**100m world record**



*Florence Griffith-Joyner meeting the US President in the Oval Office, 1988*

Florence Griffith-Joyner broke the 100m world record on July 16th 1988.

Her fans called her ‘Flo-Jo’.

More than thirty years later, her record still stands.

*Fill in the gaps to describe Flo-Jo’s world record breaking 100m race.*

*You should only use the words* ***average*** *and* ***instantaneous***

**The race:**

In 1988 Flo-Jo ran the 100m in 10.49 seconds and set a new world record. Her \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ speed for the race was 9.5 m/s.

As the starting gun went off her \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ speed was zero. She quickly sped up and at the 50m point her \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ speed was 11.0 m/s. For the first half of the race her \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ speed was 8.6 m/s.

After the half-way point Flo-Jo slowed a little. Her \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ speed for the second half of the race was 10.7 m/s. In the last few metres she sped up again and on the finish line her \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ speed was 11.2 m/s.

*Physics > Big idea PFM: Forces and motion > Topic PFM2: Moving by force > Key concept PFM2.1: Describing speed*

|  |
| --- |
| **Diagnostic question** |
| **100m world record** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Speed is a measure of how fast an object travels: how far it goes in a given time |
| Observable learning outcome: | Explain why the average speed may be different to the instantaneous speed of an object |
| Question type: | Focused cloze |
| Key words: | Average speed, instantaneous speed |

**What does the research say?**

Practical work gives students the opportunity to measure distance and time in order to calculate average speeds of moving objects and to observe their motion in detail. Introducing and rehearsing vocabulary that allows them to describe observations accurately is an essential first step towards understanding motion (Kibble, 2011; Driver et al., 1994).

This question investigates students’ understanding of *average* speed and *instantaneous* speed.

**Ways to use this question**

Video of the ‘women’s 100m world record’ race is easy to find on the internet and it makes a useful introduction to this activity. Useful questions to prompt students might be:

* Is her speed the same all the way through the race?
* How would you calculate her average speed for the race?
* How does her average speed compare to her speed at the start, middle and end?
* Why does her speed change through the race?

Students should then complete the activity individually as a pencil and paper exercise. The large text on the worksheet allows it to be copied A5 size, which fits a standard exercise book.

How students fill in the gaps will show you whether they understood the concept sufficiently well to apply it correctly.

If there is a range of answers, you may choose to respond through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs.

*Differentiation*

You may choose to read the sentences to the class, so that everyone can focus on the science. In some situations it may be more appropriate for a teaching assistant to read for one or two students.

**Expected answers**

In 1988 Flo-Jo ran the 100m in 10.49 seconds and set a new world record. Her **average** speed for the race was 9.5 m/s.

As the starting gun went off her **instantaneous** speed was zero. She quickly sped up and at the 50m point her **instantaneous** speed was 11.0 m/s. For the first half of the race her **average** speed was 8.6 m/s.

After the half-way point Flo-Jo slowed a little. Her **average** speed for the second half of the race was 10.7 m/s. In the last few metres she sped up again and on the finish line her **instantaneous** speed was 11.2 m/s.

**How to respond - what next?**

The word instantaneous may be new to many students. It can be broken into parts: *‘Instant-’*, meaning at a particular time; and *‘-aneous’* is an ending added to (Latin) words to turn them into adjectives (describing words). So instantaneous means ‘describing a particular time’.

The key idea here is that average speed does not necessarily describe the actual speed of an object. It describes the steady speed an object could travel at to complete the same journey in the same amount of time. It is likely that some students will spot that Flo-Jo ‘slowed’ in the second half of the race, and completed it at a higher average speed than the first half. She in fact slowed from her instantaneous speed at the midpoint.

If students have misunderstandings about average speed, it can help to model a journey with two students. One walks at a steady pace, the other moves at a range of different paces in order to arrive at the end-point at the same time. The two motions can be compared.

Another way to open up discussion is to ask students about the difference between ‘speed cameras’ and ‘average speed checks’ on a motorway. Discussing this in pairs or small groups would encourage social construction of new ideas through dialogue. Giving students the opportunity to write definitions of instantaneous speed and average speed in their own words can consolidate learning and check individual understanding.

The following BEST ‘response activity’ could be used in follow-up to this diagnostic question:

* Response activity: Timing problems

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Image: Florence Griffith-Joyner: *Courtesy of the Ronald Reagan Library.*

**References**

Driver, R., et al. (1994). *Making Sense of Secondary Science: Support Materials for Teachers,* London: Routledge.

Kibble, B. (2011). Forces. In Sang, D. (ed.) *Teaching secondary physics.* London: Hodder Education.