Chapter 1

Introduction

Complexity science is relatively new but already indispensable. It is important to understand complex systems because they are everywhere. Your brain is a complex system and so is your immune system and every cell in your body. All living systems and all intelligent systems are complex systems. The climate of the Earth is a complex system, and even the universe itself exhibits some of the features of complex systems. Many of the most important problems in engineering, medicine and public policy are now addressed with the ideas and methods of complexity science – for example, questions about how epidemics develop and spread. Thousands of years of mathematical and scientific study have given us the technology to create new complex systems that rival those of the biosphere, such as cities, financial economies and the Internet of Things. Business leaders have started to think in terms of complexity science, using terms such as 'robustness', 'redundancy' and 'modularity' (Sargut and McGrath 2011; Sullivan 2011). State economic institutions such as the Bank of England (Haldane 2009) have also begun to use such terminology. This book is about how scientists think about complex systems and about what makes these systems special.

However, there is confusion in some of the discussions in the professional and scientific literature, and clarity is needed to facilitate the application of complexity science to problems in science and society. There is no agreement about the definition of 'complexity' or 'complex system', nor even about whether a definition is possible or needed. The conceptual foundations of complexity science are disputed, and there are many and diverging views among scientists about what complexity and complex systems are. Even the status of complexity as a discipline can be questioned given that it potentially covers almost everything.

Most sciences admit of informative definitions that are easy to state. For