Blowing on Soup. Yay or Nay?

by James Jang and Jiaying Wei

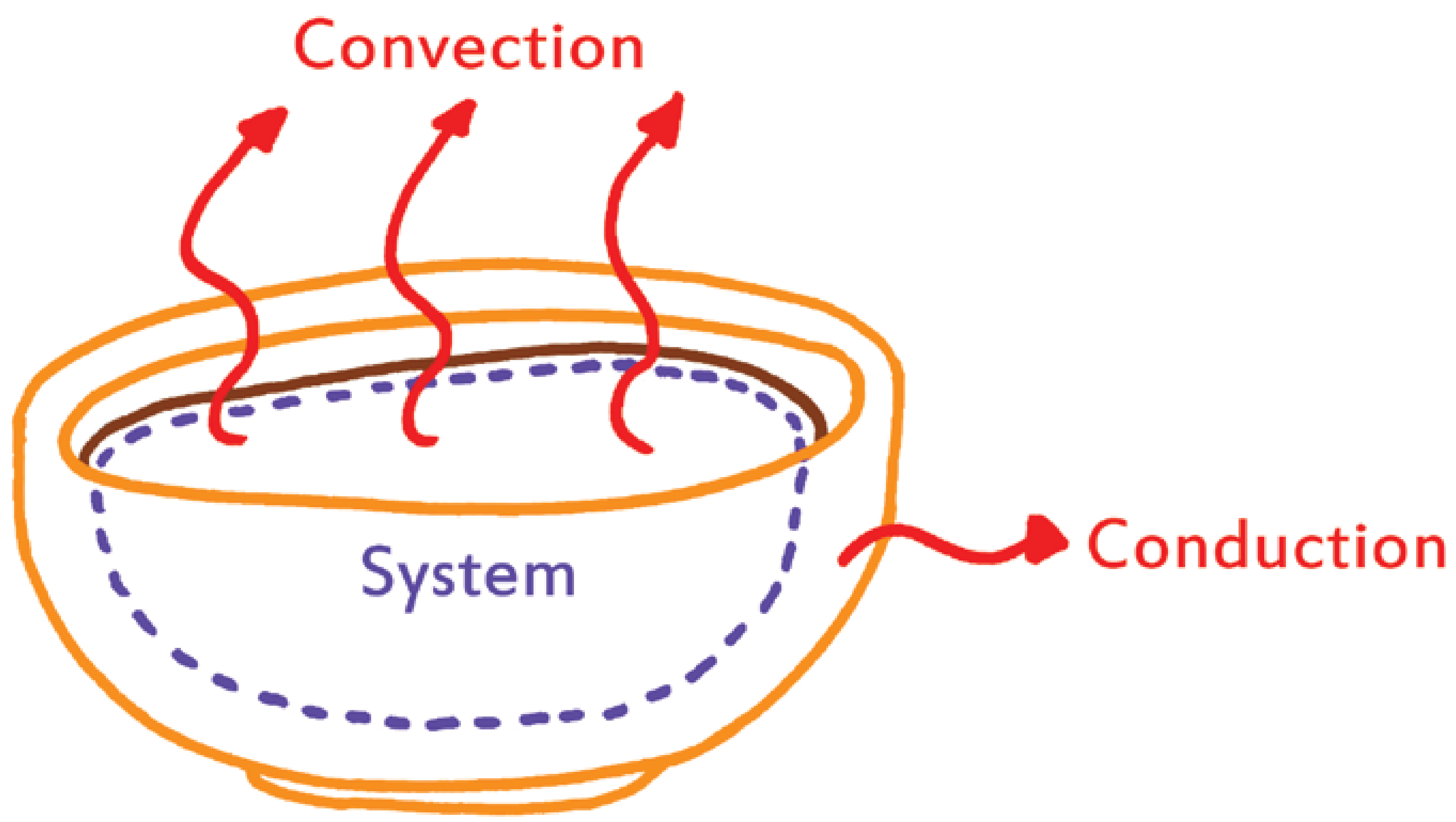
Abstract

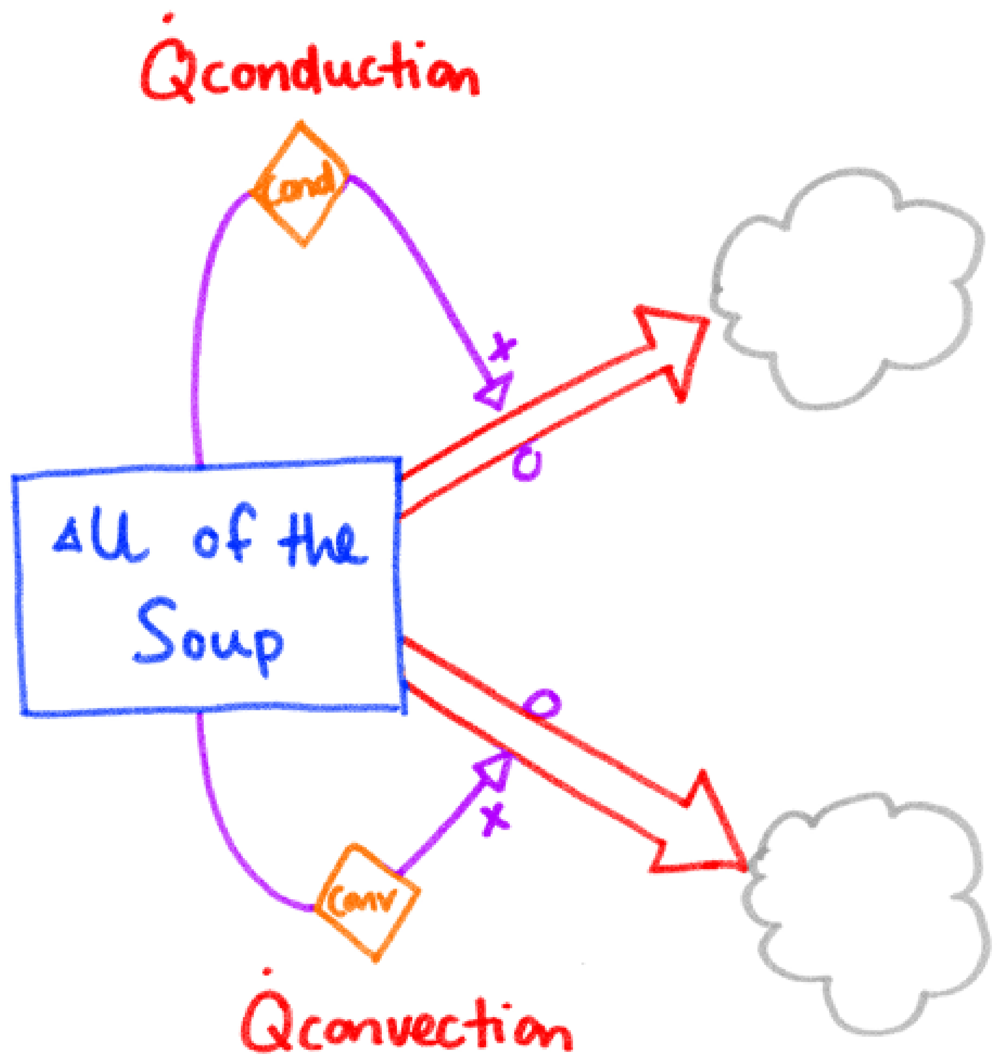
We are trying to find out if blowing on our soup is actually a viable practice. In order to do so we created a mathematical model and validated it using experimental data. What we found was that soup with water like properties will cool significantly faster with forced convection. In order to take our model further we explored the relationship between volume and time taken to cool to ideal temperature. With a bowl radius of 7cm at a depth of 60cm convection ceases to play a significant role in the cooling of the soup.

1. Why are we doing this?

For eons we have been blowing on our soup to cool it down, never questioning if huffing and puffing on our soup actually lets us enjoy our soup sooner. Well, times are changing, no longer are we willing to blindly accept the fact that blowing on our soup actually makes it cool down faster! Plus it's interesting to model a system that is actually relevant to our everyday lives. By the end of this project, people might actually make lifestyle changes in regards to their soup consumption.

2. The Model

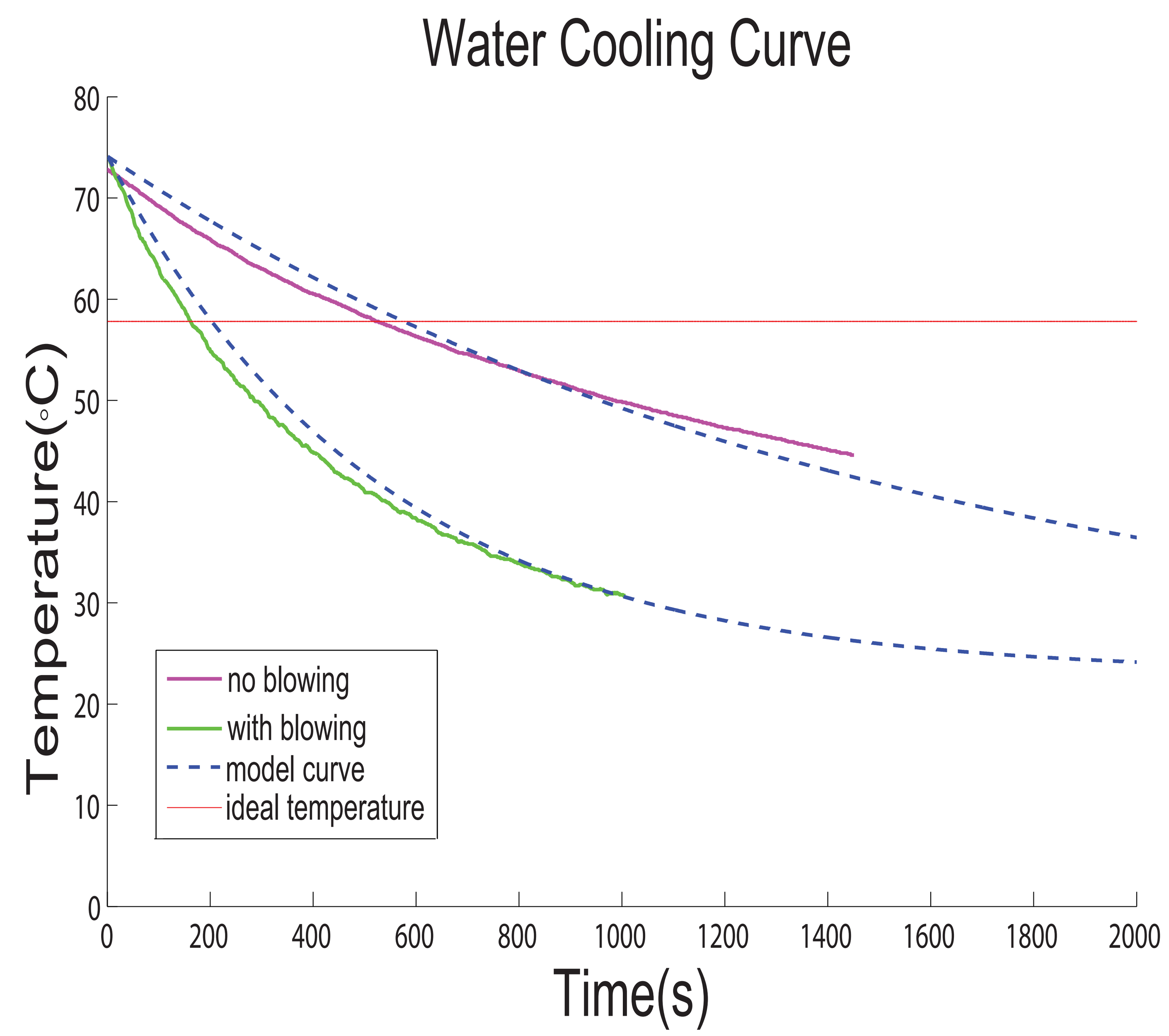




We wanted to combine modeling and experimentation in order to find the heat transfer coefficient (h) which satisfied our model. We decided to vary h because it is the constant for surface convection which is equivalent to blowing on the soup. A higher h would indicate higher forced convection. The ideal temperature for our soup is 57.8°C as found in a paper written by Brown F and Diller KR.

3. Validation and Experimentation

Since our problem was fairly simple, we decided to run experiments to validate our models with real data. Since specific heat of soup cannot be determined easily, we decided to use the specific heat of water. Properties of water are well known making it a good starting point for validation.

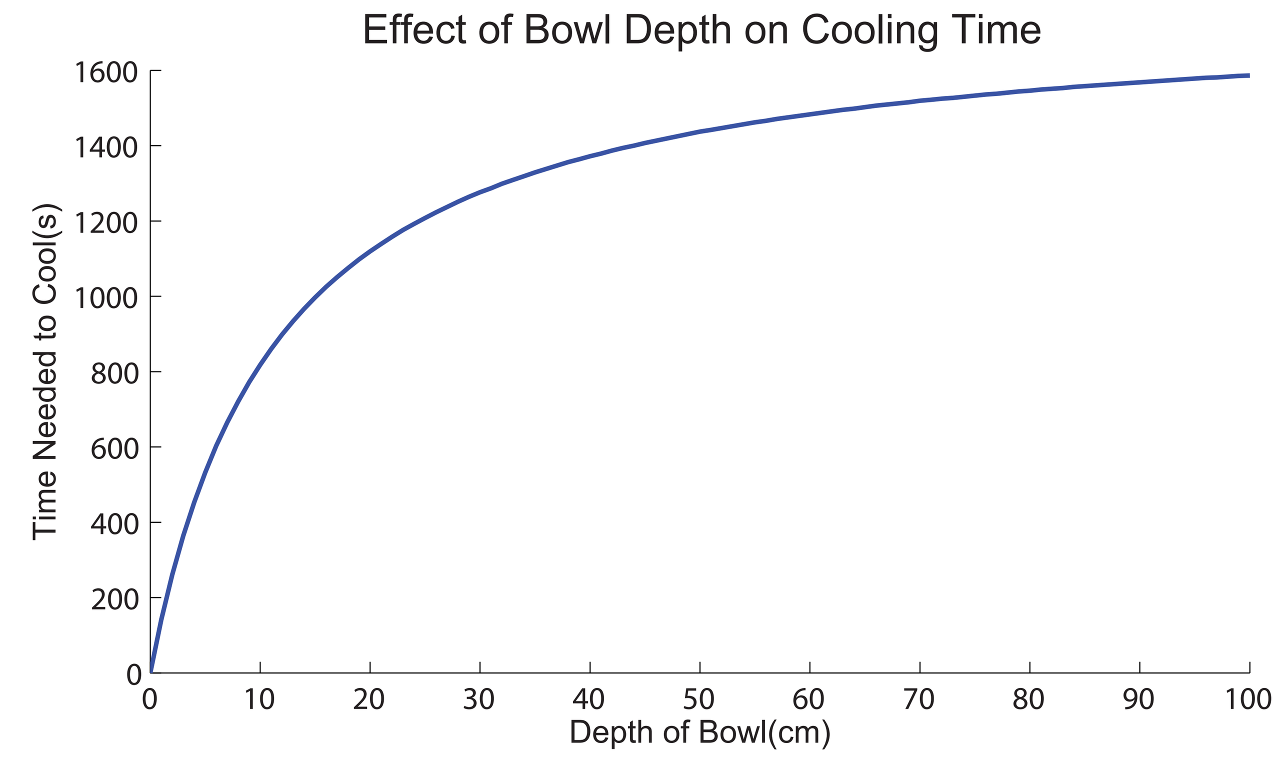


h(no blowing) = 3W/m²K t(no blowing) = 216s h(blowing) = 70W/m²K t(blowing) = 592s

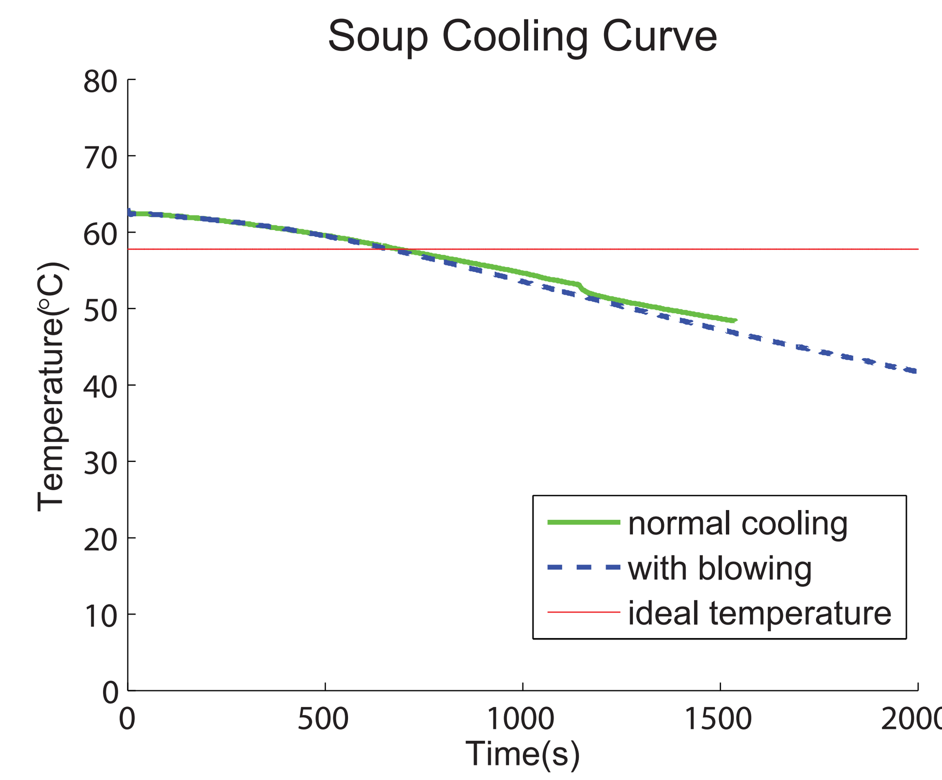
The cooling curves for water with and without blowing are pretty reasonable. If we left our water alone it would cool to 57.8°C in 8.7 minutes. With the hairdryer on it would cool to ideal soup drinking temperature in 3.6 minutes, effectively cutting our wait time down by more than a half.

4. Bowl Depth on Soup Cooling

For this bowl there should be a given depth where convection ceases to play a significant role in cooling the soup. For this particular model we kept our h value at 70 and abstracted our bowl to a cylinder of the same radius. We then plotted the depth of the bowl against the time required to cool to 57.8°C.



5. What Next?



We repeated our experiment on soup, and the data suggests that forced convection does not play a significant part in cooling our soup. Part of the reason could be that soup forms a thin layer on the surface reducing the effect of convection. The next step for our model is to explore why our experimental soup data does not match our model's curve.