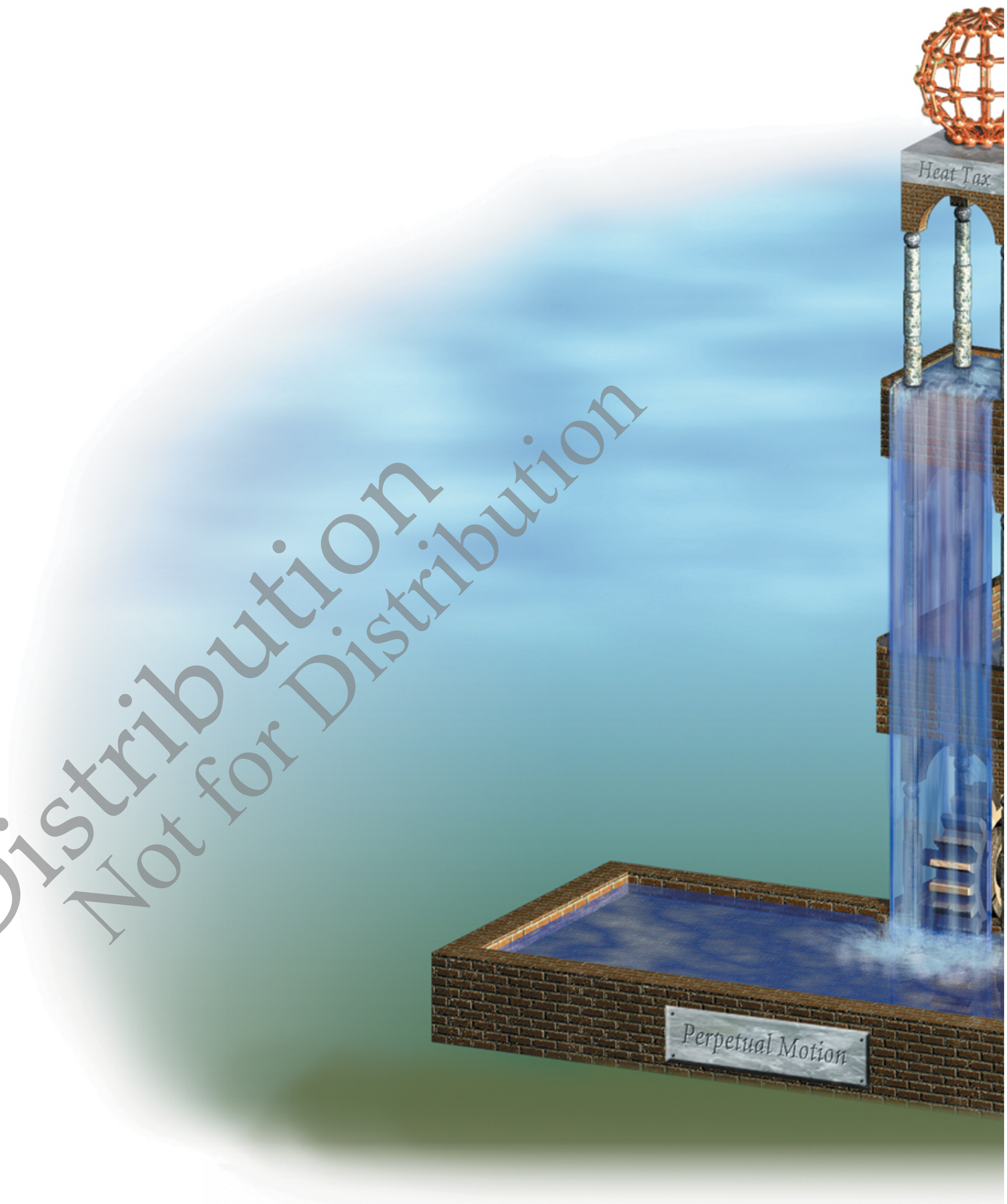
Pearson

# Chapter 18
# Free Energy and Thermodynamics






In this clever illusion, it seems that water can perpetually flow through the canal. However, perpetual motion is forbidden under the laws of thermodynamics.

> "The law that entropy always increases—the second law of thermodynamics—holds, I think, the supreme position among the

> laws of Nature."
>
> —*Sir Arthur Eddington (1882–1944)*

## Learning Outcomes



**THROUGHOUT THIS BOOK,** we have examined chemical and physical changes. We have studied how fast chemical changes occur (kinetics) and how to predict how far they will go (through the use of equilibrium constants). We have discussed how acids neutralize bases and how gases expand to fill their containers. We now turn to the following question: Why do these changes occur in the first place? What ultimately drives physical and chemical changes in matter? The answer may surprise you. The driving force behind chemical and physical change in the universe is a quantity called *entropy*, which is related to the *dispersion* (or spreading out) of energy. In this chapter, we examine entropy and how we can use it to predict the direction of spontaneous change in chemical processes.