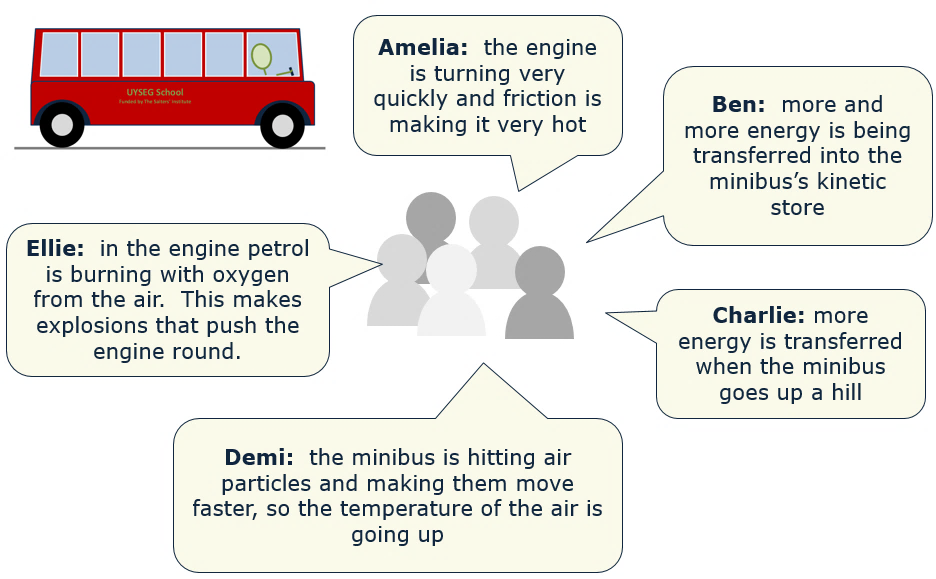
**Steady speed**

UYSEG school has a new minibus. It has cruise control that can keep it at a steady speed.

Some students are thinking about what happens at a steady speed.



**To answer**

1. Who do you think is right about how energy is transferred?

*Explain your answer*

1. What mistake do you think the other student(s) made?

*What would you say to them to help them to understand?*

|  |  |
| --- | --- |
| Steady Speed  Student statements | **Amelia:** the engine is turning very quickly and friction is making it very hot. |
| **Ben:** more and more energy is being transferred into the minibus’s kinetic store. | **Charlie:** more energy is transferred when the minibus goes up a hill. |
| **Demi:** the minibus is hitting air particles and making them move faster, so the temperature of the air is going up. | **Ellie:** in the engine petrol is burning with oxygen from the air. This makes explosions that push the engine round. |

|  |  |
| --- | --- |
| Steady Speed  Student statements | **Amelia:** the engine is turning very quickly and friction is making it very hot. |
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| **Demi:** the minibus is hitting air particles and making them move faster, so the temperature of the air is going up. | **Ellie:** in the engine petrol is burning with oxygen from the air. This makes explosions that push the engine round. |

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

|  |
| --- |
| **Response activity** |
| **Steady speed** |

**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 |
| Activity type: | Response, talking heads |
| Key words: | Energy store, energy transfer, mechanically, friction, heating |

This activity can help develop students’ understanding by addressing the sticking-points revealed by the following diagnostic questions:

* Diagnostic question: Falling apple
* Diagnostic question: Push up

**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 activity**

Students should complete this activity in pairs or small groups, and the focus should be on the discussions. The statements are also provided as cut-out cards for students to physically organise.

Students should work together to follow the instructions on either the worksheet or the PowerPoint. Giving each group one worksheet to complete between them is helpful for encouraging discussion, but each member should be able to report back to the class. Listening in to the conversations of each group will often give you insights into how your students are thinking.

If there is disagreement when you take feedback, a good way to progress might be 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*

The quality of the discussions can be improved with a careful selection of groups; or by allocating specific roles to students in the each group. For example, you may choose to select a student with strong prior knowledge as a scribe, and forbid them from contributing any of their own answers. They may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

**Expected answers**

Ben is not correct, but all the others are.

The chemical store of energy that the minibus uses is in the petrol *and* in the oxygen. Friction in the engine transfers energy mechanically, and then by heating. The minibus also hits air particles, making them move faster heating the air – and itself.

As the bus goes uphill, keeping the same speed, it transfers the same energy as before, plus extra energy to its gravitational store.

Because the minibus is travelling at a steady speed, its kinetic store remains constant. All of the energy transferred from the engine is being dissipated to the surroundings.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: UYSEG

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