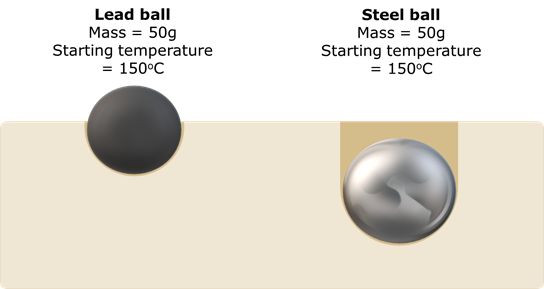
**Specific heat capacity**

Two metal balls are heated to 150oC in an oven.

The mass of each ball is the same.

The balls are put on top of a block of wax.

The metal balls melt the wax.

This is what happens.

Read each statement about the metal balls.

What do you think about each one?

For each statement, tick (✓) **one** column to show what you think*.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Statement | | I am **sure** this is right | I think this is right | I think this is wrong | I am **sure** this is wrong |
| **A** | The lead ball starts with the same amount of energy in its thermal store as the steel ball. |  |  |  |  |
| **B** | The steel ball starts with more temperature than the lead ball. |  |  |  |  |
| **C** | The steel ball starts with more energy in its thermal store than the lead ball. |  |  |  |  |
| **D** | The amount of energy in the thermal store of a 50g ball at 150oC depends on what it is made of. |  |  |  |  |

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

|  |
| --- |
| **Diagnostic question** |
| **Specific heat capacity** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Each different material will have more energy in its thermal store if either its temperature or mass is increased |
| Observable learning outcome: | Describe how the specific heat capacity of a material affects the amount of energy in its thermal store |
| Question type: | Confidence grid |
| Key words: | Thermal store of energy, temperature, specific heat capacity |

**What does the research say?**

Apart from mass and temperature, the other factor that affects the amount of energy in the thermal store of a material is the specific heat capacity of the material. It is common for students to experience specific heat capacity, c, for the first time as the constant in the equation E=mcΔT (which they often learn in their later studies at age 14-16). Although they are often able to calculate values with this equation, students do not often understand what specific heat capacity tells us about a material. Using an investigative approach has been shown to help develop a clearer understanding of specific heat capacity. (Herrington, 2011)

**Ways to use this question**

Students should complete the confidence grid 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.

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**

Statements A and B are wrong.

Statements C and D are correct.

**How to respond - what next?**

Energy in the thermal store of each ball is transferred by heating to the wax. The steel ball melts more wax and therefore must have transferred more energy as it cooled to room temperature. This shows that, like for like, steel stores more energy in its thermal store than lead. This leads to answers for statements A and C.

The question states that both balls have a temperature of 150oC, but in studies, as many as a third of students have been found to think that temperature flows from one object to another (Chu et al., 2012). Answers to statement B reveal which students hold this misunderstanding.

Statement D expresses what has been shown in this example in general terms. Because the temperature and the mass have been kept constant, the material is the only remaining variable that can affect the results.

Each material has a value called the specific heat capacity which can be used to calculate the energy needed to increase the temperature of different materials, or released as they cool.

A few students will notice that the steel ball is slightly larger. This is because steel is less dense than lead. Its extra size means that it has melted even more wax in comparison to the lead ball than the depths indicate.

If students have misunderstandings about how the material from which an object is made can affect the amount of energy in its thermal store, it can help if students carry out an investigation to experience the effects for themselves. The following BEST ‘response activity’ is one example of this and could be used in follow-up to this diagnostic question:

* Response activity: Hot metal

**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.