

## Thermodynamics - Relevance in the Practice of Pharmacy?

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When I was asked to provide an editorial for the Journal of Thermodynamics and Catalysis, my first thought was “I am a surfactant chemist. What can I say about thermodynamics or catalysis?” I have certainly used thermodynamic methods in the study of micellar systems (mainly calorimetry and volumetric studies), and micellar systems are often employed as micro-reactors to “catalyze” specific chemical reactions, but I would not consider myself to be an expert in either field. I then came to realize, that this is the case for many researchers; we use thermodynamics as a tool to help us to understand specific systems we are interested in. More importantly, this also exemplifies the history of thermodynamics in that the field arose in the early 1800’s as a means of improving the efficiency of steam engines.

But what about today? Certainly, there continues to be relevance for thermodynamics in both the natural and engineering sciences, but what about strongly interdisciplinary fields such as nanotechnology, and more applied fields such as pharmaceutical sciences, biomedical sciences, etcetera? In disciplines such as pharmacy (I will restrict my discussion to the field I am most familiar with) there is a trend to move away from more traditional physical science based courses in favor of clinically focused courses. This is in part dictated by both the needs of the health care system, and how various governments respond to these needs. In Ontario, Canada, our government is recognizing that pharmacists have an important role to play as clinicians and as such is looking to universities to increase training in clinical skills; however this increase in the clinical component(s) of a Pharmacy degree is, in many cases, coming at the expense of the physical sciences. And with this increased clinical focus, students no longer seem to see the importance of a solid grounding in the physical sciences as they relate to Pharmacy; “Why do I need to understand thermodynamics to be a pharmacist?” is a question I often hear in my first-year pharmaceuticals course.

So how do we answer this simple question? And does it lead to the broader question posed above about the relevance of thermodynamics to our increasingly interdisciplinary approach to science? This second question is obviously the easier to answer. If our students don’t see the relevance of thermodynamics to a science based profession such as pharmacy [1], then we as educators and researchers must be concerned with respect to its relevance in general. Now I will not disagree with the fact that many students, and for that matter some faculty, struggle

with various concepts that fit under the broad title of thermodynamics; however, there can be no question that nearly every aspect of how a drug behaves in solution and (more importantly) within the body is governed by the simple (?) principles of thermodynamics. Drug solubility, partitioning between immiscible solvents, drug – excipient interactions, and drug – receptor binding can all be understood based upon the description of such systems according to thermodynamic terms [2]. In fact, our understanding of these properties is critically dependent upon a basic understanding of the three fundamental laws of thermodynamics.

The challenge then becomes one of “packaging” thermodynamics into a format that highlights its relevance to the practice of Pharmacy. Textbooks such as Martin’s Physical Pharmacy and Pharmaceutical Sciences [3], or Physicochemical Principles of Pharmacy [2] do an excellent job of illustrating thermodynamic concepts with examples relevant to Pharmacy, as opposed to more standard chemistry based examples. The method of course delivery also affords an opportunity to demonstrate the importance of thermodynamic concepts, where case-study based approaches, such as those presented by David Newton in his 2007 article “Science-based Pharmacy Education” [4], can highlight the tragic results that can occur in patients due to a lack of understanding of these basic concepts.

So to answer the question posed in the title of my editorial – Is there relevance for thermodynamics in the practice of Pharmacy? I hope I have managed to convince the reader that the answer is an unqualified YES! Our challenge as researchers and educators is to help our audience SEE that relevance, and to connect it to their own areas of interest. Thermodynamics can be viewed as a complicated subject; however, its application to practice need not be complex.

### References

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