

Introduction for Module 5 – Thermodynamics

Textbook: [Open Stax Chemistry 2e](#)

Suggested Reading: Chapter 16

Learning Objectives:

- **Distinguish between spontaneous and nonspontaneous processes**
- **Predict the sign of the entropy change for chemical and physical processes**
- **Define Gibbs free energy, and describe its relation to spontaneity**
- **Explain how temperature affects the spontaneity of some processes**

Captions and Attributions:

- 1) A gas spreading into a larger container is only spontaneous in the forward direction. In other words, it will never partition itself into a vacuum and more crowded gas spontaneously. [Figure 16.4, An isolated system consists by Open Stax is Licensed under CCBY 4.0.](#) by [Open Stax](#) is [licensed under CCBY 4.0.](#)
- 2) Entropy is generally higher for liquids than solids, and much higher in the gaseous state than either liquid or gas. [Figure 16.10 The entropy of a substance increases](#) by [Open Stax](#) is [licensed under CCBY 4.0.](#)
- 3) Cards don't stay in a neat pile without attention, demonstrating a trend towards disorder. "[scattered cards](#)" by [Kaitlyn Hansen](#) is licensed under [CC BY 2.0.](#)
- 4) Wired electronics cause frustration due to tangles. Do they ever untangle themselves? "[Telework](#)" by [Peter Kaminski](#) is licensed under [CC BY 2.0.](#)
- 5) Increasing the temperature of a sample will increase its entropy. [Figure 16.11 Entropy increases as the temperature of a substance is raised](#) by [Open Stax](#) is [licensed under CCBY 4.0.](#)
- 6) Four broad possibilities for free energy change exist based on positive or negative enthalpic and entropic contributions. [Figure 16.12 There are four possibilities](#) by [Open Stax](#) is [licensed under CCBY 4.0.](#)



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