

Are Thermodynamic Principles Important to Teach in Pharmacy Education?

Antoine Al-Achi*

Campbell University College of Pharmacy & Health Sciences, P.O. Box 1090, Buies Creek, NC 27506, USA

Editorial

Thermodynamic principles are fundamental to understanding the behavior of pharmaceutical systems. These principles govern the spontaneity and extent of chemical reactions, the stability of various forms of a drug, and the interactions between drugs and their targets. In pharmacy education, a solid grasp of thermodynamics is essential for predicting and controlling the behavior of drugs in the body and in the environment. This editorial discusses the importance of teaching these principles to pharmacy students and explores the challenges associated with their instruction. It highlights the need for a curriculum that emphasizes the practical applications of thermodynamics in pharmaceutical science, ensuring that future pharmacists are equipped with the knowledge and skills necessary to provide safe and effective patient care.

The first law of thermodynamics states that energy is conserved in a closed system. In a chemical reaction, the change in enthalpy (ΔH) is equal to the heat added to the system (q) plus the work done by the system (w):

$$\Delta H = q + w$$

The second law of thermodynamics states that the total entropy of a closed system and its surroundings always increases for a spontaneous process. The change in Gibbs free energy (ΔG) is a measure of the spontaneity of a process at constant temperature and pressure:

$$\Delta G = \Delta H - T\Delta S$$

where T is the absolute temperature and ΔS is the change in entropy. A negative ΔG indicates a spontaneous process, while a positive ΔG indicates a non-spontaneous process.

$$\Delta G = \Delta H - T\Delta S \quad (1)$$

$$\Delta G = -nRT \ln K_{eq} \quad (2)$$

$$-nRT \ln K_{eq} = \Delta H - T\Delta S \quad (3)$$

$$\ln K_{eq} = -\frac{\Delta H}{R} \left(\frac{1}{T} \right) + \frac{\Delta S}{R} \quad (6)$$

*Corresponding author: Antoine Al-Achi, Campbell University College of Pharmacy & Health Sciences, P.O. Box 1090, Buies Creek, NC 27506, USA, Tel: (910) 893-1703 x1703; E-mail: alachi@campbell.edu

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