SECTION 2

Measurements in Experiments

SECTION OBJECTIVES

- List basic SI units and the quantities they describe.
- Convert measurements into scientific notation.
- Distinguish between *accuracy* and *precision*.
- Use significant figures in measurements and calculations.

NUMBERS AS MEASUREMENTS

Physicists perform experiments to test hypotheses about how changing one variable in a situation affects another variable. An accurate analysis of such experiments requires numerical measurements.

Numerical measurements are different from the numbers used in a mathematics class. In mathematics, a number like 7 can stand alone and be used in equations. In science, measurements are more than just a number. For example, a measurement reported as 7 leads to several questions. What physical quantity is being measured—length, mass, time, or something else? If it is length that is being measured, what units were used for the measurement—meters, feet, inches, miles, or light-years?

The description of *what kind* of physical quantity is represented by a certain measurement is called *dimension*. In the next several chapters, you will encounter three basic dimensions: length, mass, and time. Many other measurements can be expressed in terms of these three dimensions. For example, physical quantities such as force, velocity, energy, volume, and acceleration can all be described as combinations of length, mass, and time. In later chapters, we will need to add two other dimensions to our list, for temperature and for electric current.

The description of *how much* of a physical quantity is represented by a certain numerical measurement depends on the *units* with which the quantity is measured. For example, small distances are more easily measured in millimeters than in kilometers or light-years.

SI is the standard measurement system for science

When scientists do research, they must communicate the results of their experiments with each other and agree on a system of units for their measurements. In 1960, an international committee agreed on a system of standards, such as the standard shown in **Figure 7.** They also agreed on designations for the fundamental quantities needed for measurements. This system of units is called the *Système International d'Unités* (SI). In SI, there are only seven base units. Each base unit describes a single dimension, such as length, mass, or time.

Figure 7
The kilogram is the only SI unit that is defined by a material object. The platinum-iridium cylinder shown here is the primary kilogram standard for the United States.