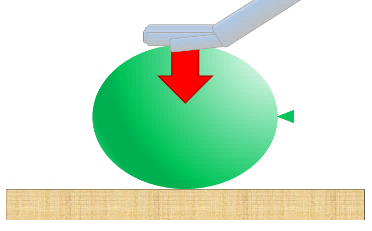
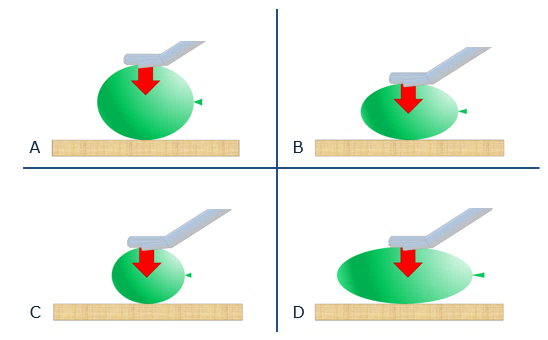
**What does this force do?**

A robot pushes down on this balloon.

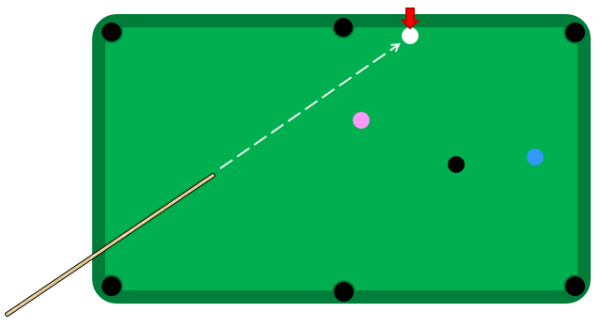
1. Which picture best shows what happens to the balloon?

Put a ring round the correct letter.



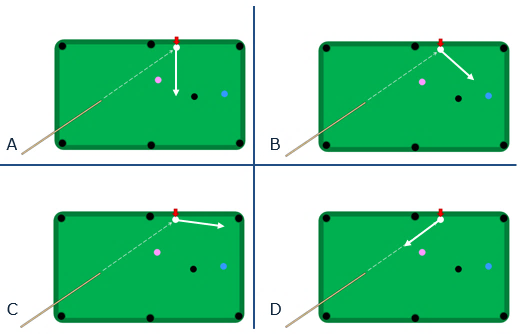
**What does this force do?**

The side-cushion pushes on the snooker ball.



1. Which picture best shows what happens to the snooker ball?

Put a ring round the correct letter.



**What does this force do?**

The gun-powder burns and pushes this rocket for three seconds.



1. The burning gun-powder pushes this rocket for three seconds.

What happens to its speed in those three seconds?

Put a tick (✓) in the box next to the correct answer.

|  |  |  |
| --- | --- | --- |
| **A** | Starts very fast and slows down |  |
|  |  |  |
| **B** | A fast, steady speed |  |
|  |  |  |
| **C** | Keeps getting faster and faster |  |

*Physics > Big idea PFM: Forces and motion > Topic PFM1: Forces > Key concept PFM1.1: What forces do*

|  |
| --- |
| **Diagnostic question** |
| **What does this force do?** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | A force makes things change: the speed, direction and/or shape of an object. |
| Observable learning outcome: | * Describe the changes, in a range of situations, which a force makes to the speed, direction and/or shape of an object. |
| Question type: | Diagnostic, simple multiple choice |
| Key words: | force, shape, direction, speed |

**What does the research say?**

In earlier teaching students are likely to have described forces as pushes or pulls.

Students commonly link forces to movement and see force as a property of something that is moving. A property that keeps it moving and which runs out when a moving object comes to rest (Gunstone and Watts, 1985, Driver *et al*, 1994).

Osborne (1985) found that students increasingly hold the view that a force, pushing in the direction of motion, is needed to keep an object moving. In a study of 200 students he found 46% of 13 year olds believed this, increasing to 53% of 14 year olds and 66% of 15 year olds.

Students often use the terms speed and acceleration interchangeably. Forces make the speed change and therefore cause acceleration. Common ways that students say this are, for example, ‘going faster’, or ‘increasing speed’. These terms are ambiguous as they do not distinguish between acceleration and a faster steady speed (Driver *et al*, 1994). It is important to be precise with the phrasing of this so that the understanding is clear. Here we have used the phrase ‘getting faster and faster’.

A scientific understanding of force is necessary in order to explain and predict motion and to apply Newton’s laws of motion correctly. ‘A force makes things change: the speed, the direction and/or the shape of an object.’

**Ways to use this question**

Students should complete the question individually. This could be a pencil and paper exercise, or you could use an electronic ‘voting system’ or mini white boards and the PowerPoint presentation.

The answers to the question will show you whether students 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 questions 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**

1. D

2. B

3. C

**How to respond - what next?**

The main point of these questions is to clarify that forces make things change. We cannot see a force, we see the effect of a change caused by a force when two objects interact.

In *question 1* there is a change in the direction the force is pushing in B, C and D, but not in A. In C there has also been a change squashing the balloon in at the sides – and you do not get a change without a force. Students choosing B or D understand that a change of shape is in the direction of a force. D is more correct because the air pushes the balloon out sideways.

In *question 2* the direction of motion is changed in the direction the force of the cushion pushes in. A is quite a common error, often signalling that students are trying to apply science ideas – in this case that a change is in the direction of the force. They have not taken account of the original motion. In each of A and D a sideways force is needed to change the sideways motion and this is not there. This is partially true for C, although this could result if there is ‘spin’ put on the ball. Students explaining this are likely to have a reasonable idea of forces and may be able to attempt an explanation of where this extra sideways force came from.

*Question 3* is more challenging. Everyday experience suggests it starts fast and slows down, as a ball does because of gravity. The resultant force (thrust –up, gravity down) is positive for the first three seconds and a steady force constantly changes the speed whilst it is acting. (The rocket slows and explodes *after* the propulsion fuel has run out). Answer B is a very common misunderstanding – ‘forces make things *change*’ should always be your catch phrase when teaching forces.

If students have misunderstandings about the changes, in a range of situations, which a force makes to the speed, direction and/or shape of an object, it is helpful to take time in guiding them through analysing the situation for themselves. Start from the idea that ‘forces make things change’, identify what force (push or pull) is acting, then consider what *changes* take place in the direction of the force. A clear approach to thinking through forces is essential for dealing with more complex situations later on.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: UYSEG

**References**

Driver, R., Squires, A., Rushworth, P. and Wood-Robinson, V. (1994) Making sense of secondary science, research into children’s ideas, Routledge, London, England.

Gunstone, R. and Watts, M. (1985) ‘Force and Motion’ in Driver, R., Guesne, E. and Tiberghien, A. *Children’s Ideas In Science*, Open University Press, Milton Keynes, England.

Osborne, R. (1985) ‘Building on children’s intuitive ideas’, in Osborne, R. and Freyberg, P., *Learning in Science,* Heinemann, Aukland, New Zealand.