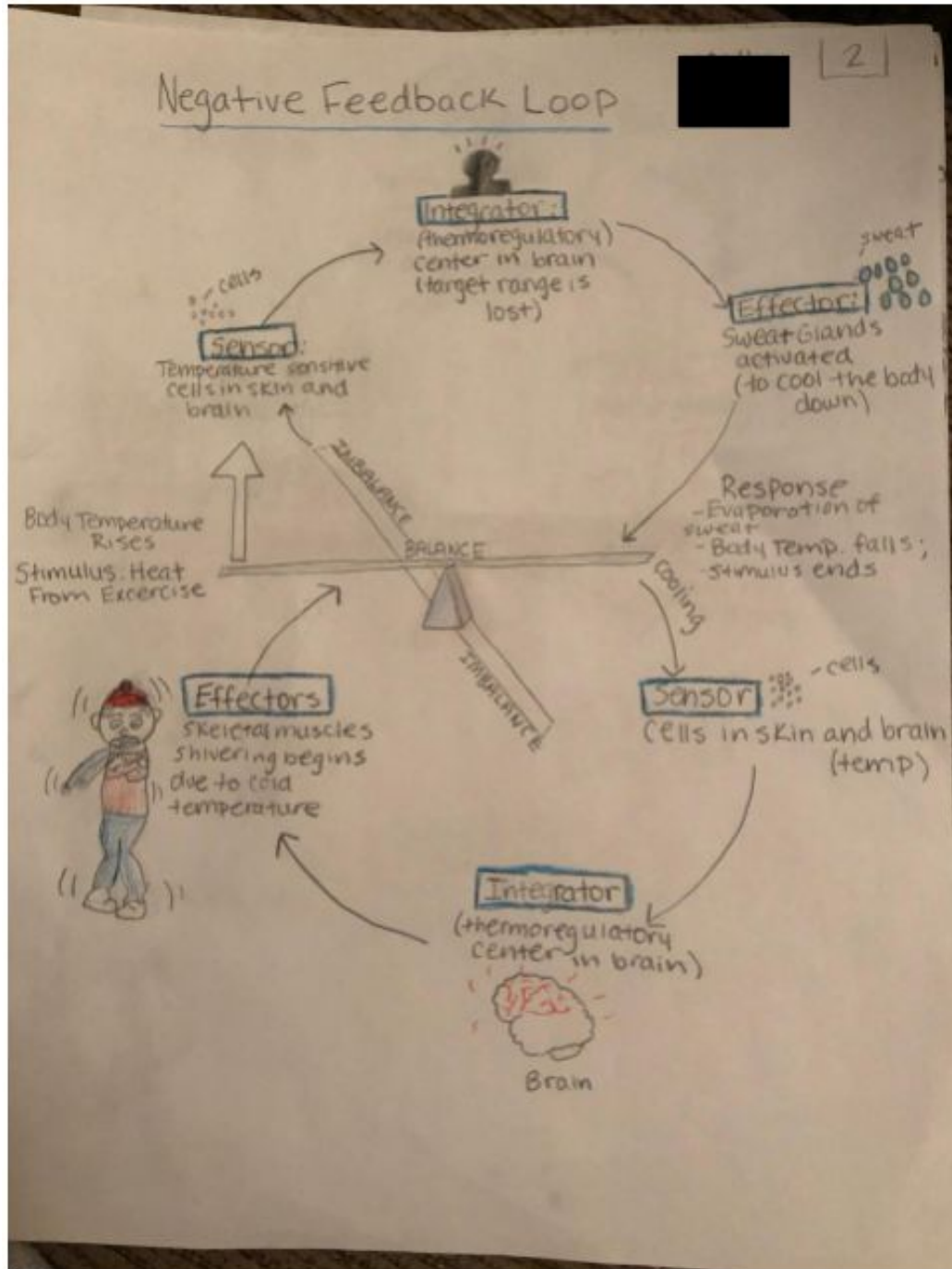
**#3 Life Sciences - Structure, Function, and Information Processing: B - *Beginning*** - Student provided a model but lacks an explanation of the relationship between the components.

**#3 Life Sciences - Structure, Function, and Information Processing: C - *Proficient*** - The student provides evidence of their investigation of a feedback loop.

**Communication: 4 - *Proficient*** - Written description and visualizations provide relevant information and are easy for the audience to digest.

**Problem Solving and Critical Thinking: 2 - *Proficient*** - Student analyzed the data from their investigation to identify patterns.

Student Work Sample #3 (page 1 of 3)



## Student Work Sample #3 (page 2 of 3)

### Body Temperature Lab

**Research Question:** How does exercise affect Body Temperature?

**Purpose:** The purpose of this experiment is to test if a certain variable is affected after performing a certain exercise. Homeostasis is keeping variables in your body within a target range to maintain balance/equilibrium. This lab is altering homeostasis because the purpose, in our case, is to see if your body temperature will differ from its resting temp or its target range.

**Hypothesis:** If we perform an exercise, then your body temperature will increase because your heart rate is increasing and your heart pumps the heat in your blood from your muscles to your skin.

#### Variables

Independent: Exercise; Planks

Dependent: Body Temperature

Control: Environment, Clothing

#### Materials

- Thermometer
- Timer
- Test Subject (1 Member of group) is able to perform planks
- Ice pack for personal benefit
- Computer

#### Procedure

Step 1: Gather a group of 3-4 members

Step 2: Decide the exercise you will be doing and which member of the group will perform it

Step 3: Measure the Resting Temperature of that member

Step 4: Have the chosen member perform a plank for 3 minutes and record their body temperature immediately after

Step 5: Once the member has cooled down, repeat steps 3 and 4 for 3 trials

Step 6: Record Data into a Table and make a Graph

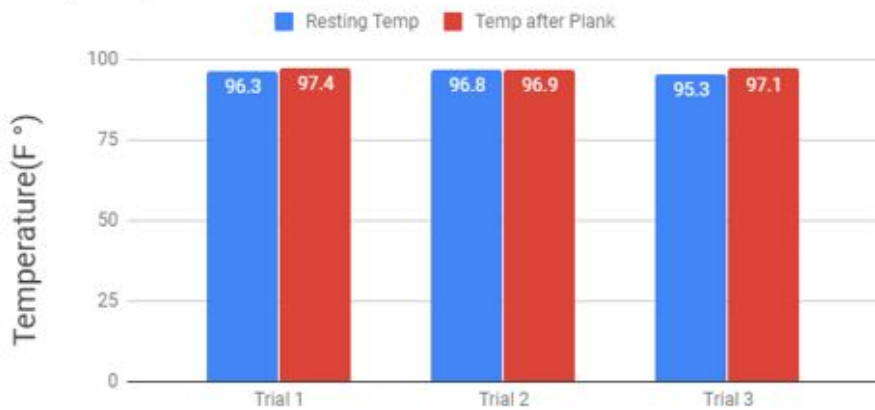
#### Data/Observations:

Test Subject-	Resting Body Temp.(F °)	Body Temp. after Plank(F °)
Trial 1	96.3	97.4

## Student Work Sample #3 (page 3 of 3)

Trial 2	96.8	96.9
Trial 3	95.3	97.1

Body Temperature Resting Vs. After Exercise



Temperature Before & After Planks

**Observations-** After observing the data, you can see that although it was very slightly, Maya's body temperature increased for each trial.

**Analysis-** The type of feedback loop our investigation and data exhibit is a Negative Feedback Loop. A negative feedback loop reverses changes in order to bring a variable back to its target range. As you can see from the data, the body temperature is being altered from its resting temp. or its target range.

**Conclusion-** The purpose of this experiment was to investigate how a variable reacts to change when it is altered. The major findings are conducting the investigation was that even after a strenuous three minute plank for each trial, the body temperature barely increased. For example is Trial 2, it only went up by 0.1 degrees. Thus, our hypothesis was correct and is supported by our data because the temperature increased from the resting temp. An idea to improve the experiment is to wait longer before each trial to make sure you have fully cooled down after performing the exercise.

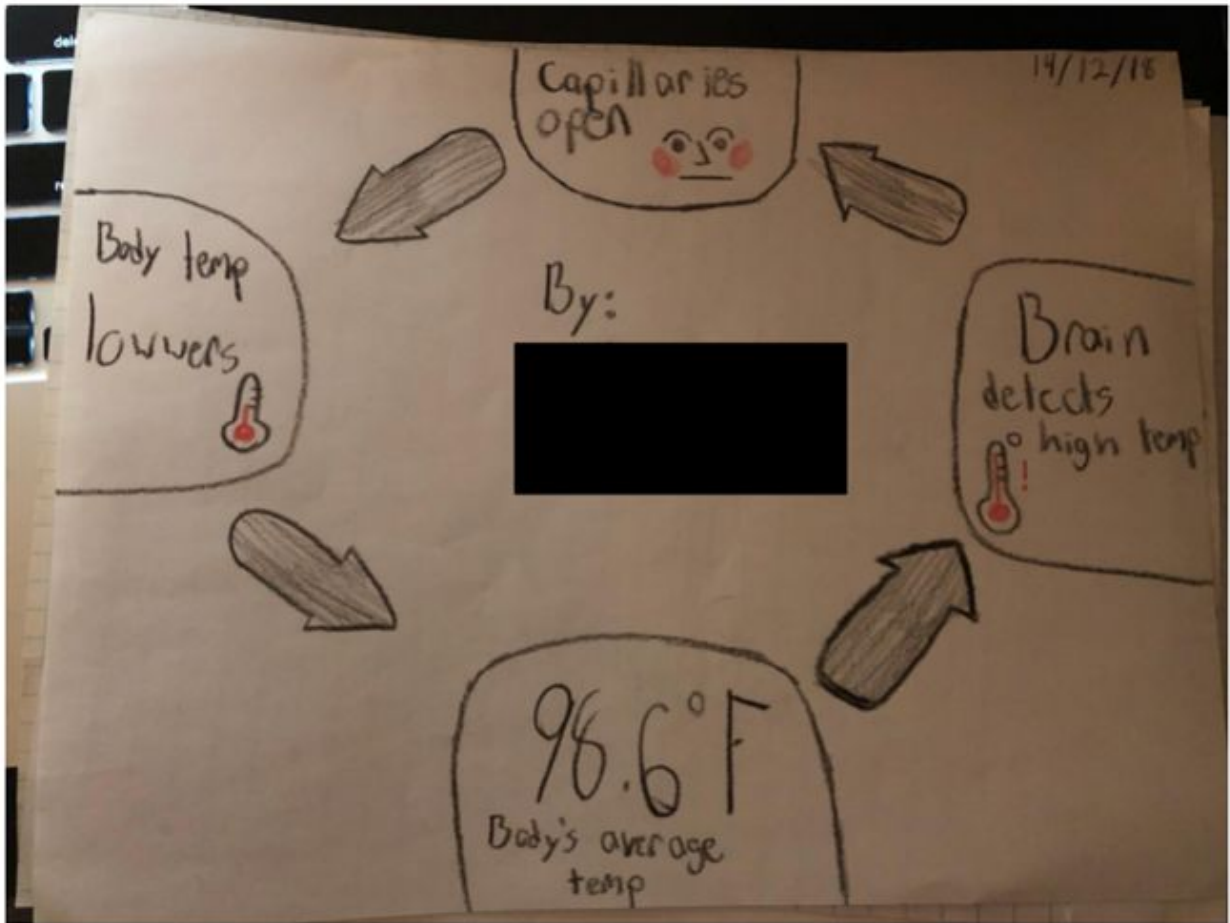
**#3 Life Sciences - Structure, Function, and Information Processing: B - Proficient** - Student provided a detailed model and description of interaction between component parts.

**#3 Life Sciences - Structure, Function, and Information Processing: C - Proficient.** Student provides evidence of an investigation of feedback loops.

**Communication: 4 - Proficient** - Student followed lab report format and provided necessary detail in each section.

**Problem Solving and Critical Thinking: 2 - Developing.** Student suggests a way to improve the experiment, but does not identify trends or patterns in the data.

Student Work Sample #4 (page 1 of 4)



## Student Work Sample #4 (page 2 of 4)

### Red Face Running

Hypothesis: Because we are going to be doing sprints our heart rates will increase because our muscles need more oxygen to be pushed to them, so our blood vessels will open, making our skin look red, like blood.

Procedure: Do push-ups increasing the amount done each time by one and seeing what happens to our skin after each time.

Purpose: The purpose of our experiment was to learn why some people's face get red after doing exercise. We learned that after some light exercise the test subjects face would become noticeably red. We learned this happens to regulate temperature in the subject,

John

Number of sprints	Level of redness. (scale of 1-10)	Observations
10	2	His face is redder
9	1.5	No change
8	1.5	His face is a little redder
7	1	No change
6	1	No change
5	1	His face is even more red
4	.5	No change
3	.5	His face is a little more red
2	0	No change
1	0	No change

Sean

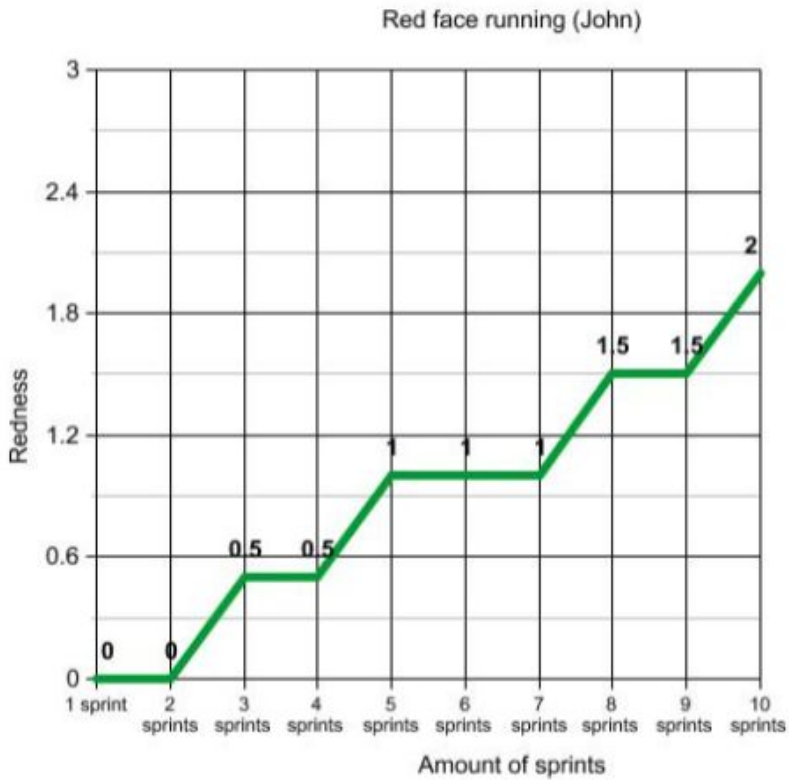
Number of sprints	Level of redness. (scale of 1-10)	Observations
10	2	His face is redder
9	2	His face is redder
8	1.5	Not noticeable, but a bit red
7	1.5	Not noticeable, but a bit red



Student Work Sample #4 (page 3 of 4)

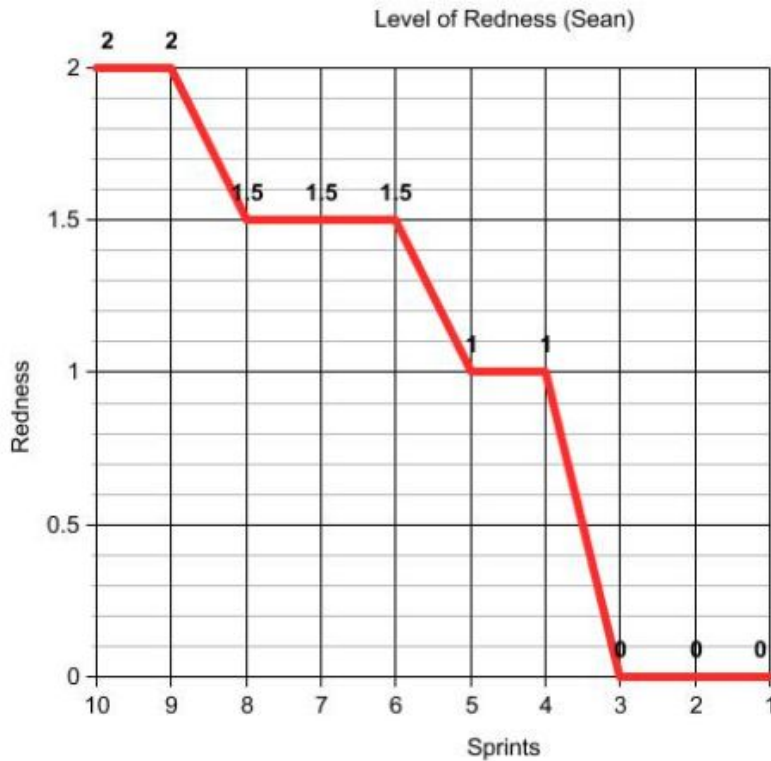
6	1.5	Not noticeable, but a bit red
5	1	Hardly any change
4	1	Hardly any change
3	0	No change
2	0	No change
1	0	No change

John's data graph



Sean's data graph

## Student Work Sample #4 (page 4 of 4)



### Analysis

This was an example of a negative feedback loops. A negative feedback loop is when a change happens and it is then un-done. This experiment showed our bodies heating up, then our bodies trying to lower our temperature, or a change, and it being un-done.

### Conclusion

In conclusion, the more energy you use seems to affect the way you look (mostly in your face) and the amount of redness of your face will decrease the less sprinting or use of energy you use.

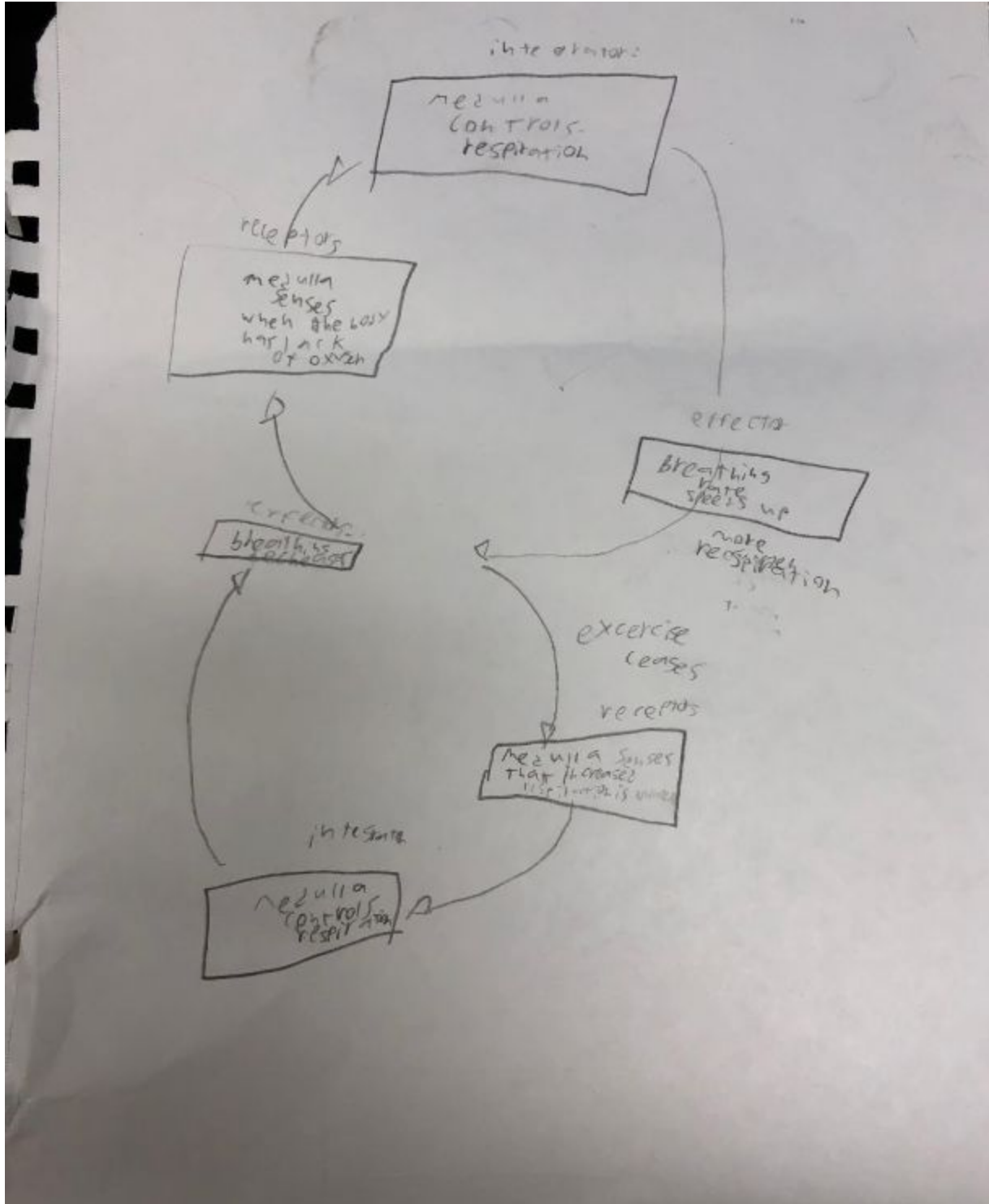
**#3 Life Sciences - Structure, Function, and Information Processing: B - Developing** - The student provided a model.

**#3 Life Sciences - Structure, Function, and Information Processing: C - Developing.** The student collected data to investigate a feedback loop.

**Communication: 4 - Developing** - While the visuals and the data table communicate the data well, the written descriptions and conclusions are lacking.

**Problem Solving and Critical Thinking: 2 - Beginning** - While the data visualizations show patterns, the student did not analyze the data or discuss the trends or patterns.

Student Work Sample #5 (page 1 of 3)



## Student Work Sample #5 (page 2 of 3)

For our lab, our research question "How is a specific variable in the human body altered during exercise". We decided to test whether breathing rate increases when a person is exercising.

Our hypothesis was as follows: If you exercise, then your breathing rate will increase because you are taking in more oxygen, and putting out more carbon dioxide.

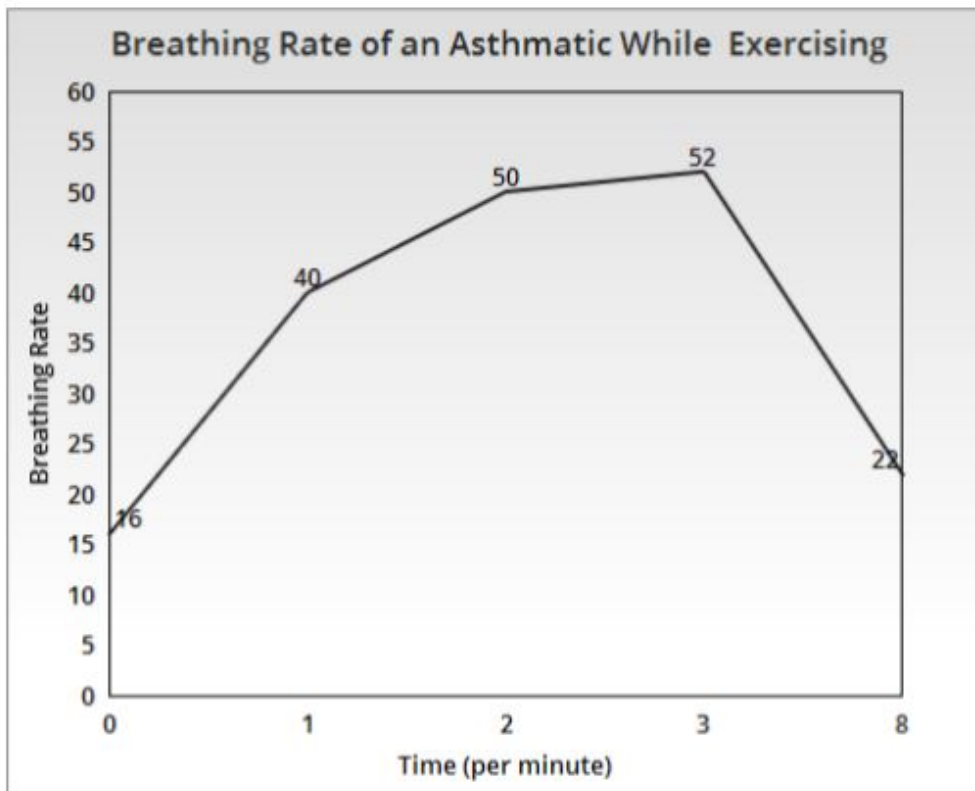
For our experiment, we measured the breathing rate of a person before exercising (in this case, running), during exercising, and after exercising.

Our procedure was as follows:

1. Count how many breaths you take in a 30 second period. Double the results. .
2. Begin by doing jumping jacks for 30 seconds. When your partner says 'go', jump until the timer is complete.
3. After completing the first trial, count how many breaths you take in 30 seconds. Double the results.
4. Repeat steps 2 and 3 to have a total of three trials.
5. Find the average of all three trials
6. Take your breathing rate at the end after a 5 minute period in order to compare it to your first resting breathing rate.

## Student Work Sample #5 (page 3 of 3)

We created the following graph to display the data which we had collected:



We found that the breathing rate had increased, proving our hypothesis and showing that breathing rate does increase while exercising.

**#3 Life Sciences - Structure, Function, and Information Processing: B - Proficient** - The student provides a model and describes the relationships between components of the model.

**#3 Life Sciences - Structure, Function, and Information Processing: C - Beginning** - The student describes an investigation and displays a data table, however, limited evidence is provided about the factors involved in the investigation or what data was collected.

**Communication: 4 - Developing** - The student provides one visual, but does not describe in words what the data shows, trends in the data, or how it helped them to reach any conclusions.

**Problem Solving and Critical Thinking: 2 - Beginning** - The student does not draw upon the data to make conclusions.