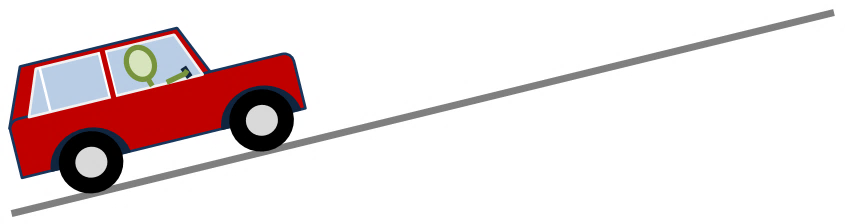
**Push up**

Albert pushes his toy car to the top of a hill.

Which energy transfer diagram best shows what happens?

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

|  |  |  |
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|  | Screen Clipping |  |
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*Physics > Big idea PFM: Forces and motion > Topic PFM1: Forces > Key concept PFM1.5: Energy stores and transfers*

|  |
| --- |
| **Diagnostic question** |
| **Push up** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | When a force makes things change it mechanically transfers energy between different energy stores.  Friction transfers energy mechanically into a heat store of energy. |
| Observable learning outcome: | * Explain how energy is almost always transferred to the heat store of the surroundings |
| Question type: | Diagnostic, simple multiple choice |
| Key words: | Energy store, energy transfer, mechanically, friction, heating |

**What does the research say?**

In teaching energy the BEST resources have adopted a framework based on ‘energy stores’ and ‘energy pathways’ which is advocated by, amongst others, (Boohan, 2014), (Millar, 2014) and (Tracy, 2014). As Millar (2014) says, this approach “is not perfect - but it is adequate and significantly better than [approaches] based on lists of ‘forms of energy’.” A clear guide to this approach can be found on the Institute of Physics’ website (Institute of Physics).

This question focuses on fully and accurately describing how energy is transferred. When explaining how energy is transferred, Tracy (2014) recommends that we focus on describing the processes and mechanisms involved. He suggests that trying to identify the ‘energy’ in each step is just a labelling exercise that can get in the way of a clear understanding of what is happening.

Describing how friction and drag cause heating introduces students to the dissipation of energy. Millar (2005) suggests that to make sense of the *law of conservation of energy*, students need to know that in almost every event there is some heating, whether desired or not, and a consequential increase in the heat store of the surroundings.

A summary of the BEST approach to teaching energy can be found on the Best Evidence Science Teaching home page which is on the STEM Learning website (Fairhurst, 2018).

**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**

C is the correct answer

**How to respond - what next?**

Answer A does not include heating of the road. The road will flex a little as the car runs over it causing it to heat by [internal] friction. Students may miss this as the effect is neither visible nor obvious.

In answer B the road does not heat up by bashing into air particles. Students may choose this answer because the air and road as the *surroundings* are grouped together in only this answer. Choosing this answer indicates that students are not thinking methodically through the mechanisms and processes of the energy transfers.

Answer D has no reference to the air heating up. The heating of the air is neither visible nor obvious. Students may not think there is friction between a solid and a gas and imagine the object slips between the particles. Waving a hand in the air is enough to notice that this is not the case.

If students have difficulty identifying all the energy transfers accurately, it can be helpful to discuss more fully the processes and mechanisms of the different ways energy is transferred in these examples. Giving students further examples to discuss in pairs or in small groups can consolidate ideas about energy transfers through dialogue.

The following BEST ‘response activities’ could be used in follow-up to this diagnostic question:

* Response activity: Energy transfers circus
* Response activity: Steady speed

**Acknowledgments**

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Images: UYSEG

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