

# Muscle Fatigue Investigation

By Doaa George, based on the workshop investigation by Murray Hegney



**Figure 1: Muscle fatigue exercise using a peg**

## **Introduction**

Our bodies have a number of systems that work together in harmony to help us with our daily living needs. One of these systems is the muscular system which plays an important role to keep us active and able to move.

## **Risk analysis**

There are not many risks with this experiment. However, students can injure themselves if they continue to exercise past muscle failure. Once you feel fatigue, you have to take a break. Otherwise, your muscle could tear and take a longer time to heal.

## Questions

Choose one of the following questions to answer.

Can all fingers on a person's hand exercise at the same rate before they become fatigued?

Does a short period of rest, say 10 seconds, between periods of exercise affect the time it takes for muscles to become fatigued?

What is the difference in muscle fatigue between the left hand and right hand?

**Aim:** To investigate one of the above questions.

Write your aim and hypothesis below (what do you think will happen in the experiment, and why).

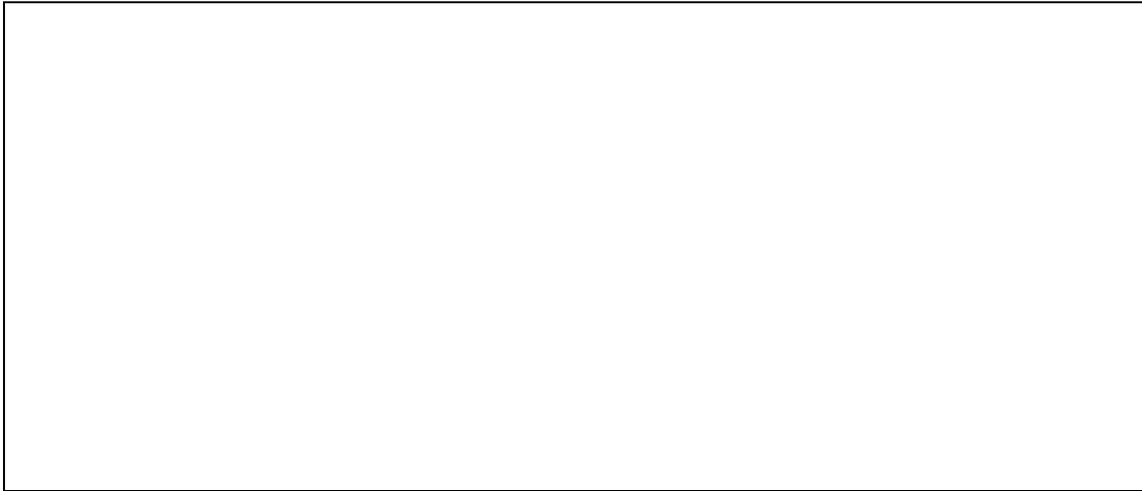
## Plan

Form a group of three and decide together which question you want to answer. You will design your own experiment and analyse the results to answer your chosen question. Write your independent and dependent variables below, and also write how you will manage your controlled variables so that your results are fair.

*Identify the independent variable*

*Identify the dependant variable*

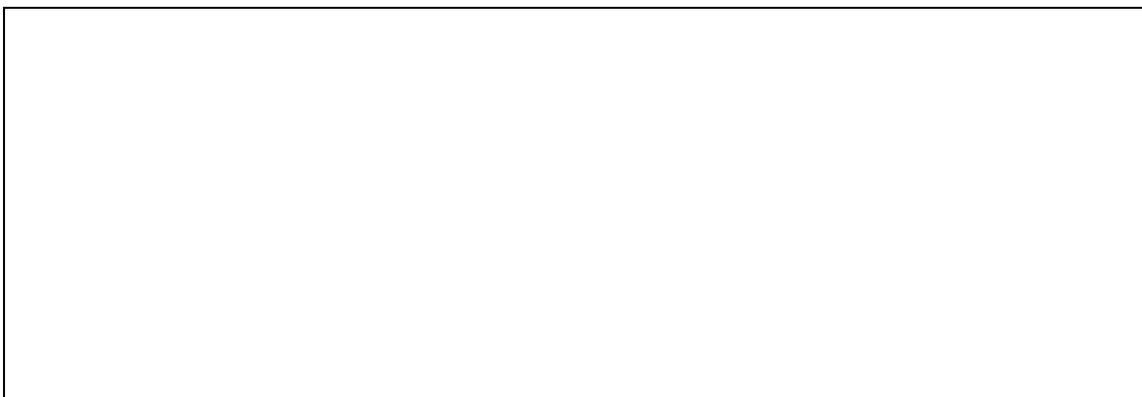
*Write a list of your controlled variables.*



*Discuss in your group why you must control these variables and write your reasoning.*



*Write your own list of materials.*



## Procedure

Write a detailed method of how you will conduct the experiment. Draw a diagram to show what you are going to do.

You should practice opening and closing the peg for a few seconds beforehand. (Make sure you open it and close it all the way each time).

*Hint:* You could count the number of times a person can fully open and close a peg in 20 or 30 second intervals. It would be easier if the person doing the opening and closing counts out loud each time they open the peg. Counts can then be scored at say 20 seconds, 40 seconds, 60 seconds, 80 seconds, etc.

Write exactly what you are going to measure and how you are going to measure it.

How are you going to make sure that your investigation is reliable?



**Conduct:** Write down your observations including anything that may have gone wrong, or not worked as you had planned, such as the accidental fall of the peg during the experiment, or any mistakes in counting.

Tabulate your results in a suitable way to make it easy to compare your results.

--

**Analysis:** Present the most significant results below.

A large, empty rectangular box with a thin black border, intended for the user to present their most significant results. The box is currently blank.

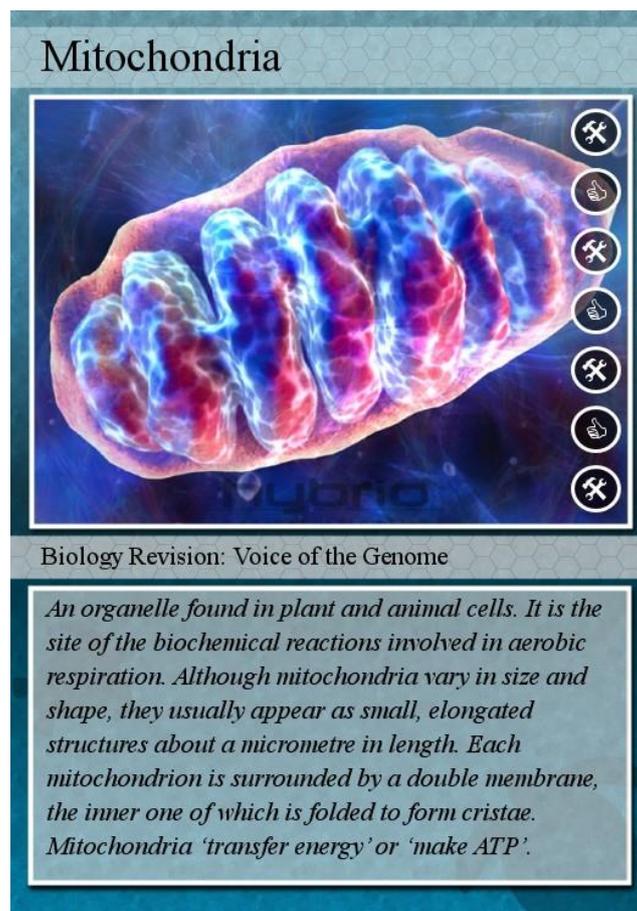
### Problem-solve:

There are three different types of muscle, the skeletal muscle, smooth muscle and cardiac muscle. The smooth muscles are responsible for the movement of inner organs such as the stomach, intestines and blood vessels, while cardiac muscles are those in the heart responsible for pumping blood through our bodies. We do not have control over these two types of muscles, and therefore they are called involuntary muscles. The skeletal muscles are the ones attached to our bones and we have conscious control over these muscles.

To create movement, muscles contract, and relax. Muscle contraction requires energy which is supplied by cellular respiration. This is why muscle cells contain many mitochondria (organelles responsible for cellular respiration), see figure 2.

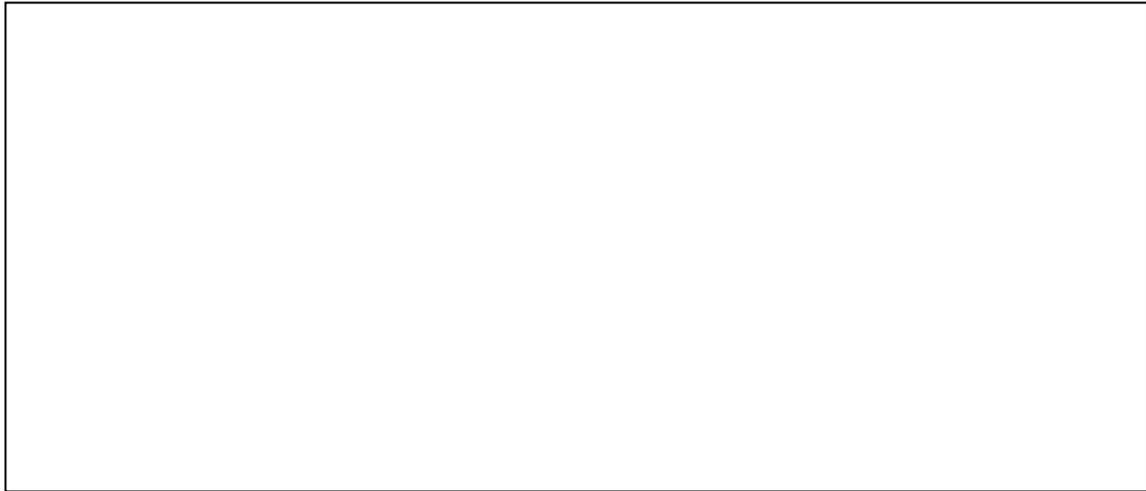
In normal conditions, cellular respiration is called aerobic respiration, where glucose is broken down in the mitochondria of cells using oxygen to produce energy. However, if not enough oxygen is present, cells can produce energy through a process called anaerobic respiration. This happens during vigorous muscular activity, where the blood cannot supply the muscle cells with all the oxygen they need and glucose is broken down without oxygen. A much smaller amount of energy is produced without oxygen than with oxygen. As a result of anaerobic respiration, a chemical called lactic acid is produced.

The fitter you are the more exercise you can do before you start to feel fatigued.



**Figure 2: The mitochondria, also known as the cell powerhouse**

Reflect on this information. What type of muscle and respiration have you been using?



### Discussion

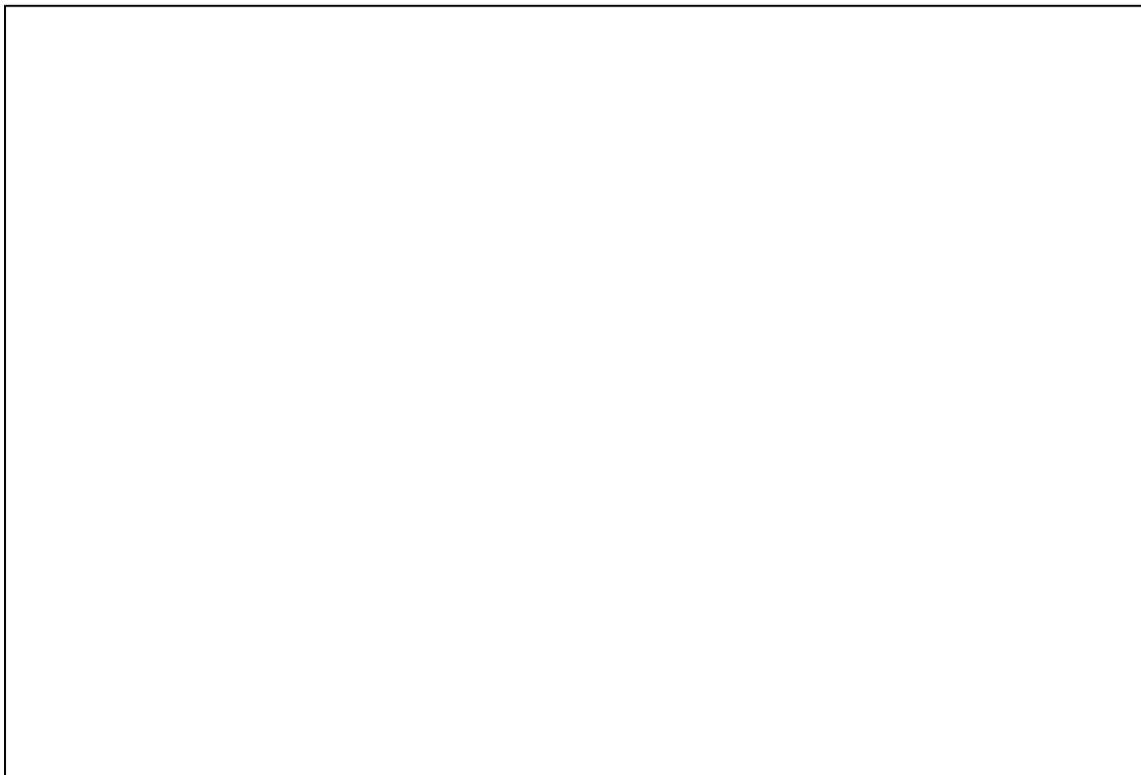
State the reasons you had when making your hypothesis.

Do the results agree with your hypothesis?

Did the experiment work as you had planned or did things go wrong and interfere with your results?

Do your results agree with the results of other groups answering the same question?

How can you improve your experiment if you were to repeat it again?



## Conclusion

Summarize your findings and state if you were able to find an answer to your chosen question.

Link to figure 1 <https://www.flickr.com/photos/121317384@N04/13726328275/in/photolist-mUX2bk-mUX4wa-bE9jPP-on8QxY-mUX1Va-pZh1ds-mUWRHT-brermu-9Pv4X4-mUWZMD-gcEyK-mUX296-9PxQXd-mUYUuj-mUX4tp-mUYUxW-mUWRk8-mUXebF-8wPzY-mKWhHh-9qrhUd-mUWR6R-bE9iRr-mUX4Kg-NBjZt-8x7Z4g-mUX4e6-mUWZWK-2eAHYe-mUX28z-mUYUsA-gTTb4C-bE9kx4-mUYVbE-bAS17j-mUWRft-mUWR9M-mUX246-mUWRDp-71qDHP-mUWRBv-SqrYcB-5dipdC-mUZ5SU-B1ivq-5LeoTk-Bxv7k7-yVwrH-9rUtya-Qfor25> Author Mike Cerrillo Licence <https://creativecommons.org/licenses/by-sa/2.0/>

Link to figure 2

<https://www.flickr.com/photos/biologyflashcards/3439703502/in/photolist-6eXo1N-7Nnc7g-7Z9AHy-4sdAzT-ack8bz-o1EBNT-dgQwGj-dgQwLW-o19UQG-qxteke-9HA8zt-Mfzb2D-a55RkG-8kjq43-a531Xt-6bayhK-9HD1Dd-rXfd3P-e5geM4-5DkmKE-3gp2F8-pe2HF-eUZCKM-9HCZmh-9HD2yQ-butKme-qwBwET-pSLTHb-dpgSSh-8P2mGy-9FGf8L-byDM5H-9HD3mC-drwDS2-6H5EcX-dtyzxX-chjWwf-qG74TA-e9Eeiz-3gtpXu-NY92E-NYFnx-i4YPie-i4Yen1-itBBDw-7yYuZG-82XLPu-cWhZLQ-4tGfUT-d2eLQG> Author Biology Flashcards Licence <https://creativecommons.org/licenses/by/2.0/>