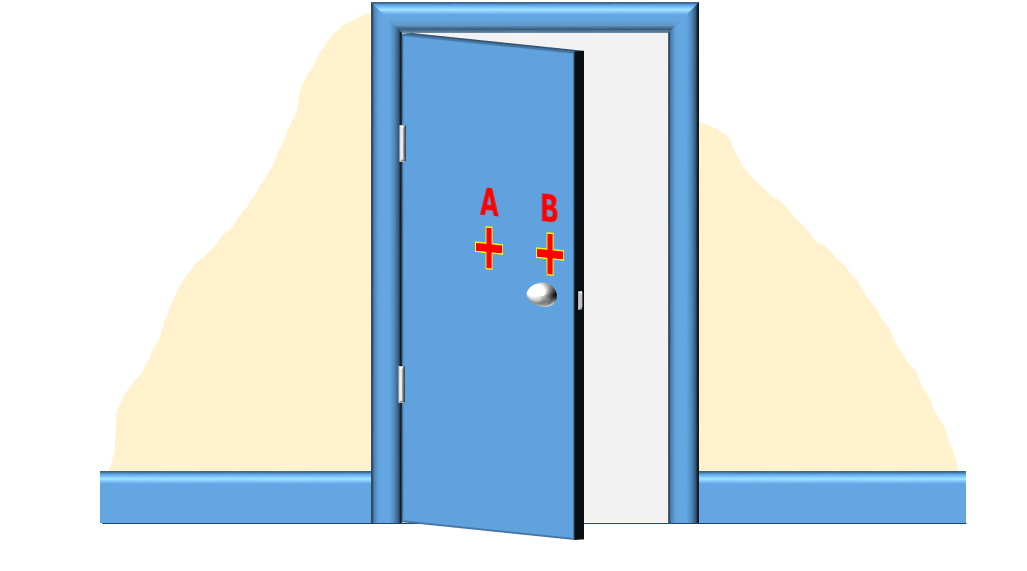
**Open door**

The classroom door has been left open.



How much force does it need to push the door shut?

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

|  |  |  |
| --- | --- | --- |
| **A** | More force pushing at A. |  |
|  |  |  |
| **B** | More force pushing at B. |  |
|  |  |  |
| **C** | The same amount of force pushing at A or B. |  |

*Physics > Big idea PFM: Forces and motion > Topic PFM3: More about force > Key concept PFM3.3: Turning effects*

|  |
| --- |
| **Diagnostic question** |
| **Open door** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | If a force acts on a pivoted object, the object turns about its pivot: the size of the turning effect depends on the size of the force and on its (perpendicular) distance from the pivot. |
| Observable learning outcome: | Recall that a bigger applied force and/or a longer lever gives a larger turning effect. |
| Question type: | Simple multiple choice |
| Key words: | force, turning effect |

|  |  |
| --- | --- |
| **P** | **PRIOR UNDERSTANDING**  This diagnostic question probes understanding of ideas that are usually taught at age 5-11, to aid transition from earlier stages of learning. |

**What does the research say?**

From an early age students often have an intuitive understanding of turning effects through their everyday interactions with doors, see-saws and other mechanical devices (Inhelder and Piaget, 1958; Driver et al., 1994a; Institute of Physics). In England students investigate levers as force multipliers at age 9-10 (Department for Education, 2013); before progressing they need to be able to put into words their intuitive understanding that an effort further from a pivot leads to a bigger turning effect (Driver et al., 1994b). Driver et al. also point out that building understanding of turning effects from students’ intuition is more effective than limiting teaching to arithmetic manipulation of the formula: moment = force x perpendicular distance from the pivot.

When teaching, it may be helpful not to use the term ‘moment’ to describe turning effects because students often associate the term with ‘time’, or confuse it with ‘movement’. Using ‘turning effect’ can be less problematic (Driver et al., 1994b).

**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**

**A** More force pushing at A.

**How to respond - what next?**

Most students will realise that the door is easier to open by pushing it nearer to the handle, however it is less likely that they will be able to put this clearly into their own words.

If students have difficulty in describing that it is easier to open a door by pushing further from the hinges, it can help to carry out a class investigation to find out where it is harder to push. This is clearly described in Supporting Physics Teaching 11-14: Machines, levers (Institute of Physics). Giving students the opportunity to give descriptions of the general rule for pushing on the door, orally and in writing, can help to clarify and consolidate students’ understanding.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Peter Fairhurst (UYSEG).

**References**

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