COURSE TITLE

Problem Title	Assessment of a 100 m sprint performance

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Learning Outcome(s)	
1	Qualitatively identify and describe the phases of sprinting through observation
2	Interpret time-motion graphs to identify and explain sprinting performance
3	Analyse sprint timing data to calculate velocity and acceleration to illustrate difference between sprint performances

Concepts / Competencies expected to engage with	• Linear kinematics

Course Level	Undergraduate introductory

This problem involves data analysis	Yes X	No	Maybe

Approximate Length	60 - 90 mins

Class/ Group Size	30 students 3 per group

Useful References	• Hamill J, Knudsen KM. (2014). Biomechanical Basis of Human Movement (4th Ed.). London: LWW. Pg 283-297 • Grimshaw, P., Lees, A., Fowler, N. and Burden, A. (2019) Instant Notes: Sport and Exercise Biomechanics (2nd Ed.). London: Taylor and Francis. Pg 11-17

Mode of Instruction	Synchronous (Face to face) or Asynchronous (Online)

The Scenario:

In the 100m track event the main criteria to determine athletic performance is that of who crosses the finish line first (Fig 1). Indeed, in global terms that is all that matters. Who reacts the quickest, or takes the lead first, or shows the best form towards the end of the race, would appear to be of little consequence to the outcome. However, are such opinions of these intermediary events entirely valid? Despite the relative brevity of the 100m event there are at least two, and probably more, distinct phases that occur in a 100m race before the athlete crosses the finish line and wins the race. Success in any or all of these different phases is dependent on variables which, if fully understood by the coach, may help to determine a training formula for future success. You understand that amongst the many components which interact with each other to determine success, are those of velocity and acceleration. The athlete who reaches and maintains the greatest velocity, whilst taking the least amount of time to achieve that velocity, will be the athlete who most likely wins the race. In this respect, it may be argued that were velocity and acceleration data made available to a coach, then the coach would be able to identify potential areas of weakness and consequently re-assess a training programme such that deficiencies could be worked on. Additionally, identifying whether earlier phases of sprint performance have a greater impact on overall success can assist the coach in developing training approaches. As a sport and exercise science student you have been asked to use your knowledge of biomechanics and specifically linear kinematic to help the coach and athletes understand their performance. You will be required to use you observation and explanation skills, alongside your ability to analyse data to achieve this.

Figure 1. Differences in athlete position at the finish of a 100 m race.

The Questions:

Make sure to include the correct biomechanics language to describe your solution correctly.

1. A coach currently works with two sprinters and asks you for advice on their performance. The coach explains that when observing a race the first sprinter (A) is poor out of the blocks but comes through strongly at the end of the race, and the second sprinter (B) is first out of the blocks but is overtaken by other sprinters towards the end of the race. From your knowledge of linear kinematics can you explain the difference between sprinter A and B. Can you display the difference between the sprinters in a graphical format?
2. You are provided with the displacement/time data for Sprinter A and B (Table 1).
    a. Calculate the mean velocity and mean acceleration for both athletes for each 10m interval.
    b. Plot the data as a displacement (y-axis) time (x-axis) curve and calculate and plot a velocity (y-axis) time (x-axis) curve, and an acceleration (y-axis) time (x-axis) curve. Use appropriate scales to optimise the area of the graph.
    c. Comment on the shape of the time-motion graphs and identify the phases of the sprint for each athlete.
3. The coach asks you to provide feedback on the two sprinters based on the data you have analysed.
    a. What do you notice from the data compared to the coaches' initial assessment of his athletes?
    b. What can the coach do to improve the performance of his sprinters?

c. Considering the phase of sprinting, what phases do the two sprinters perform well in and which need improvements?

Table 1. 10 m segment timing data of the 100m race for athletes A and B

Distance	**0 m**	**10 m**	**20 m**	**30 m**	**40 m**	**50 m**	**60 m**	**70 m**	**80 m**	**90m**	**100 m**
Athlete A	0 s	2.56 s	4.09 s	5.41 s	6.56 s	7.66 s	8.72 s	9.77 s	10.82 s	11.87 s	12.93 s
Athlete B	0 s	1.78 s	3.06 s	4.21 s	5.32 s	6.42 s	7.51 s	8.63 s	9.78 s	10.97 s	12.21 s

Expected Outcomes:

This activity is designed to be completed in person or synchronously online. Students should be split into groups or 3 to work on the problem. After being presented with the problem, each group should discuss and produce a solution to each question in written format, which would form part of an in-class assessment. Each group should be able to orally present their solution to the rest of the class and are permitted the use of a whiteboard or flipchart to diagrammatically represent the forces occurring in each scenario. Students in other groups may provide feedforward to the presenting group to develop their solution. For questions 1 and 3, students should be able to demonstrate an understanding of the concepts of linear kinematics through qualitative description. For question 2 the students need to demonstrate the ability to understand and calculate data quantitatively and to explain the data in a practical or applied process.

Guided Questions (Hints):

1. Can you define linear velocity and linear acceleration?
2. How does acceleration affect velocity?
3. State the equations for linear velocity and linear acceleration? What data do you have available for you to calculate these variables?
4. What is the difference between average and instantaneous velocity or acceleration?
5. What type of training modality can improve sprint performance?
6. What limb and joint positions are related to an improved sprint start? What phase is this?
7. In what direction should force be applied to maximise sprint velocity?