

Verifying the Mpemba effect

～Temperature inversion below freezing～

Kobe High School 1st grade 9th class

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[Motive]

The “Mpemba effect” is a physics phenomenon that insists that under certain circumstances, hot water freezes faster than cold water.

We wanted to tackle a challenge that is still not understood by many great researchers in the history of science, and decided to study the Mpemba effect.

[Preliminary experiment]

[Purpose]

We tried to **make the Mpemba effect happen** as a preliminary step to elucidating the mechanism.
.[The laboratory equipment, the operating procedure]
freezerA(-15℃) freezerB. (-80℃), demineralized water, water heater, rag, infrared thermometer, liquid thermometer, stopwatch, beaker, measuring flask, Komagome pipette. (※The freezerA cools **slowly** / The freezerB cools **rapidly**)(※This time we used demineralized water as an alternative for pure water.)

- 1.Warm the desalinated water with the water heater.
- 2.Add demineralized water to two beakers and adjust the temperature.
- 3.Put two beakers in the freezer.
- 4.Measure temperature with a thermometer every 5 minutes.
- 5.Stop cooling when water freezes.

[Result]

The Mpemba effect did not happen.

[Consideration]

It was difficult to solve the mechanism of the Mpemba effect in terms of time.In this experiment, the emphasis is on generating the Mpemba effect.

[Main experiment]

[Purpose]

Generate the Mpemba effect based on issues in the

preliminary experiments.

[The laboratory equipment, the operating procedure]

(※only changes from the preliminary experiment are desclibed.)We used **Easy Sense** for accurate and continuous measurement.→**The result is visualized on the graph.**We used the freezerB **to prioritize increasing the amount of data.**

[Result]

※The horizonatal and vertical axes show two types of water temperature.

℃	10	20	30	40	50	60	70	80
10		×	●	●	▲	●	×	▲
20			●	×	●	▲	▲	×
30				●	●	●	▲	▲
40					▲	×	●	●
50						×	▲	▲
60							●	▲
70								▲

●→The Mpemba effect happened,

●→Temperature inversion below freezing

▲→Measurement failed due to equipment malfunction, ×→No response

[Consideration•Conclusion]

From the results of the main experiment and preliminary experiment, it was found that when two amounts of water within 30 degrees difference of each other were strongly cooled, **the temperature inversion phenomenon occurred with a high probablity under the freezing point** due to supercooling . The main experiment could be done for less than a month.We focused on what temperature caused the phonomenon, so we could not pursue **reproducibility**.It is necessary to increase the number of experiments to increase the reliability of the result considering the date and the missing part.

[References]

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