



47. Making ice

Time

This is best suited to an extended study.

Curriculum links

Melting points and boiling points.

Groupsize

1–3.

Materials and equipment

Materials per group

- ▼ deionised water.

Equipment per group

- ▼ 100 and 250 cm³ beakers
- ▼ insulating material
- ▼ –5 to +100°C thermometers
- ▼ access to a refrigerator and freezer
- ▼ safety glasses.

Safety

Eye protection must be worn.

Risk assessment

A risk assessment must be carried out for this activity.

Commentary

Students will find that hot water freezes more quickly than cold water – more precisely, water freezes more slowly if the initial temperature is below room temperature. The explanation is not entirely clear, but may be because a hot liquid has a 'hot top' of mobile molecules with high kinetic energy. These molecules can escape from the liquid phase more easily than colder molecules with lower kinetic energy in a cooler liquid. The rapid cooling of the hot liquid is due to the evaporation from this 'hot top'.

This activity is based on an article that appeared in *Physics Education*. Erasto Mpemba was a student at Magamba Secondary School in Tanzania and he discovered the phenomenon while making ice cream. One day in order to be sure of space in the refrigerator Mpemba put his ice cream mixture into the fridge without letting it cool first. At the same time one of his friends, who had let his mixture cool, also put his mixture into the fridge. To everyone's surprise Mpemba's ice cream froze first after about 1 h, while his friend's remained liquid for longer.



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Francis Bacon¹ reported in 1620 that 'Water slightly warm is more easily frozen than quite cold', and some people may have come across the folklore 'never pour hot water down a frozen drain because the water will only freeze faster'.

The problem may challenge the perception of scientific 'facts'.

Reference

1. F. Bacon, *Novum Organian*, 1620.

Acknowledgement

This idea is based upon an article by Martin Sherwood.



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- ▼ Which makes ice faster, hot or cold water?