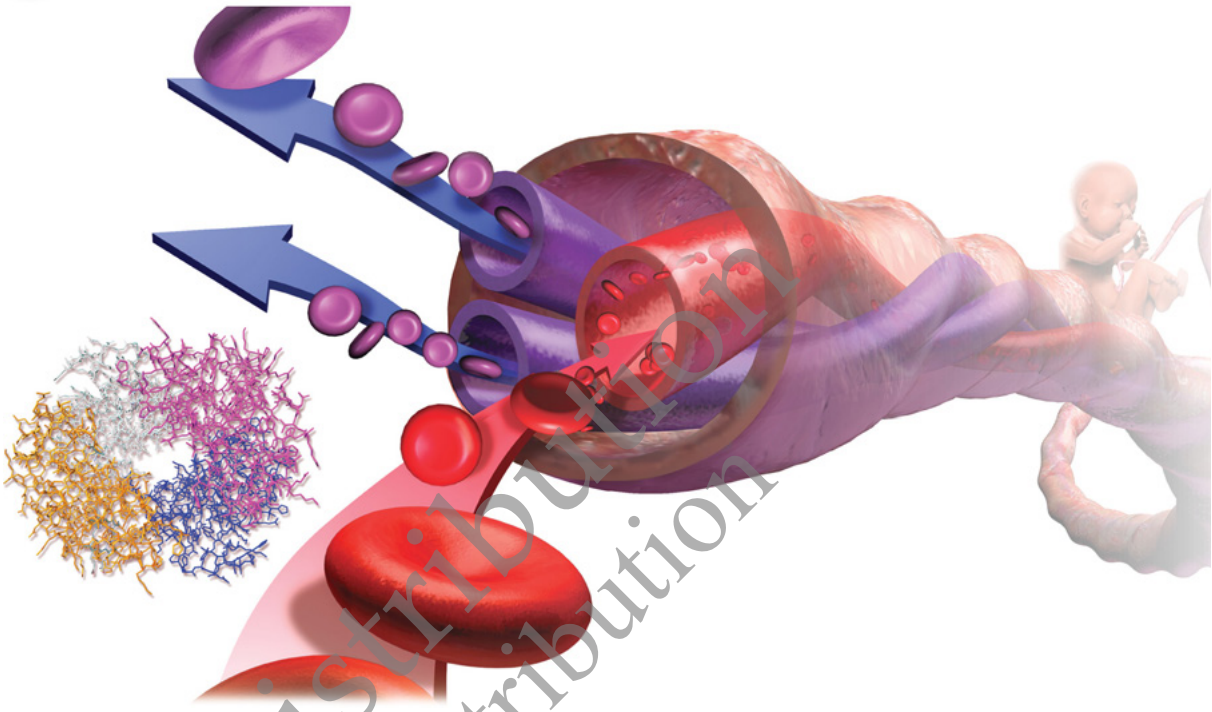
Pearson

Chapter 15
Chemical Equilibrium



A developing fetus gets oxygen from the mother's blood because the reaction between oxygen and fetal hemoglobin has a larger equilibrium constant than the reaction between oxygen and maternal hemoglobin.

> "Every system in chemical equilibrium, under the influence of a change of any one of the factors of equilibrium, undergoes a transformation … [that produces a change] … in the opposite direction of the factor in question."
>
> —*Alfred Lotka (1880–1949)*

Learning Outcomes

15.1 Fetal Hemoglobin and Equilibrium

15.2 The Concept of Dynamic Equilibrium

15.3 The Equilibrium Constant (*K*)

15.4 Expressing the Equilibrium Constant in Terms of Pressure

15.5 Heterogeneous Equilibria: Reactions Involving Solids and Liquids

15.6 Calculating the Equilibrium Constant from Measured Equilibrium Concentrations

15.7 The Reaction Quotient: Predicting the Direction of Change

15.8 Finding Equilibrium Concentrations

15.9 Le Châtelier's Principle: How a System at Equilibrium Responds to Disturbances

Key Learning Outcomes

IN CHAPTER 14, we examined *how fast* a chemical reaction occurs. In this chapter, we examine *how far* a chemical reaction goes. The *speed* of a chemical reaction is determined by kinetics, whereas the *extent* of a chemical reaction is determined by thermodynamics. In this chapter, we focus on describing and quantifying how far a chemical reaction goes based on an experimentally measurable quantity called *the equilibrium constant*. A reaction with a large equilibrium constant proceeds nearly to completion—nearly all the reactants react to form products. A reaction with a small equilibrium constant barely proceeds at all—nearly all the reactants remain as reactants, hardly forming any products. In this chapter, we simply accept the equilibrium constant as an experimentally measurable quantity and learn how to use it to predict and quantify the extent of a reaction. In Chapter 18, we will explore the reasons underlying the magnitude of equilibrium constants.