MODULE: *Marvellous Motion*

Episode 2: Jump and Run

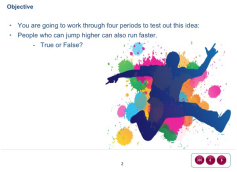
Episode Teaching Guide

Learning Objectives

Students will be able to:

- Collect useful data.
- Be able to collect and use the data to draw conclusions
- Explain the reasons for these results.

Running the Activity
Period 1–4
Activity 2.1–2.4 Vertical Jump Test and Sprint Challenge



- Introduce this episode using PPT slides 1 and 2.

  The focus of these four periods is to answer the question, ‘Can people who jump higher also run faster?’

  Normally, yes. There is a biological explanation for this, which is included as an Appendix at the end of this guide, for teacher information..

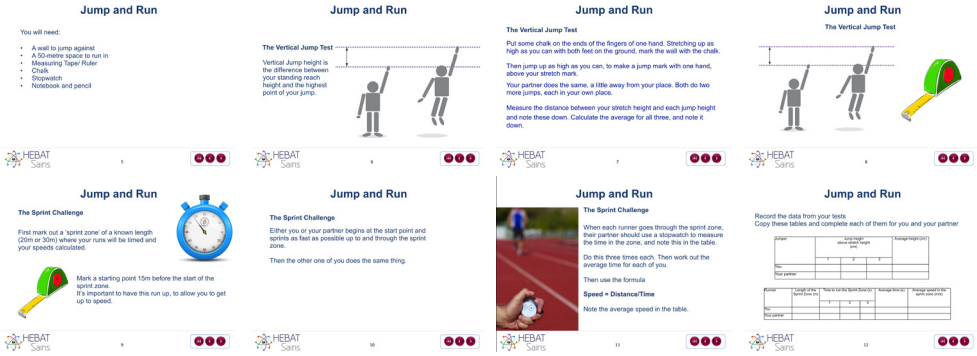
  Although the explanation lies within the field of biology, the purpose of this episode is to collect and process data. This has been set in an active context.

  Allow students, working in pairs, to spend a few minutes discussing the question. Elicit their views, encouraging them to form predictions for the outcome of their testing.

- Hand out Activity Sheet 2.1. Use PPT slides 3 and 4 to introduce the two tasks:

  The first section of the investigation is for the students to collect data relating to themselves, working with a partner to obtain the measurements and times they need. The students will need to enter these into the tables on their activity sheets (copied for you below).

  The second section combines data from the whole class, to give a much larger, and so hopefully much more reliable, set of data.



- Finally students will need to analyse the data; plotting graphs should indicate any trends and patterns and allow conclusions to be drawn.

a) The Vertical Jump Test

Show PPT slides 5 to 8, to reinforce the instructions on the activity sheet.

It is important that students measure the difference between their stretch height (the highest point they can reach with their feet still on the ground) and their three different jump heights.

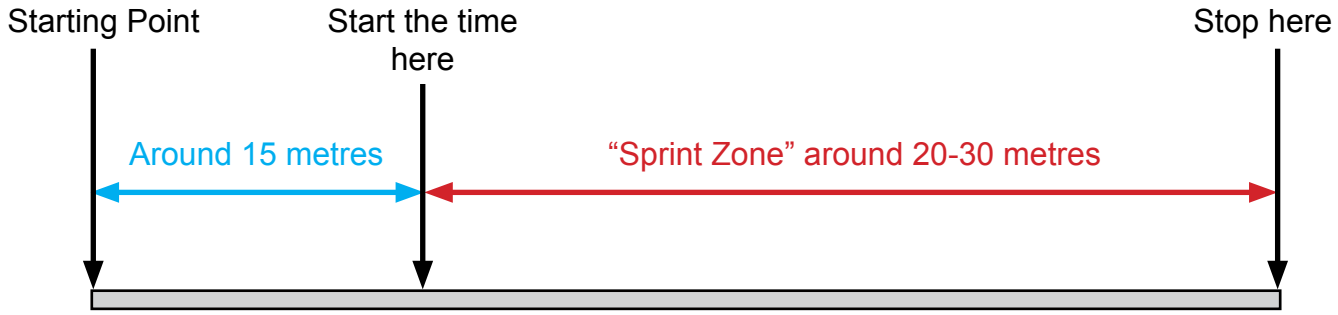
Jumper	Jump height above stretch height (cm)			Average height (cm)
	1	2	3	
You				
Your Partner				

b) The Sprint Challenge

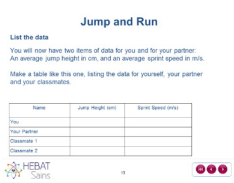
Show PPT slides 9 to 12, to reinforce the instructions on the activity sheet.

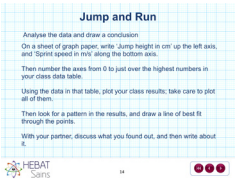
It is important that the runup zone is marked out as well as the sprint zone, as the runners need to be travelling at their fastest before their run starts being timed.

You might prefer to mark out a single runup and sprint zone wide enough for the class (possibly prior to the lesson).



Runner	Length of Sprint Zone (m)	Time to run the Sprint Zone (s)			Average time (s)	Average speed in the sprint zone (m/s)
		1	2	3		
You						
Your Partner						





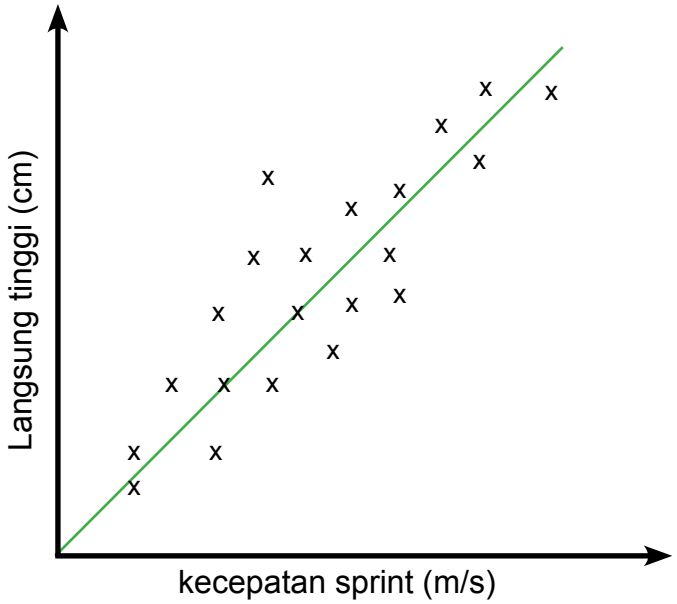
- The next part of the investigation combines all the class results to give a larger data set.

  Show PPT slide 13. Tell your students that each of them should draw up a class results table like the one in the slide. Then each student should read out their own data in turn, and everyone else should enter it into their class results table.

  (Or you could have a 'master' results table at the front of the class, in which students record their personal information, then you photocopy this to hand out).

  Show PPT slide 14. The next thing the students should do is draw up a graph and transfer the data into it; they should only mark the points, not join them up with any lines; they are then likely to produce a scatter-graph similar to that shown below.

  Next, they should draw a best-fit or trend-line to show the correlation between the two sets of data.



  This graph clearly shows that the original statement is true; nearly everyone in this sample who can jump higher can also run faster.

  The students' graphs are likely to be similar and to show the same thing. Tell them that the closer all their points are to the line of best fit, the more reliable their conclusion will be; and that any points that lie a long way from the line are anomalous results which should be disregarded when drawing a conclusion from the graph.

Resources

- *PowerPoint* Presentation - Episode 2: Jump and Run
- *Prezi Presentation*- Episode 2: Jump and Run
- Activity Sheet 2.1: Jump and Run

You will need:

1. Vertical Jump Test:

- Measuring tape and/or metre rules
- Chalk
- Results table
- Pencil
- Calculator
- Safe step stools or similar for the students to climb on, to measure the marks.

2. Sprint Challenge:

- 20 or 30 metre measuring tape
- Stopwatch
- Results table
- Pencil
- Calculator
- Graph paper
- 30cm rulers

Appendix

Various studies have highlighted the link between jump height and sprint speed. One interesting study confirmed the relationship by testing professional footballers.

But why is there a link?

Simply by looking at the movements, you can see that sprinting and jumping are both actions which use the same muscle groups – the large muscles of the legs. The actions also use the muscles in the same way, due to the nature of the actions; they are both short in duration, and they both require a maximal power output (a large force in a short time) by the muscles to achieve the best performance.

Skeletal Muscle

Skeletal muscles are made up of both slow twitch (Type I) and fast (Type II) twitch muscle fibres, with fast twitch fibres also split into two categories IIa and IIb (sometimes known as IIx). The amount of force and the way these types of muscle produce the energy to generate this force are very different.

Slow twitch muscles fibres use only aerobic energy systems to produce this energy. Type IIa fibres can use both aerobic and anaerobic systems to generate energy, and type IIb fibres only use anaerobic systems to generate energy for muscular contraction.

Because of the nature of the way they generate energy, slow twitch fibres are very resistant to fatigue. However, type IIb fast twitch fibres are very susceptible to fatigue (only useable for up to one minute at a time!). Type IIa fibres lie somewhere in between, as they use a combination of aerobic and anaerobic systems

How is this power generated?

Fast twitch fibres have a shortening speed that is three to five times faster than slow twitch muscle fibres. This allows them to complete more 'contraction cycles' in the same amount of time, to generate a higher force.

This is how they got their initial classification as slow or fast twitch muscle fibres!

For the short events like the sprints and the jumping events as well as the throwing and lifting events, athletes are likely to need a larger proportion of fast twitch muscle fibres.

Elite sprinters have been found to have up to 70% of their skeletal muscle made up of fast twitch fibres

As the activities become increasingly reliant on endurance – 800m races, team games, then marathon events – the athletes will have a heavier reliance on slow twitch muscle fibre; elite distance runners have been shown to have up to 80% slow twitch fibre in their skeletal muscle.

So is this a determining factor in elite level Olympic competition?

Evidence would suggest that the proportion of slow/fast twitch muscle fibres a person has is largely determined by their genetic make-up. However, there have been studies suggesting that certain types of training can alter the characteristics of some muscle fibres. These changes are limited, usually occurring through the Type IIa muscle fibres changing their characteristics towards either Type I or Type IIb muscle fibres, thus increasing a person's ability in endurance or power events respectively. For example, Usain Bolt will, through endurance training, change his muscle fibre proportion to predominantly slow twitch; he will be able to change the characteristics of some fibres to give a better aerobic performance.

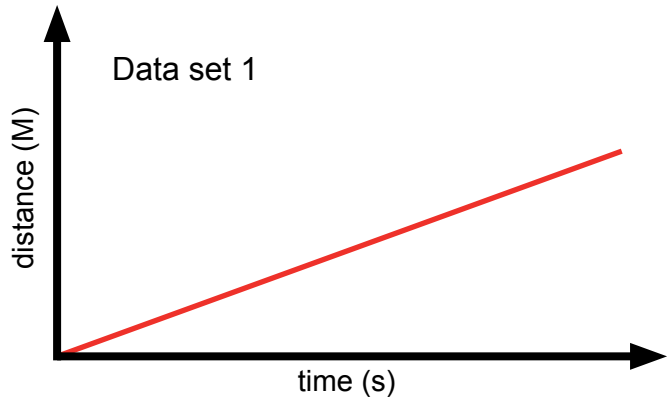
Period 5
Activity 2.5 – Interactive and Review

1. Introduce the interactive using PPT slide 1. This tells the students that they will be interpreting distance–time graphs.

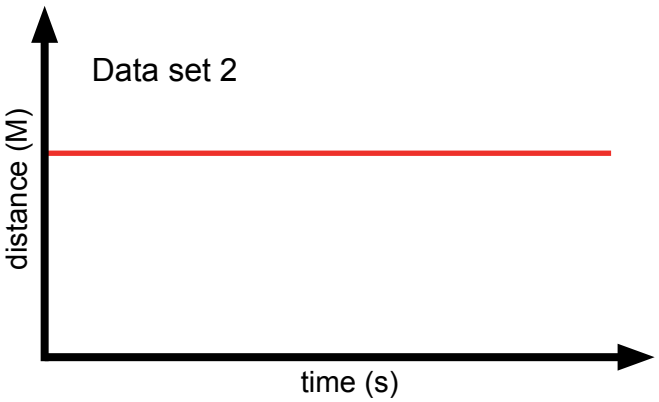
   (This may be a useful activity for you to try out for yourself before teaching Episode 1, to ensure your knowledge matches the information in this module.)

2. PPT slide 2 gives students instructions; on each of the following four slides (3 to 6), they will be given a set of data. They will need to plot the points onto the graph paper grid. When the points have been plotted correctly, the line will automatically be drawn on the graph.

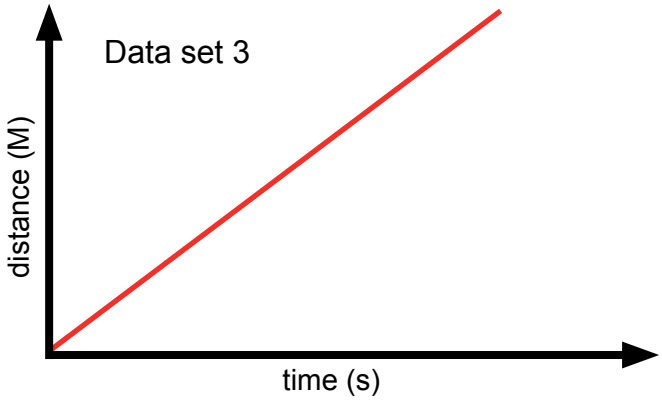
3. PPT slide 7 gives four scenarios, which students need to match with the four graphs they have drawn.

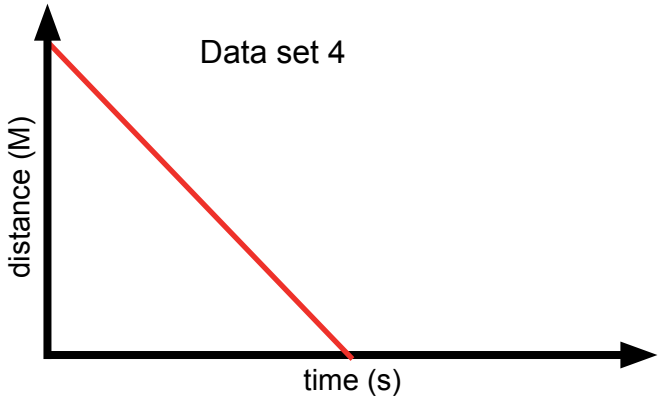


The steepness (gradient) of the line indicates the speed of the car.



The distance does not change, so the car is stationary.





The gradient of this line is steeper than in Data Set 1, showing that the speed in this diagram is greater.

The distance is decreasing, finally reaching zero – the starting point.

- PPT slide 8 summarises the graphs and their interpretations.

Resources

- *PowerPoint* Presentation- *Episode 2: Jump and Run*
- *Prezi* Presentation- *Episode 2: Jump and Run*
- Interactive Guide: Distance–time graphs.

You will need:

Access to IT equipment; computers, laptops or i-pads.

References

McArdle, W. D., Katch, F. I., and Katch, V. L. (2001). Exercise physiology: energy, nutrition and human performance, (5th Ed.) Lippincott Williams & Wilkins, Maryland.

Scott, W., Stevens, J., and Binder-Macleod, S, A. (2001). Human skeletal muscle fiber type classifications. Physical Therapy, 81, 1810-1816.

Wisløff, U., Castagna, C., and Helgerud, J. (2002). Strong correlation of maximal squat strength with sprint performance and vertical jump height in Elite soccer players. British Journal of Sports Medicine, 38, 285-288.