

Experiment: Cups and clothes

Central concepts:

- Thermal properties of materials and objects
- Heat conduction
- Heat insulation



Purpose of the experiment

The experiments are designed in order to introduce thermal properties of different materials and objects, whether they are good heat conductors or insulators.

Expected outcome

Young students may predict that the ceramic cup will get warmer than a plastic cup, by vague association with its function to deal with warm beverages. Similarly, they may think that outdoor clothes may be warmer on the outside than thin clothes, since they are good at keeping us warm. In the case of the cups, the thin plastic cup immediately adopts the temperature of the hot water, whereas it takes longer for the ceramic mug to heat up and it does not reach as high temperature as the plastic cup. After some minutes, however, the students experience that the water of the plastic cup cools down quicker than that in the ceramic mug. They typically explain this in terms of the ceramic mug insulating or holding the heat. Similarly, students can be expected to be able to explain that outdoor clothes are good thermal insulators.

Relevant age groups

The exercise may be used as part of the introduction of thermal properties of different materials, whether they are heat conductors or heat insulators. For instance, in the Swedish year 4-6 physics curriculum, "Energy flows between objects with different temperatures. How the flow of energy can be affected by such means as clothes, thermos and house insulation", is listed as a core content. At higher age levels, students may be encouraged to provide microscopic explanations of the mechanisms of heat conduction and heat convection due to molecular interactions.

Added value of IR cameras

In comparison to traditional liquid or digital thermometers, IR cameras detect the temperatures of solid and liquid surfaces. In the case of the cups, participants can see that the temperature of the water surface may differ from that of the outside of the cups. The temperature of the water surface can be decreased further by blowing on it, just like they do in order to cool down hot beverages or soup. The IR camera may also detect the difference in temperature on the inside and outside of the clothes they wear.

Tips and tricks

If many groups do the exercises, it might be good to have parallel sets of ceramic mugs, since they get warmed up in the handling.