Now that Matthew Carlson, athletic trainer for the local high school, has achieved good range of motion in Kamryn’s knee, he is ready to begin a more aggressive strengthening program. Early in the season, Kamryn injured her right knee during gymnastics practice. She underwent rehabilitation but continued to have difficulties with the knee throughout the season. Three weeks ago she underwent an arthroscopy for a medial meniscal repair.

Matthew wants Kamryn to progress in her rehabilitation program with effective, efficient, and appropriate strengthening exercises, but he’s having difficulty deciding what equipment to use. Fortunately, the high school’s booster club has been very generous to his athletic training program and has furnished his athletic training facility with a nice variety of rehabilitation equipment. Now that she can bear full weight on the extremity, he wants to do a combination of open and closed kinetic chain activities. Until now, he has used manual resistance and free-weight resistance to provide strengthening activities, but at this point in Kamryn’s program, more resistance is indicated.

Progress is impossible without change, and those who cannot change their minds cannot change anything.

George Bernard Shaw, 1856–1950, Irish playwright and cofounder of the London School of Economics

George Bernard Shaw’s words are worth considering as you begin reading about a topic that you may think you already know well. New knowledge and information continually come to light in the health sciences; if we do not keep up with the changes in our field, we become as obsolete in our practice as in our knowledge. What you learned in your earlier years may not be relevant to what you find in this chapter today. As you read this chapter, you will discover that although much is known about muscle strength, much is yet to be learned. We have come a long way in the past few years in advancing our knowledge; this has led to changes in how we manage strength within therapeutic exercise programs. This text does not come close to presenting the body of knowledge available, but we discuss the importance of having muscle strength, the methods of achieving it, and the ways in which rehabilitation clinicians can maximize the development of muscular strength and endurance in therapeutic exercise programs.

As you read this chapter, keep in mind that many of the concepts presented are not black and white but shades of gray. There is not necessarily a single answer for even simple questions such as What is the best number of repetitions for increasing muscle endurance? The “best” answer will emerge through your ability to combine the knowledge you obtain from this text, your coursework, and your own observation skills and common sense. This combination will enable you to determine your own best answers about what strengthening program will be most effective for each patient you rehabilitate.

One can never have too much knowledge. Knowledge leads to understanding, understanding leads to appreciation, appreciation leads to insight, and insight leads to appropriate application. The greater your understanding of the whys and hows, the more effective will be your application of the knowledge you possess.

Neuroanatomy was presented in chapter 6. This chapter expands on that information to include neurophysiology before we move into information on muscle anatomy and how muscular and neurological systems work together to create movement. Accordingly, we begin this chapter by describing the physiology of the neurological and muscular systems and providing biomechanical information you will need to understand the rationale for muscle strengthening techniques. The progressions provided throughout this chapter will provide you with additional skills so that you can design and build your own therapeutic exercise program for any patient, regardless of obstacles or complications associated with the patient’s injury.

**Neuromuscular Physiology**

Before we get to the muscular system, we need to review how the neurological system “talks” with the
muscular system so muscles function properly. You will come to realize how the simple action of bringing a cup to your mouth to drink involves a very complex series of activities that occur in an instant. Most of the neurological elements presented here are a review of your basic anatomy and physiology course information. As we delve into the more complex aspects of muscle activity, some information may be review and some may be new; all of it, however, is relevant to understanding how muscles work.

As described in chapter 6, many sensory receptors provide input to the central nervous system and can influence the neuromuscular system. Figure 7.1 indicates that sensory receptors on the skin—including