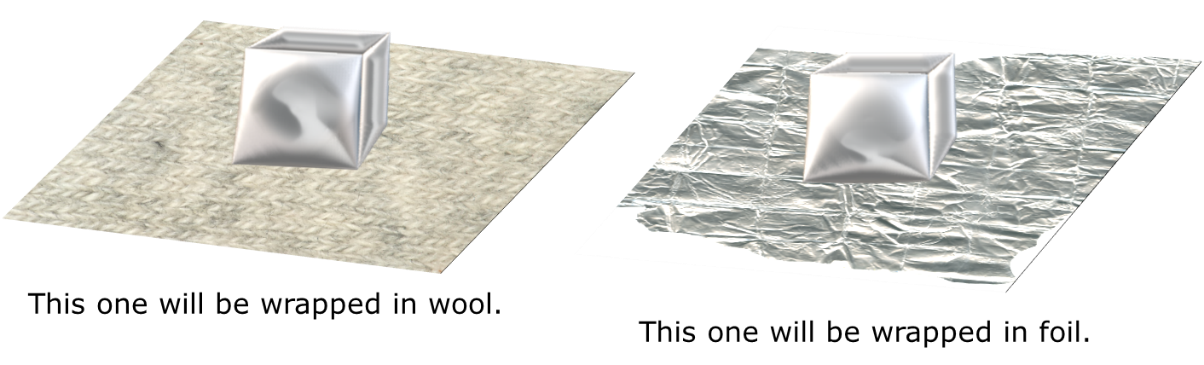
**Ice melt**

Can we change how long it takes for an ice-cube to melt?

What do you think happens if we wrap up an ice cube?



**1.** Which ice cube will melt first?

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

|  |  |  |
| --- | --- | --- |
| **A** | Ice wrapped in foil |  |
|  |  |  |
| **B** | Ice wrapped in wool |  |
|  |  |  |
| **C** | No difference |  |

**2.** Why do you think this will happen?

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

|  |  |  |
| --- | --- | --- |
| **A** | Wool has more energy than the foil |  |
|  |  |  |
| **B** | Insulators warm things up |  |
|  |  |  |
| **C** | Foil heats and cools quickly |  |
|  |  |  |
| **D** | Foil is a good thermal conductor |  |

*Physics > Big idea PMA: Matter > Topic PMA1: Heating and cooling > Key concept PMA1.3: Thermal conduction*

|  |
| --- |
| **Diagnostic question** |
| **Ice melt** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Heating makes the particles in a material move more quickly. Heating raises the temperature quickly throughout a good thermal conductor, and very slowly through a good thermal insulator. |
| Observable learning outcome: | Explain how insulators can be used to slow down heating and cooling |
| Question type: | Two-tier multiple choice |
| Key words: | Conductor, insulator, melt |

**What does the research say?**

In a study Chu et al. (2012) found that more than a quarter of 14- to 16-year olds (n=344) thought that materials like wool have the ability to warm things up. Measuring the time for an ice-cube to melt when it is wrapped in wool compared to another ice-cube wrapped in aluminium foil challenges this misunderstanding. An account of why the ice-cube wrapped in foil melts first needs to be explained in terms of how a conducting material transfers energy by heating more quickly than an insulator. The scientific approach is to consider the system, to identify where the temperature is higher and to consider how the energy can be transferred by heating to where the temperature is smaller. (Erickson and Tiberghien, 1985)

**Ways to use this question**

Students should complete the questions 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 follow on question will give you insights into how they are thinking and highlight specific misconceptions that some may hold.

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.

**Equipment**

For the class (optional):

* Two ice cubes
* Aluminium foil
* Woollen square

**Expected answers**

1. A (Ice wrapped in foil)

2. D (Foil is a good thermal conductor)

**How to respond - what next?**

Most wrong answers to Q1 are likely to be B. This answer suggests students probably think that wool has a warming effect. Students may think this because they feel warmer when they put on a coat, which stops energy in the body’s thermal store escaping. In the question, the outside has a higher temperature than the ice, which means the wool slows how quickly energy can reach the ice from the thermal store of the surroundings. Answer 2B can confirm this misunderstanding.

A few students may think that wool is at a higher temperature than the foil because it feels warmer to touch. These students may choose answer 2A. A thermometer can be wrapped in each material to confirm this is not true.

If students have misunderstandings about how insulators can be used to slow down heating and cooling, the insulating cans practical can be carried out to produce results that challenge them.

The investigation can be carried out filling cans with hot water to measure how quickly they cool. One can be wrapped in foil and compared to another wrapped in wool. Other cans could be filled with iced water to measure how quickly their temperature increases. The temperature difference for the latter is smaller and the rate of change of temperature will be slower and differences in temperature will be harder to notice.

You may choose to set up the investigation with iced water as a demonstration, using data loggers to measure the temperature changes over a lesson, whilst students carry out the investigation using hot water.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG), from an idea in Chu et al. (2012).

Images: Peter Fairhurst (UYSEG).

**References**

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Erickson, G. and Tiberghien, A. (1985). Heat and Temperature. In Driver, R., Guesne, E. & Tiberghien, A. (eds.) *Children's Ideas In Science.* Milton Keynes and Philadelphia: Open University Press.