**Effect of Difficulty of Exercise on Ability to Return to Resting Heart Rate**

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Singh, Biology H, Period B

On my honor, I have neither given nor received any unauthorized aid on this lab.

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**Problem:** How does exercise difficulty affect one’s ability to return to resting heart rate?

**Hypothesis:** When a person does vigorous exercise, his or her heart rate will rise and take longer to return to resting heart rate than if the person did moderate exercise.

**Rationale:** Vigorous exercise expends more energy and oxygen, therefore the heart will have to pump blood faster to distribute oxygen throughout the body. It also takes longer for the body to recover after vigorous exercise because the heart will need time to return to normal.

**Introduction:** This experiment measures a person’s ability to maintain homeostasis. Homeostasis is an organism’s ability to “maintain…internal stability despite…change” (Saladin). Homeostasis was measured by determining the resting heart rate of the person and how long it took for his or her heart rate to return to resting heart rate after various difficulties of exercise. Heart rate is a “measure of the number of times that the heart beats in one minute”("Heart rate: Target heart rate."), while resting heart rate is one’s heart rate while “the heart [is] pumping the lowest amount of blood need[ed]”(American Heart Association) when one is not exercising. During this experiment, the scientific method and experimental design were utilized. The scientific method is a method of research where an experiment is used to test a hypothesis, and it often involves a series of steps that includes experimental design ("Experimental."). Experimental design refers to the blueprint by which a researcher aims to control factors and “reach… valid conclusions about relationships between independent and dependent variables” (Key).

**Materials:**

* Timer
* Ladder

**Procedure:** 1. Measure subject’s resting heart rate for 10 seconds.

2. Have subject do sit ups for 30 seconds. Observe breathing.

3. While subject’s heart rate is above resting, have subject measure

his or her heart rate for 10 seconds, then wait 10 seconds before

repeating, until his or her heart rate returns to resting.

4. Repeat step 3 after having the subject use the ladder for 60

seconds.

5. Collect data.

**Data:**

**Table 1: Heart Rate of Subject 1 over Time**

|  |  |  |  |
| --- | --- | --- | --- |
| **Time (s)** | **Resting Heart Rate (bpm)** | **Heart Rate After Moderate Exercise (bpm)** | **Heart Rate After Vigorous Exercise (bpm)** |
| 10 | 72 | 102 | 120 |
| 30 | 72 | 90 | 114 |
| 50 | 72 | 78 | 108 |
| 70 | 72 | 72 | 102 |
| 90 | 72 | 72 | 90 |
| 110 | 72 | 72 | 90 |
| 130 | 72 | 72 | 84 |
| 150 | 72 | 72 | 78 |
| 170 | 72 | 72 | 72 |

**Table 2: Heart Rate of Subject 2 over Time**

|  |  |  |  |
| --- | --- | --- | --- |
| **Time (s)** | **Resting Heart Rate (bpm)** | **Heart Rate After Moderate Exercise (bpm)** | **Heart Rate After Vigorous Exercise (bpm)** |
| 10 | 72 | 84 | 138 |
| 30 | 72 |  | 120 |
| 50 | 72 | 78 | 114 |
| 70 | 72 | 72 | 108 |
| 90 | 72 | 72 | 96 |
| 110 | 72 | 72 | 90 |
| 130 | 72 | 72 | 84 |
| 150 | 72 | 72 | 78 |
| 170 | 72 | 72 | 72 |

**Table 3: Breathing Observations after Exercise**

|  |  |  |
| --- | --- | --- |
| **Subject** | **After Moderate Exercise** | **After Vigorous Exercise** |
| 1 | No breathing change | Breathing slightly harder |
| 2 | No breathing change | Slight increase in breathing rate, barely noticeable |

Vigorous exercise causes the heart rate to rise more and take more time to return to resting than moderate exercise. This is evidenced by Graph 1, where the subject’s heart rate rose to 120 bpm after vigorous exercise compared to 102 bpm after moderate exercise. Graph 1 also shows that it took the subject 170 s for his heart rate to return to resting after vigorous exercise compared to 70 s after moderate exercise. Likewise, Graph 2 shows the same trend. The subject’s heart rate rose to 138 bpm after vigorous exercise compared to 84 bpm after moderate exercise, and it took the subject 170 s for his heart rate to recover after vigorous exercise compared to 70 s after moderate exercise.

The control group in this experiment was needed to determine the recovery rate of the subjects. Without the resting heart rate, it would not be possible to determine how long it took for the subjects’ bodies to maintain homeostasis after the exercise.

The athleticism and body types of the subjects likely affected the data. Subject 1 recovered at a steadier rate than Subject 2, and his heart rate increased less than Subject 2’s did for vigorous exercise and more than Subject 2’s did for moderate exercise. This may be because one of the subjects was more athletic, or because their body types affected their bodies’ reactions to exercise. In addition, sample size also affected the data. Only 2 subjects were used in this experiment, whereas had there been more subjects, more trends in the data would be made evident.

Evidently, the more the heart rate increased, the longer it took to recover. When Subject 1’s heart rate rose 41.66%, it took 70 s to recover, while it took 170 s to recover from a 66.6% rise. When Subject 2’s heart rate rose 16.66%, it took 70 s to recover, while it took 170 s to recover from a 91.66% rise. From this data, it is difficult to tell if there are any other correlations between heart rate increase and recovery rate, as the data from the 2 subjects are highly different when it comes to heart rate increase.

**Conclusion:** The hypothesis of this experiment was that when a person does vigorous exercise, his or her heart rate will rise and take longer to return to resting heart rate than if the person did moderate exercise. The data supports this hypothesis, as seen in Graph 1, where the subject’s heart rate rose to 120 bpm after vigorous exercise compared to 102 bpm after moderate exercise. Graph 1 also shows that it took the subject 170 s for his heart rate to return to resting after vigorous exercise compared to 70 s after moderate exercise. Likewise, Graph 2 shows the same trend. The subject’s heart rate rose to 138 bpm after vigorous exercise compared to 84 bpm after moderate exercise, and it took the subject 170 s for his heart rate to recover after vigorous exercise compared to 70 s after moderate exercise.

Error in this experiment was likely caused by differences in the subjects’ bodies, which made interpreting the data difficult. This could be fixed by using more subjects so that comparisons could be drawn between those with similar athleticism and physique.

The trainer should use a program that is similar to the ladder in that the exercise is vigorous and done at rapid pace. This creates a program that highly increases heart rate and causes long recovery rate.

To clients with asthma, the trainer should provide workouts that are similar to sit-ups in that the exercise is moderate and does not cause the heart rate to rise much. These workouts will still keep the clients healthy, but will not risk a heart rate rise that will cause discomfort.

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