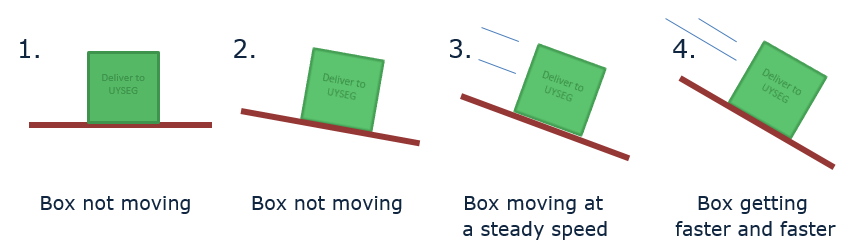
**No friction**

The force of friction can change. Think about the force of friction on this box.



1. Which boxes have no friction?

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

|  |  |  |
| --- | --- | --- |
| **A** | They all have friction |  |
|  |  |  |
| **B** | Box 1 has no friction |  |
|  |  |  |
| **C** | Boxes 1 and 2 have no friction |  |
|  |  |  |
| **D** | Boxes 3 and 4 have no friction |  |
|  |  |  |
| **E** | Box 4 has no friction |  |

1. Why do you think this?

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

|  |  |  |
| --- | --- | --- |
| **A** | There is no force pushing sideways |  |
|  |  |  |
| **B** | The surfaces are a little bit rough |  |
|  |  |  |
| **C** | There **is** movement |  |
|  |  |  |
| **D** | There is **no** movement |  |
|  |  |  |
| **E** | There is no force to slow the movement |  |

*Physics > Big idea PFM: Forces and motion > Topic PFM1: Forces > Key concept PFM1.4: Friction*

|  |
| --- |
| **Diagnostic question** |
| **No friction** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Friction is a force generated by an interaction between two surfaces, and which acts to resist movement between them. |
| Observable learning outcome: | * Explain how friction, generated *by* the interaction between two objects, can stop them from moving. |
| Question type: | Diagnostic, two-tier multiple choice |
| Key words: | Friction, force |

**What does the research say?**

Friction is the force generated *by* an interaction between two objects. This is different to most forces which *cause* the interaction (Hart, 2002). This perhaps led to the finding from a study of thirty-eight 12-16 year olds, that fewer than half of students identify friction as a force (Stead and Osborne, 1980).

A later study of forty-seven secondary students, by Stead and Osborne (1981), showed that some students think that:

* friction depends on movement (seventeen students)
* friction only happens between solids (twelve students)
* friction is the same thing as reaction (nine students)

In Stead and Osborne’s 1980 study they found that half of 13-year old students also thought of friction as rubbing. But friction is also acting between objects that are not moving. Text books for 11-14 year old students often talk about shoes or tyres having a good grip. The implication is that the shoe or tyre ‘has a lot of friction’, which It does not. Rather it is good at *generating* friction when it is pushed along a surface, and often the friction it generates *prevents* it from moving.

In a study of 32 Canadian students aged 6 – 14, Erikson and Hobbs (1978) found that when thinking about two forces acting on the same object, students appeared to think of the forces as being engaged in a struggle, with the bigger force dominating the smaller one. This may lead some students to think that friction disappears when an object starts moving.

This question identifies those students who maintain any of these common misunderstandings about friction, and whether students understand that friction is a reaction force that is generated *by* an interaction between two objects.

**Ways to use this question**

Students should complete the questions 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 follow on question will give you insights into how they are thinking and highlight specific misunderstandings that some may hold.

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) B, b) A

**How to respond - what next?**

Box 1 is the only one with no friction because there is no external force ‘trying’ to slide it across the surface. Friction is generated *by* the action of such an external force – which in the other examples is gravity.

Students who select answer a) A, are likely to be thinking of friction as a property of the surfaces: whether it would be easy to slide the box or not. They are not thinking about friction as a force that is pushing (against movement or attempted movement). This is largely confirmed by answer b) B.

Answer a) C, b) D show that students are associating friction with rubbing that is caused by movement.

Answers a) D, b) C or a) D, b) E suggest that students are picturing friction as a ‘grip’ that acts like glue and is either sticking or not.

Answer a) E, b) E also suggests that students may be picturing friction as acting like glue, but that they are also trying to combine this thinking with the scientific explanation. The accelerating box might indicate to them that this is the point at which friction has ‘lost control’ completely.

If students have misunderstandings about how friction is generated by the interaction between two objects then it may help to give students the opportunity to apply the scientific explanation to a new situation. Discussing this in pairs or small groups would encourage social construction of new ideas through dialogue. The following BEST ‘response activity’ could be used in follow-up to this diagnostic question:

* Response activity: Shoe slope

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG), developed from EPSE activity F3-05.

Images: UYSEG

**References**

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