Hot or not?

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Dad likes what he calls ‘hot’ showers. I like what I call warm showers. Bangkok has just had five hot summer weeks. The tap water in the house is 32 ºC. That is the temperature I like my shower.

Tap water - 32ºC.

I had to have a hotter shower (for science). Do this he said: “*Stand up close to the shower-head with the water on your face: stand back so the water hits you in about the middle: stand right back so the water hits your feet*.” The water felt different in each place.

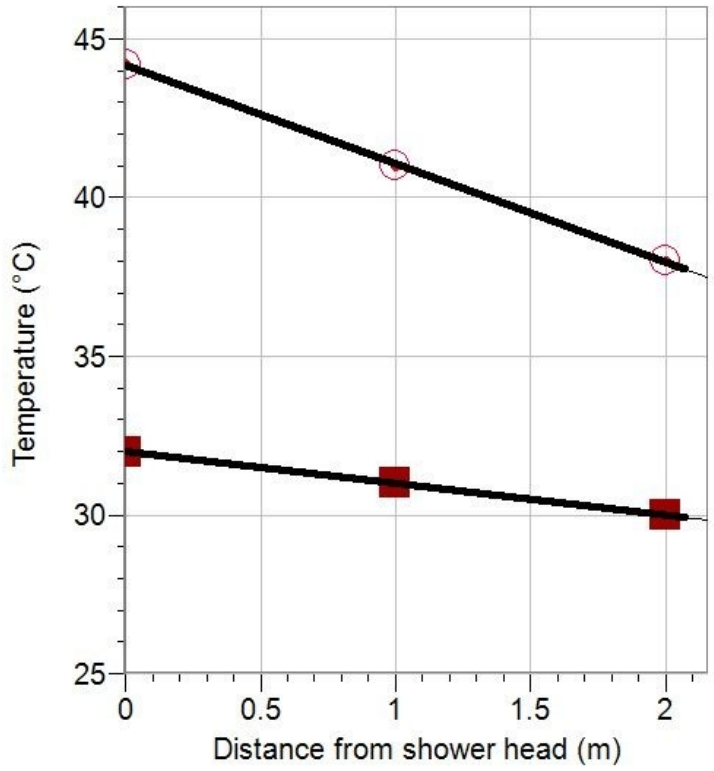
The water felt really hot up close on my face, not so hot in the middle and a bit cooler on my feet. I thought that showed my face to be more sensitive to high temperatures. I thought I was right, but I couldn't be sure, so we got a thermometer and a tripod.

1 I made the shower hot. Close to the shower-head the water was 44.0 ºC. At one metre (half way to the floor) it was 41.0 ºC. At two metres (just above the floor) it was 38.0 ºC.

> *I thought shower water was all at one temperature, but it's not. The water gets cooler towards the floor. My feeling of hotness has more to do with the water than my face.*

2 What about my normal shower at 32 ºC? *I tried that*. Up close the water temperature was 32.0 ºC. Half way to the floor it was 31.0 ºC and on the floor it was 30.0 ºC. Room temperature in the bathroom was 28.5 ºC.

The data is graphed below in Logger pro.



The line graphs are both straight. When the shower is hot the temperature drops three degrees per meter. When it's cooler the temperature drops only one degree per metre. The temperatures are less different but the same thing happens. The water cools towards the floor.

Conclusion

I thought hot shower water would be at about 60 ºC and was surprised that 44ºC is as hot as I can put up with. I was also surprised that I can easily tell the difference when the water is even half a degree cooler. I can't tell you what the temperature is, but I can tell you it's cooler.

Now I understand something that's puzzled me. I hold the shower-head in my hand and turn the water heater on and let water run on my feet to check the temperature. When I put the head back on the wall and go up close I always think the water has suddenly got hotter and have to turn the heater down. I'm not wrong. The water feels cooler on my feet.

More examples of forced cooling

I know that blowing on hot soup cools it so I asked about that. He said that the cooling in both cases is due to *forced evaporation*. A little warm water evaporates into the air flow and is carried away. As a little water changes to gas (water vapour) it takes heat from the remaining water.

The steel mug on the table was full of ice cubes. Water at 32ºC was then added from a jug. As ice melted it took heat energy from the water and the water temperature dropped. You can see that the water is now cold because water vapour from the air has condensed on the outside of the mug.

Stirring the ice/water mixture to force the ice to melt lowers the water temperature faster. I always stir my mug of water in a restaurant so I can drink cold water sooner, but I notice that no matter how much I stir, I can't get the water temperature down to zero degrees Celsius. It's cold: but never as cold as crushed ice. I wonder why? I wonder if there's a way to get it really cold and form ice on the outside of the mug?