



## What affects our muscle performance during sport?

**AGE RANGE: 11-14 years**

### OVERVIEW

Pupils ask and investigate scientific questions to better understand how human bodies function and perform differently in sporting activities. The excitement created by the Olympic Games is an ideal context for sports science. Particular focus is paid to developing predictions and analysing and interpreting evidence gathered. Substantive curriculum content covered includes links to respiration and breathing. Sustainable Development Goal 3 is addressed as pupils are encouraged to actively explore physical activities linked with sport which keeps their minds and bodies healthy.

**3** GOOD HEALTH  
AND WELL-BEING



### LEARNING OBJECTIVES

- Explain why muscles become fatigued with less rest/more exercise
- Describe aerobic and anaerobic respiration in living organisms

### WORKING SCIENTIFICALLY



- Use prior and new understanding to develop predictions based on a hypothesis
- Report and present findings, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms
- Form a conclusion using new knowledge to explain the relationship seen in the investigation linked to their prediction.

### RESOURCES (Groups of 2-3)

For each pair of pupils:

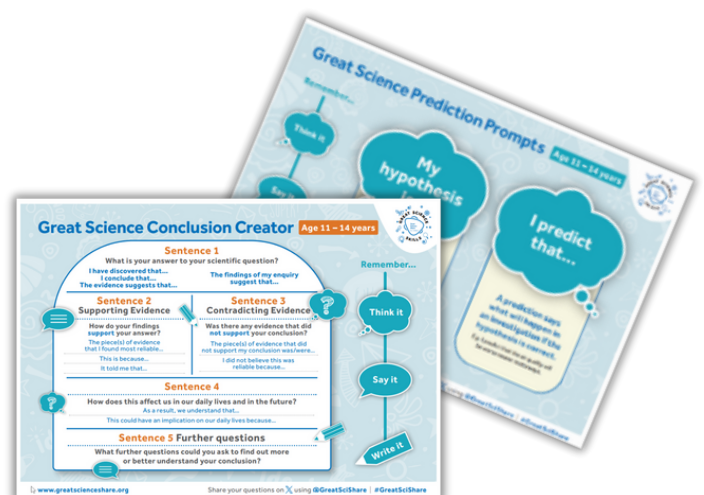
- 1 x 1kg mass (recycled drinks bottles full of stones, gravel)
- 1 x timer/stop clock

### KEY WORDS

- anaerobic
- respiration
- fatigue
- lactic acid
- accurate
- precise
- reliability

### TO SUPPORT TEACHING

- [11-14 Great Science Prediction Prompt](#)
- [11-14 Great Science Conclusion Creator](#)
- [Video link to BBC - Brownlee Brothers](#)



# Step-by-step guide

1. Watch Jonny Brownlee: Alistair helps brother over finish line in dramatic World Series finale - BBC Sport. Invite pupils to use the Think-Pair-Share talking strategy to offer ideas about what is happening to Jonny Brownlee. Encourage them to draw on what they know about exercise and training and their experiences of developing skills in sport. Focus on how training improves the way people's bodies perform. Bring out the key learning that although we are able to do much to improve ourselves, there are many variables that also affect athletes' performance on the day of an event.



2. Ask pupils to identify factors that can affect sporting performance using post-it notes to create a class brainstorm. They'll use these ideas to ask-investigate and share evidence from a scientific question that they are interested in, based on **'What affects our performance during sport?'**

3. Explain that the pupils will be planning and gathering evidence from a practical investigation where they consider **how the amount of rest affects muscle performance**.

Key points to reinforce:

- 'performance' is a term which describes how successfully we do something
- the difference between respiration and breathing, by thinking about why do muscles need oxygen and what happens if muscles don't get enough
- the definition of 'fatigued' is when muscles become tired and do not have enough oxygen, which results in athletes feeling pain and cramp in their muscles
- the differences between aerobic and anaerobic respiration, explaining that when muscles become fatigued they produce lactic acid due to anaerobic respiration and that this is only broken down into CO<sub>2</sub> and water when allowed to rest
- that the independent, dependent and control variables are in the question and enquiry they have chosen

## Examples of enquiries in the context of sport:

How does the amount of rest affect the number of arm lifts people can perform?

How does the amount of rest affect the number of leg lifts people can perform?

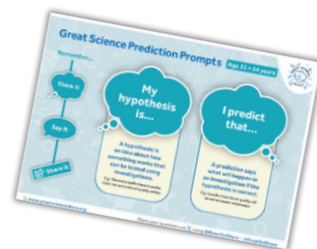
Do older or younger people tire quicker during muscle contraction exercises?

How does the time after eating affect the number of arm lifts people can perform in 3 minutes?

This is a worked example for the enquiry question: **How does the amount of rest affect the number of arm lifts people can perform?**



4. Demonstrate how to rest your arm flat on a table whilst holding the mass - keep feet under the table. The arm is to be lifted until it touches the shoulder and then moved back down to touch the table. Pupils identify their independent, dependent and control variables.



5. Based on the hypothesis *'The amount of rest affects muscle performance,'* pupils talk to a partner and make a prediction. Use the [11-14 Great Science Prediction Prompt](#)  
E.g: *'I predict that the number of lifts I can do in 60 seconds will **decrease** as the amount of rest **decreases** because the muscles will start to use anaerobic respiration to release energy as there will not be enough oxygen getting to the cells. This means that lactic acid will be produced causing fatigue.'*

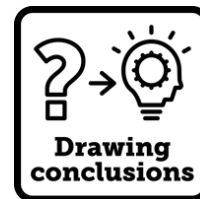
# Step-by-step guide cont.



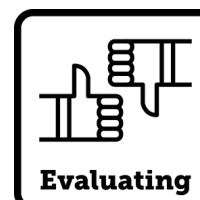
6. In pairs, pupils take it in turns to carry out their investigations and record data in their own table. e.g: Count how many arm lifts you can do holding a 1kg mass in 60 seconds. Then repeat but with differing rest periods: a) plenty of rest >60 seconds b) 60 seconds of rest c) 30 seconds of rest d) 0 seconds of rest. Repeat readings should be taken if time allows.



7. Analyse and interpret results using bar charts. If averages have been calculated, pupils could add range bars to their graph to demonstrate the highest and lowest values for each rest period (this represents the precision of the data).

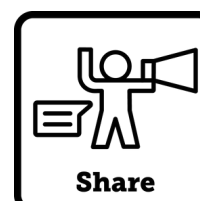


8. The [11-14 Great Science Conclusion Creator](#) will enable pupils to identify any causal relationship shown by their data, leading them to explain their findings using scientific knowledge. Remember to make links back to predictions and evaluate how they relate to the evidence gathered.



9. Evaluate the level of reliability of their conclusions, e.g.

- Are the repeated readings close together with small range bars?
- Is there any overlap between the range bars of the different data sets?



10. Encourage pupils to ask the question **'So what?'** when thinking about their enquiry. What implications from their results would there be on sports people taking part in the Olympics? What innovations or mitigations could there be to cope with signs of fatigue or muscle stress? Give your pupils a voice and take time to share their findings and questions - this could be a form time presentation, poster or blog on the school website.



Use the Talk Prompts in the sports-linked [Great Question Ponder](#) as part of science and oracy development.



How are the Olympic games fair if athletes have different training opportunities?