

# Using Vernier Temperature Probes to do Distillations in Introductory Physical Science

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Typically, at some point in a physical science course, students collect time and temperature data for the heating or cooling of various liquids. They then follow this up with the preparation of temperature vs. time graphs. This activity allows students to, among other things, identify the “plateau”, or leveling off of the temperature curve, at the boiling point. These learning activities are a key component of the *Introductory Physical Science (IPS)* course, originally developed under a National Science Foundation grant and currently (in its 9th edition) published by Science Curriculum Inc.

Students in our 8th grade physical science course at St. Paul Academy and Summit School use laboratory activities as an integral part of their learning process. They use temperature probes from Vernier Software & Technology to help them to simultaneously collect and graph the data. Using Vernier *Logger Pro* software and temperature probes that are fitted through a typical distillation apparatus such as the one shown in Figure 1. Figure 2 shows that the temperature probe is placed high in the flask to measure the temperature of the vapor, rather than the liquid in the flask.



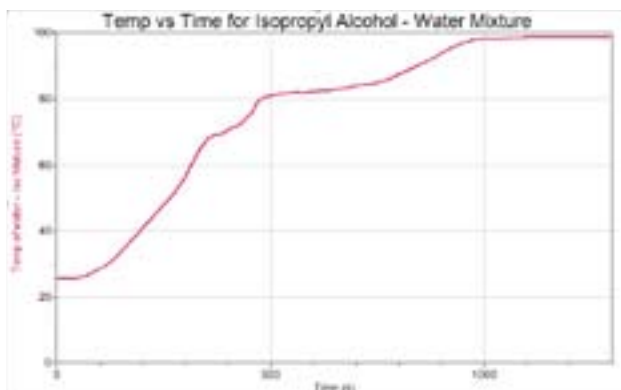
**Figure 1**  
The distillation apparatus fitted with a Vernier temperature probe.



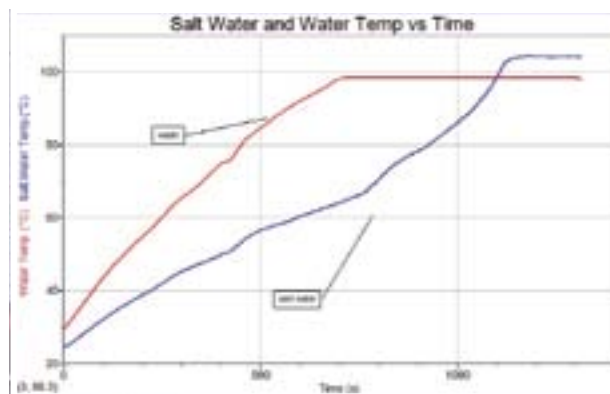
**Figure 2**  
The placement of the temperature probe in the flask.

To assemble this apparatus, one can use a two-hole #5 stopper, which will fit into a 125 ml Erlenmeyer flask. Into one of the two holes, the typical bent glass tubing/rubber hose assembly is inserted. The Vernier temperature probe is inserted into the other hole. Care must be taken to use duct tape or some other adhesive/liner so that there is a full seal in the hole through which the Vernier probe has been inserted. *Caution – if this assembly is exposed to very high heat over a long time, the adhesive/tape could melt.* Though this could be a concern, we have not found it to be an issue while doing the distillations that are typical of our science course.

Using this apparatus, students are able to obtain graphs such as the one shown in Figure 3.



**Figure 3**  
A typical temperature vs. time graph obtained using the temperature probe.



**Figure 4**  
Multiple curves allow students to compare data and draw conclusions.

One advantage of using Vernier's *Logger Pro* software and temperature probe in this apparatus is that multiple graphs can be generated. This allows for comparison with a "control", such as pure water. For instance, Figure 4 shows temperature vs. time curves for regular water and salt water. By comparing the curves, students are able to attribute the increase in boiling temperature to the dissolved salt and not to thermometer uncertainties.

Care should be taken in planning classroom use of this equipment. In some cases, given logistical, equipment, or space constraints, it may be best to do a teacher demonstration. Other options include having some students use traditional thermometers while others use the Vernier equipment. Use of the Vernier probe/distillation apparatus described above is also good for individual student use during the *IPS* Sludge Test!

#### Acknowledgements

Special thanks to co-teacher Stacy Overgaard for helping to plan for the use of this equipment in distillation labs in the classroom.

Thanks also go to John Gastineau of Vernier Software and Technology for his technical assistance in preparing this article. For additional information about Vernier's data-gathering probes, visit [www.vernier.com](http://www.vernier.com).

Additional information about *Introductory Physical Science (IPS)* textbooks and ebooks can be found online at [www.sci-ips.com](http://www.sci-ips.com).

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