**Hot fill**

Lots of people mix up ideas about temperature and energy.

*Fill in the gaps to complete each sentence.*

*You should only use the words* ***energy*** *and* ***temperature***

**Energy or temperature?**

1. \_\_\_\_\_\_\_\_\_\_ is a measure of how hot or cold something is.
2. A thermometer measures \_\_\_\_\_\_\_\_\_\_.
3. A candle flame has a bigger \_\_\_\_\_\_\_\_\_\_ than a bath of lukewarm water.
4. A bath of lukewarm water has a bigger \_\_\_\_\_\_\_\_\_\_ than a white hot spark.
5. A cup of boiling water has the same \_\_\_\_\_\_\_\_\_\_ as a kettle full of boiling water.
6. Adding water at 40oC to a cup of water at 40oC increases its \_\_\_\_\_\_\_.

*Physics > Big idea PMA: Matter > Topic PMA1: Heating and cooling > Key concept PMA1.4: Thermal store of energy*

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| **Diagnostic question** |
| **Hot fill** |

**Overview**

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| Learning focus: | Each different material will have more energy in its thermal store if either its temperature or mass is increased |
| Observable learning outcome: | Explain the difference between energy (in a thermal store) and temperature |
| Question type: | Focused cloze |
| Key words: | Thermal store of energy, temperature |

**What does the research say?**

Most students correctly understand that raising the temperature of a particular object also increases the energy in its thermal store. However, fewer than half of 11- to 14-year-olds understand that, when they are at the same temperature, a larger mass of a material contains more energy in its thermal store than a smaller mass of the same material. It is common for students to think that an object at a higher temperature has more energy in its thermal store than an object at a lower temperature, even when the hotter object has a much smaller mass. (Gonen and Kocakaya, 2010)

It has been found that about a quarter of students aged 10-16 do not distinguish between temperature and energy in a thermal store. They often have the misunderstanding that temperature is a means of measuring energy in a thermal store. (Driver et al., 1994; Tiberghien, 1983)

This question investigates students’ understanding of the terms energy and temperature.

**Ways to use this question**

Students should complete the activity individually as a pencil and paper exercise. The large text on the worksheet allows it to be copied A5 size, which fits a standard exercise book.

How students fill in the gaps will show you whether they 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 sentences 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. **Temperature** is a measure of how hot or cold something is.
2. A thermometer measures **temperature**.
3. A candle flame has a bigger **temperature** than a bath of lukewarm water.
4. A bath of lukewarm water has a bigger **energy** than a white hot spark.
5. A cup of boiling water has the same **temperature** as a kettle full of boiling water.
6. Adding water at 40oC to a cup of water at 40oC increases its **energy**.

**How to respond - what next?**

The first two answers are facts that students need to learn.

A lukewarm bath has more energy than the candle flame or the white hot spark because it has so much more mass than either.

In Q5 the cup and kettle contain water at the same temperature, but the kettle contains more water and has more energy in its thermal store.

Q6 has more energy because there is now more mass, although temperature is still 40oC.

It is common for students to answer questions 4, 5 and 6 wrongly, and this is likely to be because they are thinking of temperature as a measure of energy.

If students have misunderstandings about how to explain the differences between energy and temperature, it can help to use a model to demonstrate it. The following BEST ‘response activity’ could be used to do this, in follow-up to this diagnostic question:

* Response activity: Energy v temperature

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

**References**

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