



## Keeping an Open Mind

My first blog on this site challenged the generally accepted notion that DNA is a double helix. Indirectly it asked why do we take some hypotheses seriously but reject others. Science is not usually about absolute truth it's more about the weight of evidence. Hence as we update our knowledge, our theories and hypotheses change.

We often dismiss ideas which seem unnatural and accept what is written in the text book or taught to us. I remember being puzzled as a student; when I was trying to measure the freezing point depression of solutions, the solutions cooled below the supposed freezing point, sometimes by as much as 10 °C, and the temperature at which the solution actually froze varied from experiment to experiment. None of my teachers offered an explanation and I did not pursue the issue. I was happy to accept what I was taught, that the "freezing point" was the temperature to which the solution equilibrated *after* freezing. Yet I had clearly seen that the solutions froze at a different temperature. I now know, and we teach this on the BioUpdate Freeze Drying course, that the freezing of water is a probability event and the temperature at which a sample of water actually does freeze is variable. Probability means that systems can fall out of equilibrium; the laws of physics and chemistry, which we are taught, generally apply only to systems in equilibrium. Thus the comforting notion that things will always happen the same way, every time we do an experiment, may not always reflect what we see.

Perhaps persistence plays a role, if you believe in something you should not give up. The Mpemba Effect is a good example. A 13 year old Tanzanian schoolboy, Erasto Mpemba noticed that, when making ice cream, hot mixes sometimes froze before cool mixes. His teachers were not interested, and when he tried to pursue the matter he was ridiculed. But he did not give up [see Physics Education, 1969 (May, Vol 4) pp 172-175]. The Mpemba effect is not entirely reproducible, and it is better to say that warm water *sometimes* freeze in a shorter time. Difficult to reproduce events are often difficult to believe especially when they seem unnatural. Yet despite being irreproducible, and seemingly impossible, Mpemba's observation has been taken seriously. Recently the Royal Society of Chemistry awarded a £1000 prize for the "best and most creative" explanation (see <http://www.rsc.org/mpemba-competition>).

Quite why Mpemba's apparently illogical observation was eventually taken seriously, I do not know. Searching for Erasto Mpemba on Google Scholar suggests he has not been a prolific author. For some reason enough people have kept an open mind and have not dismissed an apparently irrational observation. I am not sure that this always happens. It is always worth keeping your knowledge up to date, I did after all eventually come to understand my student lab observation. Above all be objective; keep an open mind and neither dismiss nor forget things simply because you can't explain them, or they do not fit your current understanding.

**Tony Auffret**  
**January 2013**