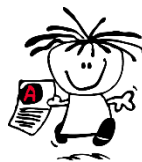


SCIENTIFIC INVESTIGATION GRADE 11

Topics: Gaseous Exchange & Cellular Respiration

Term: 3

Total: 40



THE
ANSWER
SERIES Your Key to Exam Success

AIM

To determine the influence of exercise on the amount of carbon dioxide produced in living organisms.

REQUIREMENTS

1. Three test tubes half filled with a pink phenolphthalein indicator and water solution
2. A straw or glass tube
3. Stopwatch

RESEARCH/PRE-KNOWLEDGE (Class discussion)

Phenolphthalein is a pH indicator often used in acid-base titrations:

1. What colour is phenolphthalein in an acid?
2. What colour is phenolphthalein in a base?
3. How do you measure someone's resting heart rate?

INSTRUCTIONS

1. Work in groups of **three**:
 - o learner one will do the exercise
 - o learner two will be the timekeeper
 - o learner three will handle the apparatus and measure the heart rate
2. In a resting state, learner one must take the first test tube and slowly exhale/blow into the solution using the straw/glass tube. Learner two must measure how long it takes the pink phenolphthalein solution to turn colourless and learner three measures learner one's heart rate. Note this in **TABLE 1**.
3. Learner one will then jog up and down for 4 minutes.
4. Directly after the exercise learner one must exhale/blow into the second test tube whilst learner two measures how long it takes the pink phenolphthalein solution to turn colourless, and learner three must measure learner one's heart rate. Note this in **TABLE 1**.
5. Allow learner one to rest for a few minutes until his/her heart rate is back to the resting state.
6. Lastly learner one will perform 50 *jumping jacks*.
7. Repeat **STEP 5** directly after the exercise.

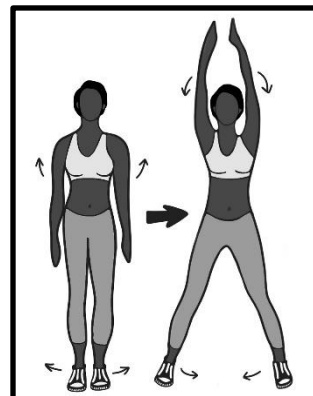


TABLE 1 – Data collected during the experiment

Activity/ Test tube		Heart rate (beats/minute)	Time taken for the pink phenolphthalein solution to turn colourless (seconds)
1	<i>Resting state</i>		
2	<i>Jogging 4 minutes</i>		
3	<i>50 Jumping Jacks</i>		

TABLE 2 – Data collected for all the groups in class

Activity/ Test tube	Heart rate	Phenolphthalein time	Activity/ Test tube	Heart rate	Phenolphthalein time
Group 1			Group 6		
1			1		
2			2		
3			3		
Group 2			Group 7		
1			1		
2			2		
3			3		
Group 3			Group 8		
1			1		
2			2		
3			3		
Group 4			Group 9		
1			1		
2			2		
3			3		
Group 5			Group 10		
1			1		
2			2		
3			3		

TABLE 3 – Averages of data collected per activity for all groups

Activity/ Test tube	Heart rate (beats/minute)	Time taken for the pink phenolphthalein solution to turn colourless (seconds)
1		
2		
3		

Round all values to the nearest whole number.

Answer the following questions:

1. Write a suitable hypothesis for this investigation. (2)

2. Identify the independent variable for this investigation. (1)

3. Identify the dependent variable for this investigation. (1)

4. How is the dependent variable measured? (1)

5. What happens to the heart rate with exercise? (1)

6. Explain the reason for the observation in **QUESTION 5** (why is it necessary?). (2)

7. Is more or less carbon dioxide produced after exercise? (1)

8. Explain your conclusion in **QUESTION 7**, based on the data in **TABLE 3**. (3)

9. Explain why the phenolphthalein changes from pink to colourless when you exhale/blow into it. (3)

10. Which exercise had the most significant effect on both heart rate and the production of CO₂? Explain the reason for this. (5)

11. Name **TWO** variables that were controlled during this investigation. (2)

12. Provide **TWO** variables that were not controlled during the investigation and explain how they would affect the validity of the investigation. (3)

13. Explain **ONE** way in which the reliability of this investigation was ensured. (2)

14. Show your calculations for the average time taken for the phenolphthalein solution to turn colourless during activity 2.

(3)

15. Use **TABLE 3** and draw a **double bar graph** to show the average heart rate (bpm) and the average time it took for the phenolphthalein solution to turn colourless (sec) for all three test tubes (activities). You will therefore have two y-axes, one on either side of your graph. Put 'Heart rate' on the right-side y-axis and 'Time for solution to turn colourless' on the left side y-axis. (10)