



Name: **Answers**

## Introduction

Understanding and testing drag force is important in different sports to give athletes an edge. Scientists are constantly developing materials that help athletes deal better with drag force. This experiment demonstrates the effect of drag force on a runner.

## Aim

To determine the effect of drag on a runner.

## Vocabulary

1. In relation to physics, define the term drag.

A force acting in the opposite direction of a moving object
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## Hypothesis

2. Complete the following sentence.

**A runner experiencing more drag will slow down**

## Materials

- Runner (you)
- 2 x witches hats (or plastic bottles)
- Stop watch
- Timer (someone from your family)
- Small plastic bag (i.e. shopping or freezer bag)
- Large plastic bag (i.e. garbage bag)

## Method

1. Set up a running course by placing the witches hats (or bottles) around 10 m apart (you can step this out if you don't have access to a measuring tape)
2. Stand with the timer (with stop watch) at one of the cones.
3. When the timer says "go" (and starts the stop watch), run up to and around the second cone and back to the timer.
4. As you pass the timer they stop the stop watch.
5. Record this value in the table below.
6. Repeat this trial 3 times (have at least a one min rest in-between)
7. Repeat the experiment holding the small bag behind you and then the large bag behind you so that they act like a parachute.

# Results

Time taken to complete running course (seconds)

Trial	No bag	Small bag	Large bag
One			
Two			
Three			
<b>Average (total/3)</b>	Fastest value		Slowest value

3. Calculate the average time for each of the experimental trials.
4. Use excel to display the average results on a column graph (the experimental trials should be on the x axis and the time on the y axis)

# Discussion

1. Describe the result trends in a sentence (make sure you mention results in the sentence).

Refers to results. Should indicate that the larger the bag the slower the time

2. Did the results match the hypothesis? Provide a reason as to why these results were obtained.

Students should refer to the larger bag provided a larger surface area that catches the air and slows the runner down.

3. Compare your result to two other class members. Explain why any similarities or differences exist.

Addresses different times depending on course run, ability of runner etc, similarities should show that the bigger bags slowed all runners

4. Describe why reducing drag in sport is important.

Many sports rely on the winner recording the fastest time

5. Describe a non-sporting situation where reducing drag is important.

Reduced drag in aeroplanes reduce fuel use (and cost). Other examples could be used.

6. A fair test using the scientific method always has clear independent (experimental), dependent (observed) and controlled variables. Identify the variables in the experiment by completing the table below. The following clip may help you: <https://www.youtube.com/watch?v=iaewZmc4TYQ>

Variable	In drag experiment
Independent	The different size bags
Dependent	the time take to complete the course
Controlled	the length of the running course

**7. Do you think that this was a fair test? What modifications could you make to the method to make this test fairer?**

Not a true fair test. Running style was compromised when holding bags – design a suit that creates a large surface area that does not compromise running style. Timer not accurate – use electronic timing. Students may think of other examples.

## Conclusion

**8. Write one clear paragraph that summarises your findings. The conclusion should relate directly to the question answered, your hypothesis and the results that you obtained (make sure you quote your results).**

Good sentence starters are “The question that was investigated...”, “It was predicted that...”, “The results were ...” and “The results indicated that...”.

Students use all sentence starters to refer to experiment.

## Investigate further

1. Speedo designed a “shark skin suit” to help swimmers gain an edge. Find out the effect that this suit had on world record times and if athletes are still wearing it now.
2. Wind tunnels are used extensively in many industries to test for drag. Find out how a wind tunnel works and how different industries use it.
3. “Slip streaming” is a technique used by athletes to gain an edge. Find out what this technique involves and how much of an advantage athletes can get.