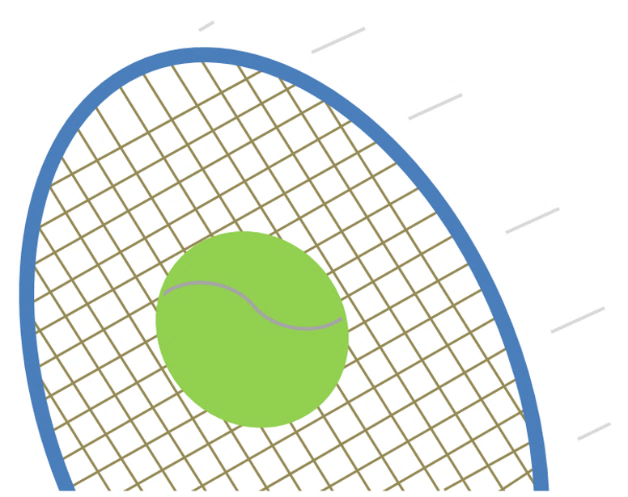
**Big force, little force**

A tennis ball is hit with a tennis racket.



* 1. What does the force of the racket do to the tennis ball?

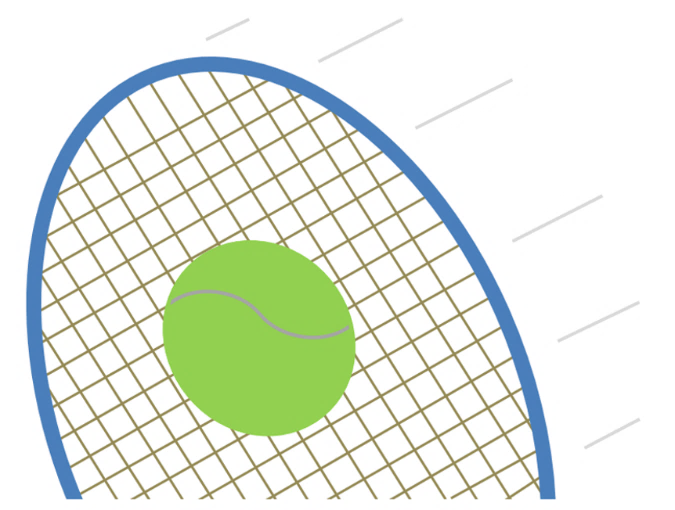
Look at these statements.

For each statement, tick (✓) **one** column to show what you think about it.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Statements** | | I am **sure** this is correct | I think this is correct | I think this is wrong | I am **sure** this is wrong |
| **A** | It changes its speed. |  |  |  |  |
| **B** | It changes its direction. |  |  |  |  |
| **C** | It changes its shape. |  |  |  |  |

**Big force, little force**

The same tennis ball is hit with a tennis racket, but with more force.



* 1. The ball is hit harder. What does the force of the racket do to the ball now?

Look at these statements.

For each statement, tick (✓) **one** column to show what you think about it.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Statements** | | I am **sure** this is correct | I think this is correct | I think this is wrong | I am **sure** this is wrong |
| **A** | It changes its speed *more.* |  |  |  |  |
| **B** | It changes its direction *more.* |  |  |  |  |
| **C** | It changes its shape *more.* |  |  |  |  |

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

|  |
| --- |
| **Diagnostic question** |
| **Big force, little force** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | A force makes things change: the speed, direction and/or shape of an object. |
| Observable learning outcome: | * Predict correctly the changes caused by forces of different sizes and direction on an object. |
| Question type: | Diagnostic, confidence grid |
| Key words: | force, shape, direction, speed |

**What does the research say?**

Some students find it hard to think of forces in terms of their magnitude and direction (Driver *et al*, 1994). Taking the strength of a force into account is essential to analysing the effect of forces in different situations.

**Ways to use this question**

Students should complete the confidence grid 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.

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.

*You can emphasise that forces make thing change: speed, direction and/or shape.*

*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. It changes speed, direction and shape
2. It changes speed and shape more. Its new direction is just about the same as before.

**How to respond - what next?**

Most students will agree that the tennis ball changes direction and speed when it is hit with a racket. The change of shape is very fast and not normally observable. You may choose to show your students a slow motion video clip a tennis ball deforming – a search for ‘tennis ball bounce’ works.

Question 2 checks what for many is an obvious link, that bigger forces cause bigger changes. It is perhaps worth exploring the idea that the ball is only increasing its speed during the time it is in contact with the racket. This means that as well as force, a skilful shot will follow through and increase the time the force is working for. (This idea is normally covered at ages 14-16)

If students have misunderstandings about predicting correctly the changes caused by forces of different sizes and direction on an object, then giving them opportunities to discuss different situations of forces acting with other students can help to clarify their thinking, or raise more specific questions for them to ask. The following BEST ‘response activity’ could be used in follow-up to this diagnostic question:

* Response activity: Cycling forces

**Acknowledgments**

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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.