**Muscle Fatigue/Cellular Respiration Lab**

**Introduction:**

How long does your supply of ATP last? What happens when your muscles run out of ATP? How long does it take to make more ATP? As your muscles do continuous activity, they will eventually begin to feel tired and fatigued. Muscles get fatigued because when they contract, they restrict blood flow which supplies glucose, oxygen and water to the cells. They eventually begin to work **anaerobically**, or without the necessary oxygen which is a less efficient process. In this lab, you will measure how long it takes before muscle fatigue begins.

**ESSENTIAL QUESTIONS**

1. How much time does it take for muscles to become fatigued and how does this relate to cellular respiration?
2. How long does it take to recover from muscle fatigue?
3. Is the recovery of ATP with repeated sets as complete as when the activity began?

**MATERIALS**

1. tennis ball
2. timer with a second hand <http://www.online-stopwatch.com/>

**PROCEDURES**: *READ ALL DIRECTIONS FIRST, ESTABLISH JOBS FOR EACH PERSON THEN BEGIN.*

1. Use the data table on the reverse to record your results.

2. Chose one test subject in your group to hold a tennis ball in their weaker or less dominant hand. When the time begins, this person will squeeze the tennis ball as hard and fast as possible for 120 seconds while the team pushes them to maximize their efforts.

3. The timer will tell the test subject when to begin and will call out every time 10 seconds passes until 120 seconds (2 minutes) have passed.

3. Every 10 seconds, a 3rd and 4th team member will record the number of times the ball was squeezed in a 10-second interval - alternate counting in a 10-second period the main timer calls out so there is a continuous tracking being done. Do this for the entire 2 minutes.

4. Wait 30 seconds then repeat, using the same person to squeeze the ball.

5. Wait 30 seconds then repeat one last time, using the same person to squeeze the ball.

**Cautions:**

* Use the *same person* for each trial, all the way through.
* *Squeeze as hard and quickly as possible all the way through* - do not try to pace yourself.
* Squeeze the *same way every time and with the same hand*.

You are TRYING to reach muscle fatigue, NOT see how long you can go!

**MUSCLE FATIGUE LAB**

**TABLE 1. TIME AND NUMBER OF TENNIS BALL SQUEEZES - normal conditions**

Time (sec) Number of Squeezes Number of Squeezes Number of Squeezes

*TRIAL 1 TRIAL 2 TRIAL 3*

|  |  |  |  |
| --- | --- | --- | --- |
| 0-10 |  |  |  |
| 11-20 |  |  |  |
| 21-30 |  |  |  |
| 31-40 |  |  |  |
| 41-50 |  |  |  |
| 51-60 |  |  |  |
| 61-70 |  |  |  |
| 71-80 |  |  |  |
| 81-90 |  |  |  |
| 91-100 |  |  |  |
| 101-110 |  |  |  |
| 111-120 |  |  |  |

**TABLE 2. TIME AND NUMBER OF TENNIS BALL SQUEEZES - variable: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Time (sec) Number of Squeezes Number of Squeezes Number of Squeezes

*TRIAL 1 TRIAL 2 TRIAL 3*

|  |  |  |  |
| --- | --- | --- | --- |
| 0-10 |  |  |  |
| 11-20 |  |  |  |
| 21-30 |  |  |  |
| 31-40 |  |  |  |
| 41-50 |  |  |  |
| 51-60 |  |  |  |
| 61-70 |  |  |  |
| 71-80 |  |  |  |
| 81-90 |  |  |  |
| 91-100 |  |  |  |
| 101-110 |  |  |  |
| 111-120 |  |  |  |

**TABLE 3. TIME AND NUMBER OF TENNIS BALL SQUEEZES - variable: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Time (sec) Number of Squeezes Number of Squeezes Number of Squeezes

*TRIAL 1 TRIAL 2 TRIAL 3*

|  |  |  |  |
| --- | --- | --- | --- |
| 0-10 |  |  |  |
| 11-20 |  |  |  |
| 21-30 |  |  |  |
| 31-40 |  |  |  |
| 41-50 |  |  |  |
| 51-60 |  |  |  |
| 61-70 |  |  |  |
| 71-80 |  |  |  |
| 81-90 |  |  |  |
| 91-100 |  |  |  |
| 101-110 |  |  |  |
| 111-120 |  |  |  |

**GRAPHING DATA:** Construct a line graph using graph paper and a ruler, Microsoft Word or Excel, or Google Sheets that displays your data and your partner’s data. Make sure to include the following on your graph:

* 1. title,
  2. labeled x axis **Time (seconds),**
  3. labeled y axis **Muscle Fatigue (number of squeezes),**
  4. a key/legend**, Use a different color for each set of trials.**

**ANALYSIS:** Using your best writing skills to answer the following (*elaborate, use specific data for examples*):

1. Describe patterns you see in the number of squeezes - in number of squeezes per 10 seconds within each trial and between trials for each condition:

Table 1 - normal conditions:

Table 2 - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_:

Table 3 - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_:

1. Explain what was happening to the supply of glucose, oxygen and water to your muscle cells as the ball was being squeezed. *Remember, your muscles are in constantly repeating contractions*. Explain the impact on ATP production and why.
2. Using examples from the results of this lab, explain why your brain will not work at its best when you:

* Skip meals
* Slouch and remain inactive (so your heart rate stays low)
* avoid drinking at least 1 cup of water each hour
* eat salty or sugary foods (think about what you learned in the egg lab)

**Summary**

Reflect on changes you can make in your daily life to make learning and success easier in school that relate to what you have learned in this part of the unit and this lab (relate to ATP production and the conditions required and what you saw in this lab).