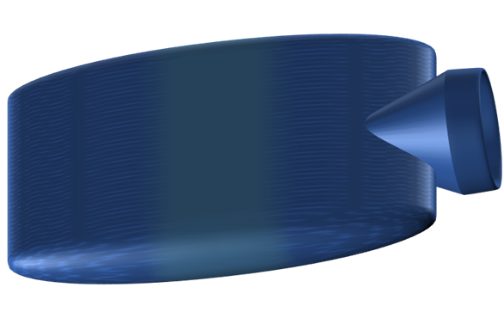
**Hot water bottle**

Bed warming bricks are heated in an oven.

Hot water bottles are filled with hot water.



Bed-warming brick

Hot water bottle

A bed-warming brick is heated to 90oC and placed in a bed.

A hot water bottle is filled with water at 90oC and is also put in a bed.

They both have about the same mass.

The specific heat capacity of water is 4200 J/kg/oC

The specific heat capacity of the brick is 900 J/kg/oC

*To do:*

*Fill in the gaps to describe how the hot water bottle compares to the bed-warming brick.*

*You should only use the words* ***more*** *or* ***less*** *or* ***the same amount of***

**Compared to the bed-warming brick:**

* the water starts off with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy in its thermal store.
* as they cool to 60oC, the water transfers \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy to the thermal store of its surroundings.
* the hot water bottle stays hot for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ time.
* through a full night the hot water bottle transfers \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_ energy to the thermal store of its surroundings.

*Physics > Big idea PMA: Matter> Topic PMA3: Energy of moving particles > Key concept PMA3.2: Specific heat capacity*

|  |
| --- |
| **Response activity** |
| **Hot water bottle** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Specific heat capacity is the amount of energy added to the thermal store of a material in order to increase the temperature of 1kg of that material by 1oC. |
| Observable learning outcome: | Explain why a material’s specific heat capacity affects the rate at which its temperature will change as its thermal store gains or loses energy. |
| Question type: | Focused cloze |
| Key words: | Energy, temperature, mass, specific heat capacity, thermal store |

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

* Diagnostic question: Hot drinks
* Diagnostic question: Bed warmers

**What does the research say?**

Herrington (2011) suggests the traditional method of teaching specific heat capacity, which involves learning the related definitions and equations and using equations to determine the specific heat capacity in a laboratory setting contributes to confusion about specific heat capacity. Although students are often able to calculate values with the equation, they often do not often understand what specific heat capacity tells us about a material. Instead it can be more effective to introduce students to the concept of heat capacity and to guide them to make connections to their own personal experiences before introducing definitions and equations.

One way to think about specific heat capacity is as a measure of how hard it is to change the temperature of a material. For two objects of the same mass, the one with the bigger specific heat capacity will be harder to warm up as it requires more energy to increase its temperature by 1oC. The same object will also be more resistant to cooling down, as it needs to transfer more energy to its surroundings in order to reduce its temperature by 1oC. Adadan and Yavuzkaya (2018) found that 35% of 13- to 16-year-olds (n=518) had the misunderstanding that objects that warm up readily retain their temperature better than objects that are harder to heat up.

**Ways to use this question**

Students should complete the activity in pairs or in small groups 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 group to explain why they gave the answer they did; ask another group 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 pairs or groups.

**Expected answers**

**Compared to the bed-warming brick:**

* the water starts off with **more** energy in its thermal store.
* as they cool to 60oC, the water transfers **more** energy to the thermal store of its surroundings.
* the hot water bottle stays hot for **more** time.
* through a full night the hot water bottle transfers **more** energy to the thermal store of its surroundings.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Peter Fairhurst (UYSEG).

**References**

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Herrington, D. G. (2011). The heat is on: an inquiry-based investigation for specific heat. *Journal of Chemical Education,* 88(11)**,** 1558-1561.