

## 2-1 Matter in Motion

The focus on matter and motion has been central to physics for hundreds of years. It happens at many levels. Our understanding of distant objects in the vastness of space began with careful observers tracking their motions. On a less obvious level, we often try to understand a complex system by thinking about the tiniest particles that make up the system—how they move and how they affect one another's motions. For example, we may think about the motions of the atoms or molecules that make up the atmosphere or the seas or that participate in the furious internal activity of our own sun or a distant supernova.

Even the study of life lends itself to this approach. The atoms that make up a living being come together in precise and specialized configurations during the individual's lifetime, are rearranged as they participate in the body's *chemistry*, and are eventually dispersed again after the individual's death.

In modern times, indirect evidence about the motion of distant stars has helped guide us to the idea of an expanding universe originating in a “Big Bang.” Detection devices that show the tracks of subatomic particles passing through them have provided insights into the most fundamental constituents of matter.

To deal scientifically with matter and motion, physicists had to do two things. First, they had to develop a precise quantitative vocabulary to describe how things move. But objects affect one another as they move; in other words, they interact—they exert forces on one another. So physicists also had to look for rules governing these forces or interactions and their effect on motion. The detailed quantitative description of motion will be the focus of this chapter and the next; the concept of force and its relation to motion will be developed in Chapters 4 and 5. In a sense, we will investigate how the universe works by studying the motions and interactions of its parts, much as if it were a great machine. For that reason, the study of forces and motion in nature is called **mechanics**.