Great Sports Share

A whole-school framework for asking-investigating and sharing scientific questions

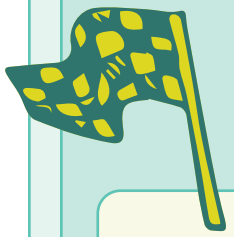
Great Science Share for SCHOOLS

Context

Pupils ask and investigate scientific questions to enable them to better understand how human bodies function and perform differently in sporting activities. The excitement and engagement created by the Olympic Games is an ideal context for pupils to share their investigations. This Guided Enquiry provides ample opportunities to explore progression in working scientifically from EYFS to 14 years years of age. In particular, focus is paid to developing predictions and analysing and interpreting evidence that has been gathered. Pattern seeking is very likely to occur as humans are involved in the data gathering process.

This enquiry links to SDG3 Good Health and Well-being as pupils are encouraged to actively explore physical activities linked with competitive sport which keeps their minds and bodies healthy.

What affects our performance during sport?



For example

- Do people with longer legs jump further?
- Do people with longer arms throw further?
- Do people with shorter hair swim faster?
- Are there any patterns between height and running speed?
- Are there any patterns between foot/shoe size and jump height?
- How does a javelin fly?
- Which food groups are best at providing slow release energy?

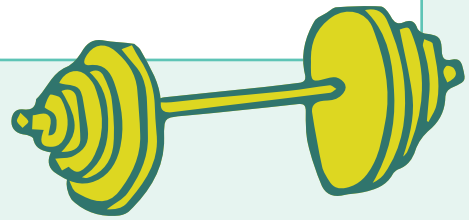
Learning Outcomes

Pupils will be able to:

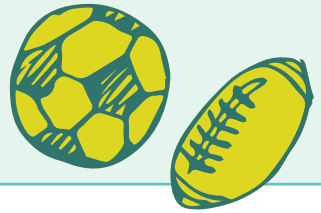
- develop a prediction linked to their enquiry question
- gather and analyse evidence using tables and graphs
- draw a conclusion that relates to their predictions and evidence

Teachers will be able to:

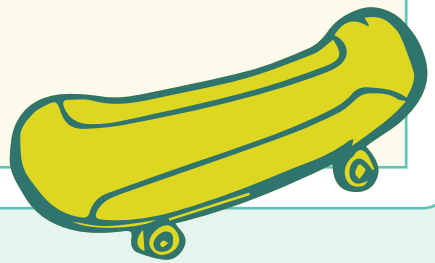
- describe progression in scientific enquiry skills from EYFS-age 11-14
- provide feedback to pupils, aligned to prior and future learning outcomes



Curriculum Links

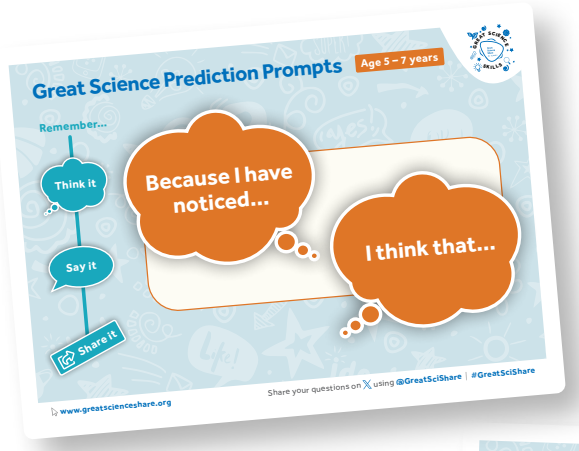


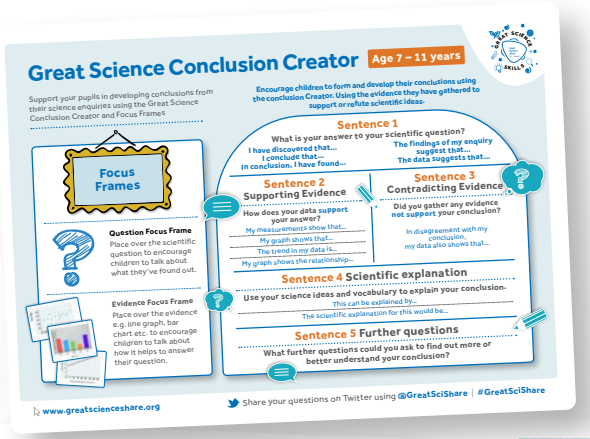
3-5 years	5-7 years	7-11 years	11-14 years
Pupils are working scientifically by:			
ELG: Listening, Attention and Understanding • make comments about what they have heard and ask questions to clarify their understanding **ELG: Gross Motor Skills** • move energetically, such as running, jumping, dancing, hopping, skipping and climbing **Characteristics of Effective Learning** **Finding out and exploring** • Showing curiosity about objects, events and people **Being willing to "have a go"** • Showing a 'can do' attitude • Taking a risk, engaging in new experiences, and learning by trial and error	• asking simple questions and recognise that they can be answered in different ways • performing simple tests • gathering and recording data to help answer questions • using non-standard units or cm/m (dependent on confidence of learners)	• asking relevant questions and using different types of scientific enquiries to answer them • taking accurate measurements using standard units • recording data and results of increasing complexity using tables and scatter graphs • reporting and presenting findings from enquiries, including conclusions and causal relationships • using results to draw conclusions	• asking questions and developing a line of enquiry based on observations of the real world alongside prior knowledge and understanding • making predictions using scientific knowledge and understanding • making and recording observations and measurements using a range of methods • presenting observations and data using appropriate methods, including tables and graphs • interpreting observations and data, including identifying patterns and using observations, measurements and data to draw conclusions present reasoned explanations, including explaining data in relation to predictions and hypotheses
Pupils are drawing on substantive knowledge by:			
Development Matters: Mathematics • Compare length using the key vocabulary - 'longer/shorter' • Notice patterns **Physical Development** • Further develop and refine a range of ball skills including: throwing, catching, passing • Revise and refine the fundamental movement skills such as walking, jumping, running	• describing the importance of exercise for humans • identifying, naming, drawing and labeling the basic parts of the human body	• identifying that humans and some other animals have skeletons and muscles for support, protection and movement • recognising the impact of exercise and lifestyle on the way their bodies function	• identifying the structure and functions of the human skeleton, to include support, protection and movement • recognising the function of muscles and give examples of antagonistic muscles

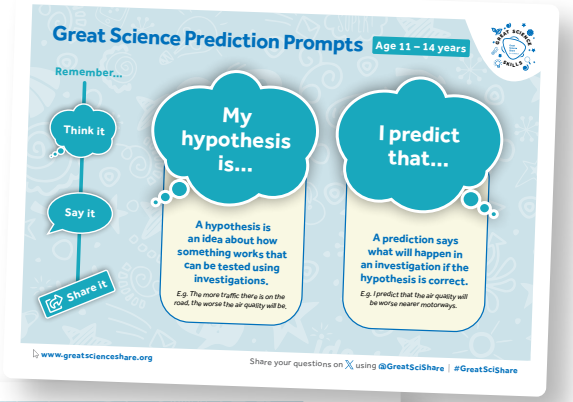


Resources

3-5 years	5-7 years	7-11 years	11-14 years
• School device to take photos to record results	• Measuring equipment – e.g. metre sticks, rulers, measuring tape (non standard units of measuring can also be used as appropriate to learners) • 5-7 Great Science Prediction Prompt	• Measuring equipment - eg. metre sticks, rulers, measuring tape • 7-11 Great Science Prediction Prompt • 7-11 Great Science Conclusion Creator	• Measuring equipment - eg. metre sticks, rulers, measuring tape • 11-14 Great Science Prediction Prompt • 11-14 Great Science Conclusion Creator

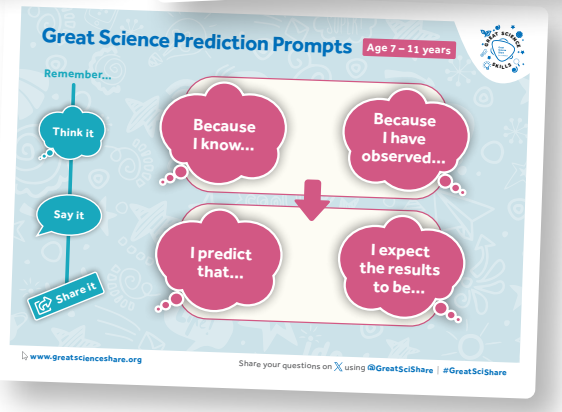


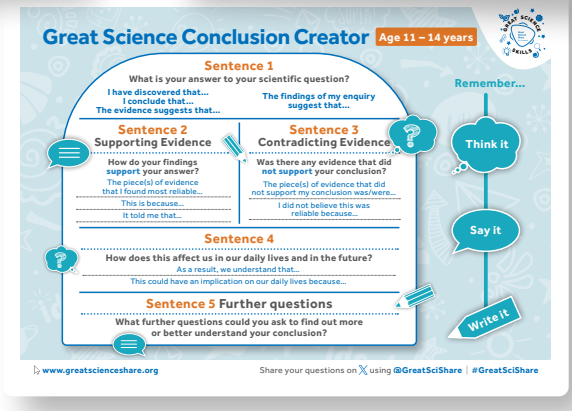




Find all of the GSSfS Toolkit in one place

Great Science Toolkit





Step-by-Step Guide

1

Engage the pupils in watching **Markus Rehm smashes long jump world record** from the Olympics.com website. Introduce the current key Olympic records for long jump; 8.90m for men set by Bob Beamon in 1968 and 7.40m for women set by Jackie Joyner-Kersee in 1988 noting how these demonstrate how amazing the human body is. Explain that the body is a system of parts that work together to enable movement, growth and learning. Exercise and training of any skill can improve the way our bodies perform. The Olympics is a global occasion that showcases various sports and how performance differs between athletes from around the world.

Olympic Games website

Summer, Winter Olympics, YOG & Paralympics

There is a wide range of information about sports and sports people for you to explore.

2

Explain that pupils will have the opportunity to ask-investigate and share an enquiry question that they are interested in. The overarching question:

What affects our performance during sport?

Expand on the key term – 'performance'.
What definitions do the pupils have for this term?

Clarify that 'performance' is a term that can describe:

- **something that happens in a theatre**
- **the way we do something**
- **how successfully we do something**

Now, ask the pupils to talk and list different factors they think can affect someone's performance when doing sports. Collate these as you think best. Ideas could include – someone's health, how much training they've done, what they're wearing, the temperature around them, what food they've eaten, time of day, physical characteristics/features etc.

Video source ©: International Olympic Committee

Step-by-Step Guide

3 Use Great Science Question Makers to inspire pupils to generate different scientific questions that they could investigate.

If inspiration or support is required, the Great Sports Share Ideas for Questions is offered as a stimulus. Encourage pupils to think about factors affecting performance during sport. You may wish to use the terms variables, causes, effects, independent or dependent, and to discuss their meaning.

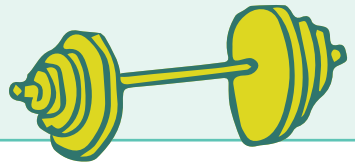
Decide on the enquiry questions to investigate in pairs, groups or as a whole class.

Progression in asking scientific questions

3-5 years	5-7 years	7-11 years	11-14 years
Explore through play: Ask the pupils to move in different ways – you could try jumping, running, dancing, hopping, skipping, climbing. Now challenge the pupils to choose one type of movement (e.g. jumping) and see if they can do this in different ways (e.g. jumping up and down, jumping moving forwards/backwards, two feet to two feet, striding etc).	Ask simple questions and recognising that they can be answered in different ways **Identify:** • *What are we changing?* • *What are we measuring?* • *What are we trying to keep the same?* **You may wish to use** '5-7 Asking Scientific Questions' Skills Starter video to support	Ask relevant questions and use different types of scientific enquiries to answer them Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary **Identify with support:** • *What is the independent variable?* • *What is the dependent variable?* • *What are the control variables?* **You may wish to use** '7-11 Planning Enquiries' Skills Starter video to support	Ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience Select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables **Independently identify:** • *What is the independent variable?* • *What is the dependent variable?* • *What are the control variables?*

Note: *That in a Pattern Seeking enquiry pupils cannot change or control the variables as easily as in a comparative fair test. In this case, they should be encouraged to look for differences in the measurements and look for any patterns.*

Step-by-Step Guide



4 Ask the pupils to make a prediction. What do they think will happen in the investigation?

Clarify that a prediction is a statement that describes what they think will happen.

Use the Great Science Prediction Prompts to support.

Progression in making predictions

3-5 years	5-7 years	7-11 years	11-14 years
Answer 'Yes' or 'No' to simple questions *Do you think the tallest people in our class will perform the longest jumps?*	Pupils will be making predictions. *Because I have noticed that some people have longer legs than me I think that they will be able to jump further than me.*	Use a sentence that includes 'because' *We predict that people with longer legs will jump further because they will be able to stretch their legs further in front of themselves compared to people with shorter legs.*	Make a prediction based on a **hypothesis** A **hypothesis** is an idea about how something works that can be tested using investigations. *E.g. The length of a person's legs affects how far they can jump.* A **prediction** says what will happen in an investigation if the hypothesis is correct. *E.g. I predict that the longer a person's legs are, the further they will be able to jump because they will be able to stretch their legs further in front of themselves when they land.'*

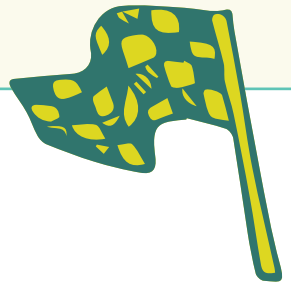
Step-by-Step Guide

5 Give time and access to resources for pupils to carry out their planned investigation.

Older pupils should select the resources they need. In groups of 3-4, pupils should take measurements in a systematic way, relative to age expectations.

Progression in taking measurements

3-5 years	5-7 years	7-11 years	11-14 years
Use non-standard units of measure or simply describe what they find. *E.g. the jump was as long as 5 hand lengths; Kamal's jump was longer than Alex's.* *Use of photos or chalk markings on outside spaces are visual ways to chart results.*	Measure using either non-standard or standard units of measure. Each group can record results. Use ranks to sort measurements from longest to shortest etc. Teacher can then collate class results by asking each group, 'Did the person with the longest legs jump furthest in your group?' A Yes/No tally chart can be created on the board. **'5-7 Gathering Evidence' Skills Starter video support can be used to support**	Measure accurately using standard units. Independently choose the most appropriate piece of equipment to measure. Design their own table to record results e.g. distance of each jump for every member of their group. Apply age-related maths by using repeat readings and calculate a mean of their results. **'7-11 Measuring Accurately' Skills Starter video can be used to support**	Measure distances accurately and with precision to within 0.5cm. Present observations and data using appropriate methods, including tables and graphs. Calculate mean distances.



Step-by-Step Guide

6

To analyse and interpret the measurements gathered, encourage pupils to collate and create ways to show their results in an ordered way to others.

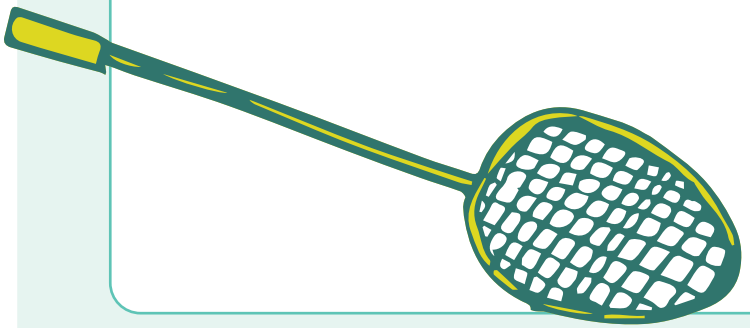
This may include images, tables and graphs. Teachers should model this process according to pupils' confidence. They may collate multiple data sets together across the class based on the same question. Encourage them to spot and explain patterns they find.

Great Idea!

Challenge pupils to work in cross-age groups to create a giant whole school scattergraph on the playground using chalk. Suggest everyone records their longest jump or furthest throw.

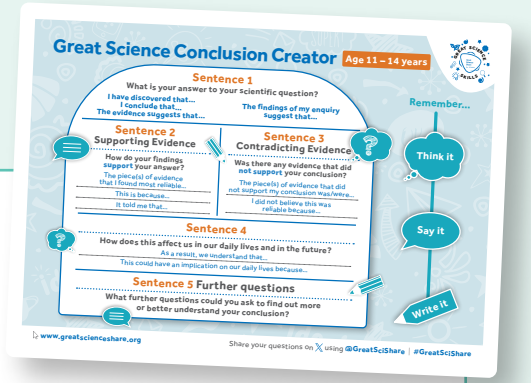
Progression in analysing evidence gathered

3-5 years	5-7 years	7-11 years	11-14 years
Looking at and talking about the measurement, in-person or using photographs of the results. Group discussion.	Draw a **block diagram or pictogram** to represent measurements taken.	**Draw block diagrams or scattergraphs** to represent measurements taken.	Pupils decide which type of graph would be best to represent the data they have collected. Consider if using an average may be appropriate.



Use the Great Science Skills Starters videos:

Step-by-Step Guide



7 Support the pupils to draw conclusions from their investigations by revisiting their predictions.

The Great Science Conclusion Creators are helpful in structuring conclusions.

Progression in drawing conclusions

3-5 years	5-7 years	7-11 years	11-14 years
Simple noticing differences between people's results. *E.g. Zak jumped far. They are tall...* Pupils share what they have found out and answer the enquiry question, where appropriate. Discussions around whether what they have found out was what they expected.	Use vocabulary to make comparisons, e.g. longest, shortest, furthest based on patterns in the data. Draw a conclusion making links to the original prediction. *I have discovered that most people with longer legs can/cannot jump further than people with shorter legs...*	Identify patterns and relationships between the possible cause and effect, e.g. leg length and length of jump. Consider how the measurements could be: • more reliable, e.g. repeat readings and/or • more valid, e.g. improving measuring techniques. Revisit predictions and whether the conclusion supports the prediction or not. *E.g. We predicted that people with longer legs would jump further than people with shorter legs. My measurements support this prediction. This can be explained by people with longer legs being able to stretch their legs further in front of themselves more when landing.*	Identify patterns and relationships between the cause and effect, introducing the terms 'correlation'. Correlation is when there is a relationship between two variables. *E.g. Most people with longer legs did jump further, showing a direct correlation between leg length and length of jump. Participant C and F's results show some correlation but not as much as others. Participant G's results do not fit the pattern at all. This is an anomalous result.* *We predicted that a person's leg length affects how far they can jump which is supported by the majority of the data gathered.* *Ask pupils if they feel they have gathered enough evidence to consider their results reliable. e.g. repeat readings would improve the reliability of the data.*

8 Share conclusions from the enquiry.

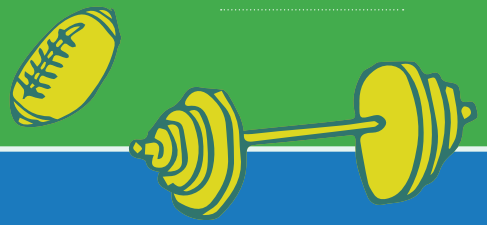
This could be a whole-school science assembly, where the wider community is invited. Posters could alternatively be made and be put out in line with a Sports Day event.

Great Sports Share Ideas for Questions

Great Science Share for SCHOOLS

Research using secondary sources

- What's the difference in fat content between plant and meat-based foods?
- Which vitamins keep us healthy and which foods contain more or less of them?
- How have running shoes changed over time?
- Is it true that having a positive mindset can impact on sports performance?
- Why is it important to wear protective headgear in contact sports?



Comparative tests and fair testing

- How does the angle of launch affect how far a ball will go?
- How does the type of material affect how much it can stretch?
- Which type of shoe sole gives most grip?
- How does the wind speed affect the the time it takes for a shuttlecock to fall to the ground?
- How does the shape of a boat hull (canoe) affect the time it takes to move through water?

Observing over time

- How much exercise do we do in a week?
- How does our heart rate change at key times of the day?
- Can we jump for longer in the morning, lunch time or afternoon?
- Which time of the day is the best to throw a javelin?
- How do the changing light levels in our classroom affect the accuracy we hit a target?

Pattern seeking

- Are foods that are high in energy always high in sugar?
- How does our choice of breakfast affect how fast we can run?
- How does the size of our hands affect the size of ball we can grip?
- Do younger people have faster reaction times?
- How does age affect the accuracy we throw?

Identifying, classifying and grouping

- What are the organs of the body and how can we sort them?
- How can we sort the Olympic sports in groups?
- Can we make a chart to sort and classify foods into different groups?
- Which clothes keep athletes cool/warm/dry?
- Which sports involve things that float, fly or fall?

View the **Enquiring science 4 all** resources here

www.greatscienceshare.org

Great Sports Share

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.

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_2 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?

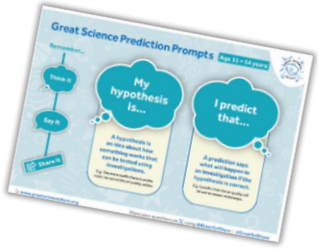
How does the amount of rest affect the number of leg lifts people can perform?

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.

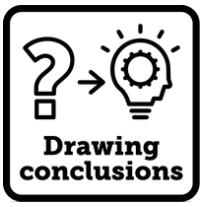


5. Based on the hypothesis *'The amount of rest affects muscle performance*,' pupils talk to a partner and make a prediction. Use the **11-14 Great Science Prediction Prompt**
*E.g: ' I predict that the number of lifts I can do in 60 seconds will **decrease** as the amount of rest **decreases** because 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.'*

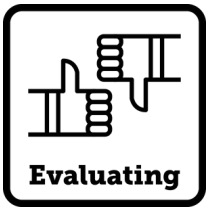
Step-by-step guide cont.

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?