Col 1

you divided your body into piles of all the different molecules and cells that make you up, you would have an ensemble of uninteresting (and insentient) chemical piles. But rearranging those chemicals into a particular organization, with particular relationships among the molecules, can restore the motivated, dreaming, volitional creature that your friends know and love. The brain's organization, function, and emergent properties are what neurobiology seeks to understand.

Col 1

To comprehend the connection between mind and brain, it is necessary to ground ourselves in two concrete bodies of data: (1) the way humans behave, perceive, and decide and (2) the biological mechanisms that underlie those behaviors. In this book we will begin at the molecular level and work our way up to larger scales, highlighting the fundamental principles at work at all stages.

Col 1

From the whirlwind of the brain's great complexity we will glimpse the remarkable mystery that sensations, perceptions, selves, minds, and even consciousness are biological products. After reading this book, it will be easy to understand how, for example, an idea in your head can cause passion or peacefulness, elevate blood pressure and pulse frequency, dispatch a hot upsurge of adrenaline, or make you feel cold with fright. Ideas lead to physical and chemical changes because they themselves are constructed of physical and chemical changes. Neural computations are required at all levels for you to read this page, just as they were required to compose it. Ideas are not incorporeal: they are constructed of parts that are increasingly amenable to description, and that is the journey we will take in this book.

Col 0

Neuroscience Is a Relatively New Field

Col 0

How can biological tissue act like a special kind of computer? How do we connect neural function to cognitive capacities? What is the relationship between the brain and the mind, between biology and psychology?

Col 0

We live in a time of rapid progress in many scientific fields. Neuroscience is no exception. The word *neuroscience* only entered the English lexicon in the 1960s, representing a new understanding that the study of the brain—and the mind—encompasses a field of study in its own right (Schmitt, 1966). Each year remarkable progress is made in understanding the biology of the brain, and much of this progress centers on the detailed biophysical and biochemical processes that attend the operation of the cells comprising the brain. This progress has shone light on the physical mechanisms that permit neurons to organize and operate. The interactions of these neurons give rise to cognitive processes such as attention and memory. These same approaches have yielded important insights into the disease processes that attack the nervous system. These advances, when combined with the revolution in molecular biology, represent a burgeoning picture of the brain and its operations.

Cognitive neuroscience has not always had a distinct name and was once the remote province of visionary thinkers from

FIGURE 1.4 Every year, nearly 30,000 researchers, fellows, students, and health professionals attend the annual meeting of the Society for Neuroscience. Their areas of expertise are diverse and include applied mathematics, biophysics, molecular and cellular biology, neuroimaging, electrophysiology, pharmacology, neurology, psychiatry, psychology, and cognitive science.

Col 2

disciplines as diverse as physics, computer science, biology, psychology, philosophy, mathematics, and engineering. It is now a maturing discipline, and although it continues to draw professionals from those various disciplines, many of them consider themselves "neuroscientists" (FIGURE 1.4). The recent, expansive growth in the field also owes a debt to: (1) unprecedented amounts of detailed biological data, (2) high-speed, low-cost computing power, and (3) rapidly maturing theoretical approaches that have allowed us to see the underpinnings of many frameworks for perception, learning, reasoning, decision making, and disease states.

Col 2

In Pursuit of Principles

Col 2

The Functions behind the Form

Col 2

Although human brains perform feats that seem almost magical, we are, after all, made of biological parts. Somehow these parts run programs that throw balls, walk along uneven paths, detect danger, lift a cup to our lips, phrase a question, communicate with facial expressions, write this sentence, read this sentence, and effortlessly perform the further profusion of sophisticated activities we enjoy each hour. Cognitive neuroscience seeks to determine how the organization and function of the brain's parts engender these everyday, seemingly effortless feats.

The goal is to look under the panels of the machinery of our everyday actions and behaviors to see what's making the engine run. The challenge is that we find a universe of