



Developing and Assessing Physical Fitness

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Our medicines are no further away than the shelves of the grocery and the sidewalks that we can use for a brisk walk.
—Tommy Thompson, former Secretary of Health and Human Services

Study Questions

You will have successfully mastered this chapter if you can answer the following:

1. What are the benefits of physical fitness?
2. What are the five health-related fitness components?
3. What are the purpose, content, and time of the three parts of a workout?
4. What are the principles of fitness development?
5. What is cross training? Give one example.
6. What are one or more tests for each component of health-related fitness?

You will find the answers as you read this chapter.



Visit the Online Learning Center for *A Wellness Way of Life*, www.mhhe.com/robbins8e, where you will find additional quizzes and study aids.

Terms

- ballistic stretching
- body composition
- cardiorespiratory endurance (CRE)
- conditioning bout
- cool-down
- cross training
- exercise tolerance test
- fat-free tissue
- flexibility
- hypokinetic disease
- lean body mass
- muscular endurance
- muscular strength
- physical fitness
- principle of individual differences
- principle of reversibility
- principle of specificity
- progressive overload
- skinfold calipers
- static stretching
- subcutaneous fat
- task-specific activity
- warm-up

If there was a magic potion that you could take to increase your energy and help you manage weight, decrease stress, feel better, and decrease the risk of heart disease, cancer, and diabetes, would you be interested? The benefits of regular physical activity include these and many more. It is perhaps our cheapest preventive medicine. To live a wellness lifestyle, you must be physically active. While moderate levels of activity produce improvements in health, physical fitness requires higher-intensity activity and produces greater benefits. Physical fitness is an important component of wellness, because what affects the body ultimately affects the mind. Physical fitness enables you to function at the peak of your capacity physically and mentally—to enjoy life more fully—to be all that you can be.

You want to become more physically fit. How do you begin? This chapter discusses the benefits of physical activity and how much activity is needed to maintain health. It reviews basic principles of developing physical fitness, gives guidelines for health benefits, and details methods of assessing the health-related physical fitness components. This enables you to measure your current fitness levels, set goals, and develop a plan for working toward those goals. It will provide you with the information you need to begin a fitness program so that you can reap the benefits for life!

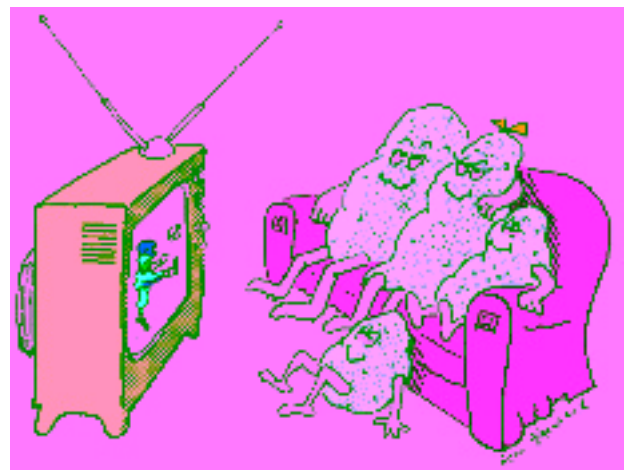
IMPORTANCE OF EXERCISE

The natural peak of fitness occurs at physiological maturity, in the late teens to early twenties. After this, life becomes a slide down the aging curve for sedentary individuals, who gradually lose 1 to 3 percent per year of their cardiorespiratory endurance, muscle mass, flexibility, and so on. If you have observed friends who are older, you have seen that many of them are beginning to show physical deterioration due to lack of exercise: decreasing energy levels, increasing body fat, loss of muscle tone. Our bodies were designed for physical activity, but few occupations provide enough to maintain health or fitness. Homemakers, office workers, and students have busy, stressful lives and may feel tired at the end of the day, but they often lack the physical activity vital to tone muscles, stimulate the heart and lungs, or produce a training effect. This has resulted in an epi-

demic of **hypokinetic diseases** related to an inactive lifestyle, such as obesity, coronary heart disease, cancer, osteoporosis, and diabetes. Older adults are sometimes erroneously told to “slow down” and “take it easy,” resulting in increasing weakness and accelerated physical decline. Unfortunately, too many people feel that they don’t have time for exercise and are satisfied with minimal exertion in their lives. Approximately 250,000 premature deaths per year in the United States can be attributed to lack of exercise. According to Dr. Steven Blair, epidemiologist for the Cooper Institute for Aerobics Research, a sedentary lifestyle is as much a risk factor for disease as are smoking, obesity, and high blood pressure, but inactivity is more prevalent.

Inactivity also contributes to the problem of obesity in our country. Over 60 percent of American adults are overweight, and nearly a third are obese. In the last 10 years, adults have shown an average weight gain of nearly 8 pounds per person. Our nation’s children are fatter, too, and about half are not physically active enough for aerobic benefit; this increases their risk of heart disease. Consuming too many calories and not getting enough exercise are to blame. The problem is compounded by the abundance of labor-saving devices, such as remote controls, computers, and riding lawn mowers. Children’s playtime often consists of watching television; surfing the Internet; or sports lessons where sitting, standing, or watching consumes a major portion of the time. To make matters worse, although childhood is the best time to develop a lifelong habit of physical activity, many physical education programs face elimination because they are considered a frill when educational budgets are crunched. In a world filled with labor-saving devices, it is more important than ever to build exercise into our lives for optimal health and well-being.

For young people, levels of physical activity decline sharply through adolescence. Many college students show early signs of hypokinetic disease. If you are



We have become a nation of spectators.

concerned about slowly gaining weight from pizza, shakes, and fries, a good fitness program can reverse the trend. If normal daily activities leave you feeling worn out, you can boost your energy with regular exercise 3 to 5 days a week. Because routine activities such as sitting in class, watching TV, and walking across campus seldom require the physical effort needed to develop fitness, we must plan for daily vigorous exercise. The old saying “Use it or lose it” has never been more true.

PHYSICAL ACTIVITY AND HEALTH

We know that many people can improve their health and the quality of their lives with lifelong physical activity, yet about 60 percent of adult Americans are not regularly active and nearly 90 percent need more physical activity to improve their health. Almost half our young people are not vigorously active. To encourage Americans to get moving and reverse the increasing toll of health-care costs related to chronic diseases, the American College of Sports Medicine and the American Heart Association issued a joint recommendation for the quantity of physical activity needed by healthy adults to improve and maintain health:

1. To promote and maintain health, all healthy adults ages 18 to 65 should maintain an active lifestyle.
2. Include moderately intense aerobic exercise 30 minutes a day, 5 days a week, or vigorously intense aerobic exercise 20 minutes a day, 3 days a week.
3. The 30 minutes of moderate-intensity exercise can be accumulated in bouts of 10 minutes or more. Examples of moderate-intensity exercise are given in Figure 3-1. Combinations of moderate- and vigorous-intensity exercise can be done, such as 30 minutes of brisk walking 2 days during the week and 20 minutes of jogging another 2 days.
4. Also do 8–10 strength-training exercises, 8–12 repetitions of each, twice a week on nonconsecutive days. This can include lifting weights, calisthenics, elastic bands, etc., using major muscle groups.
5. “More is better.” Because greater amounts of physical activity (longer duration or greater intensity) can provide additional health benefits, people who wish to further improve their fitness, reduce risk for chronic disease, or prevent weight gain may benefit by exceeding the minimum recommended amounts of exercise.
6. Aerobic activity is needed in addition to the routine light-intensity activities of daily life, such as shopping, mopping, or taking out the trash. However, moderate to vigorous activities

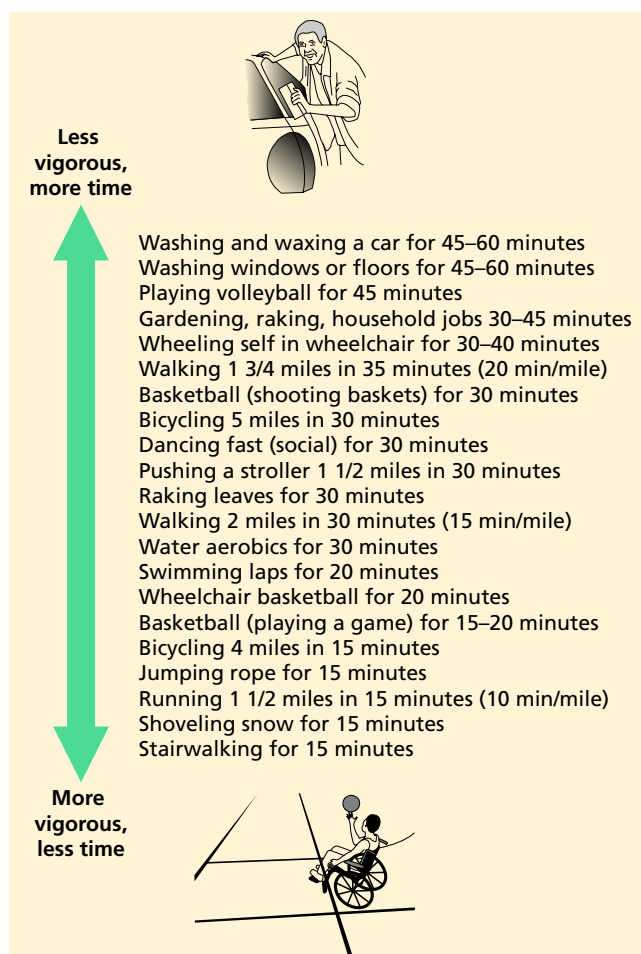


FIGURE 3-1 Moderate amounts of physical activity. SOURCE: U.S. Department of Health and Human Services Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion. *Physical Activity and Health: A Report of the Surgeon General*. Atlanta: USDHHS (1996).

performed for more than 10 minutes, such as shoveling snow or walking to work, can count toward the goal.

If you are in the contemplation stage of change, weighing the benefits and costs of an exercise program can help you move to the next stage. If lack of time is a concern, note that a minimum of 1 hour of exercise (20 minutes \times 3 days) out of 168 hours in your week pays big health dividends:

- ✓ Reduces risk of premature death.
- ✓ Reduces risk of dying from coronary heart disease and developing high blood pressure, cancer, and diabetes.
- ✓ Helps reduce body fat and control weight.
- ✓ Helps reduce blood pressure in some people who already have high blood pressure.
- ✓ Helps build and maintain healthy bones, muscles, and joints.

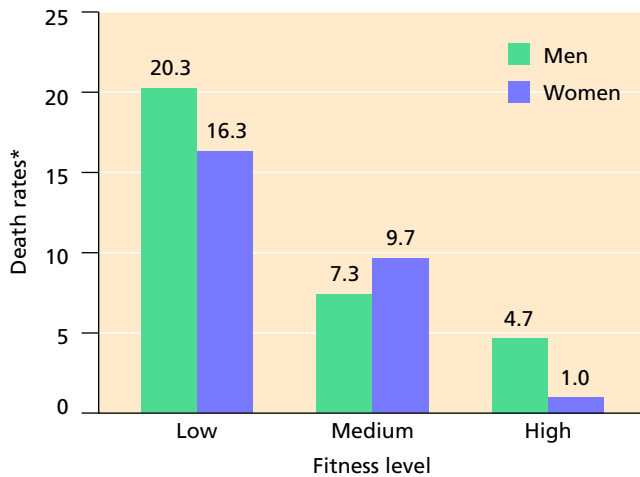


FIGURE 3-2

Effects of physical fitness on mortality rates.

*Age-adjusted per 10,000 person-years at follow-up.

- ✓ Reduces the risk of developing metabolic syndrome, a deadly combination of three or more of abdominal obesity, insulin resistance, elevated triglycerides, low HDL, and elevated blood pressure.
- ✓ Prevents cognitive decline in older individuals and may improve cognitive performance in people of all ages.
- ✓ Reduces anxiety and depression and improves mood.
- ✓ Promotes psychological well-being.

A landmark study conducted at the Institute for Aerobics Research in Dallas by Steven Blair et al. provides evidence that physical fitness is associated with longevity (Figure 3-2). In this 8-year study, physical fitness was quantified by using an exercise tolerance test on a treadmill. The subjects were categorized into physical fitness levels based on the treadmill test. The greatest reduction in risk of death occurred between the low and medium levels of fitness. Therefore, a modest improvement in fitness among the most unfit can bring about substantial health benefits.

Healthy People 2010 (see Chapter 1) also contains exercise objectives, which include the following:

- ✓ To reduce to 20 percent the proportion of adults who engage in no leisure-time physical activity.
- ✓ To increase to 30 percent the proportion of adults who engage regularly in moderate physical activity for at least 30 minutes or more.

Accomplishing these objectives would greatly reduce premature mortality rates. Then, perhaps, these individuals will enjoy a new active lifestyle and begin to see and feel the health benefits of exercise. Eventually, they may invest additional time and energy, increasing the

potential to acquire greater benefits from increased levels of activity.

Moderate Physical Activity for Health Promotion

There are differences in the intensity and duration of physical activity needed for health, for physical fitness, and for performance, such as in athletics. What is involved in adopting a moderately active lifestyle?

First, realize that physical activity does not have to be punishing to be beneficial. The emphasis should be on activity of *moderate* intensity. This would be equivalent to walking approximately 2 miles at a pace of 15 minutes per mile. You don't have to be soaked with sweat for improvements in health to occur.

Second, exercise does not have to be done all at one time. We know that 20 minutes or more of vigorous exercise is recommended for high-level fitness (full cardiorespiratory benefit), but all activity is beneficial to our health. Something is better than nothing. Incorporate bits of activity every day whenever and wherever you can. For example: Ride your bike to mail a letter; play racquetball, walk, swim, or run at noon; take a walk after dinner; walk to the grocery when you need only a few items. *Look* for opportunities to add daily activity—get up earlier, use TV commercial time, when working out a problem, when visiting a friend, and so on.



Just 30 minutes of moderate activity can provide many health benefits.



THE NUMBERS

250,000	Premature deaths per year in the United States attributable to lack of exercise.
89%	Adults who need more physical activity to improve their health.
60%	Adults who are not regularly active.
29%	Adults who are not active at all.
30	Minutes of daily moderate activity needed to gain health benefits.

How Much Exercise Is Needed for Health—30, 60, or 90 Minutes?

The amount of daily physical activity recommended depends on your goal. To lower the risk of chronic diseases, 30 minutes of moderate activity is recommended on 5 days of the week. This is important for reducing risk of coronary heart disease, diabetes, and cancer. Walking 2 miles in 30 minutes, or mowing the lawn with a push mower for 30 minutes, would meet the goal. However, this may not be enough to prevent weight gain. People can get greater health and fitness benefits from more vigorous activity or longer duration. Studies of people who have lost weight and kept it off for several years show that 60 minutes of moderate-intensity

activity, or lesser amounts of vigorous activity, are needed to lose weight. For those who have lost weight and are trying to keep it off, 60 to 90 minutes of physical activity are recommended to prevent gaining it back.

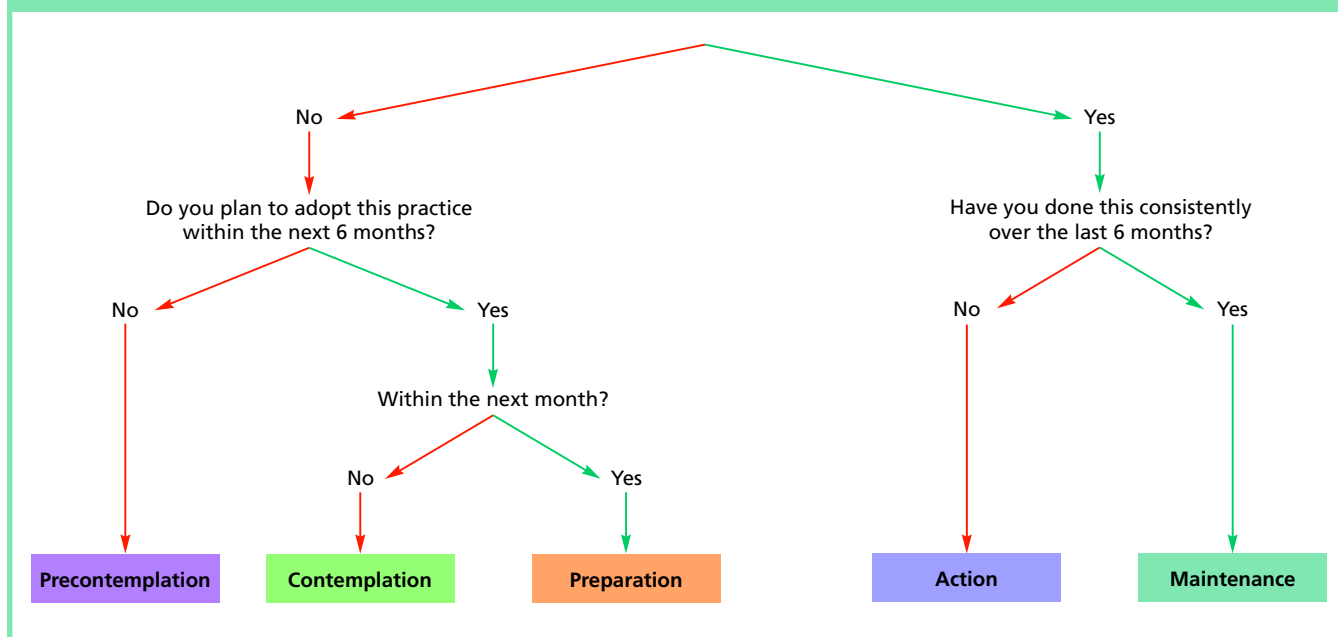
Most people declare lack of time as a reason for not exercising, but the average person spends 15 to 20 hours watching television. For the time-crunched, Figure 3-1 has some suggestions for working exercise into your day.

The Activity Pyramid

The Activity Pyramid (Figure 3-3), like the Food Guide Pyramid (see Chapter 11), is a guide to help you choose activities to improve your health and fitness level. The activities at the base of the pyramid, such as walking the dog

What Stage of Change Are You In?

Do you occasionally find ways to add physical activity into your daily life?
(e.g., taking the stairs instead of the elevator)



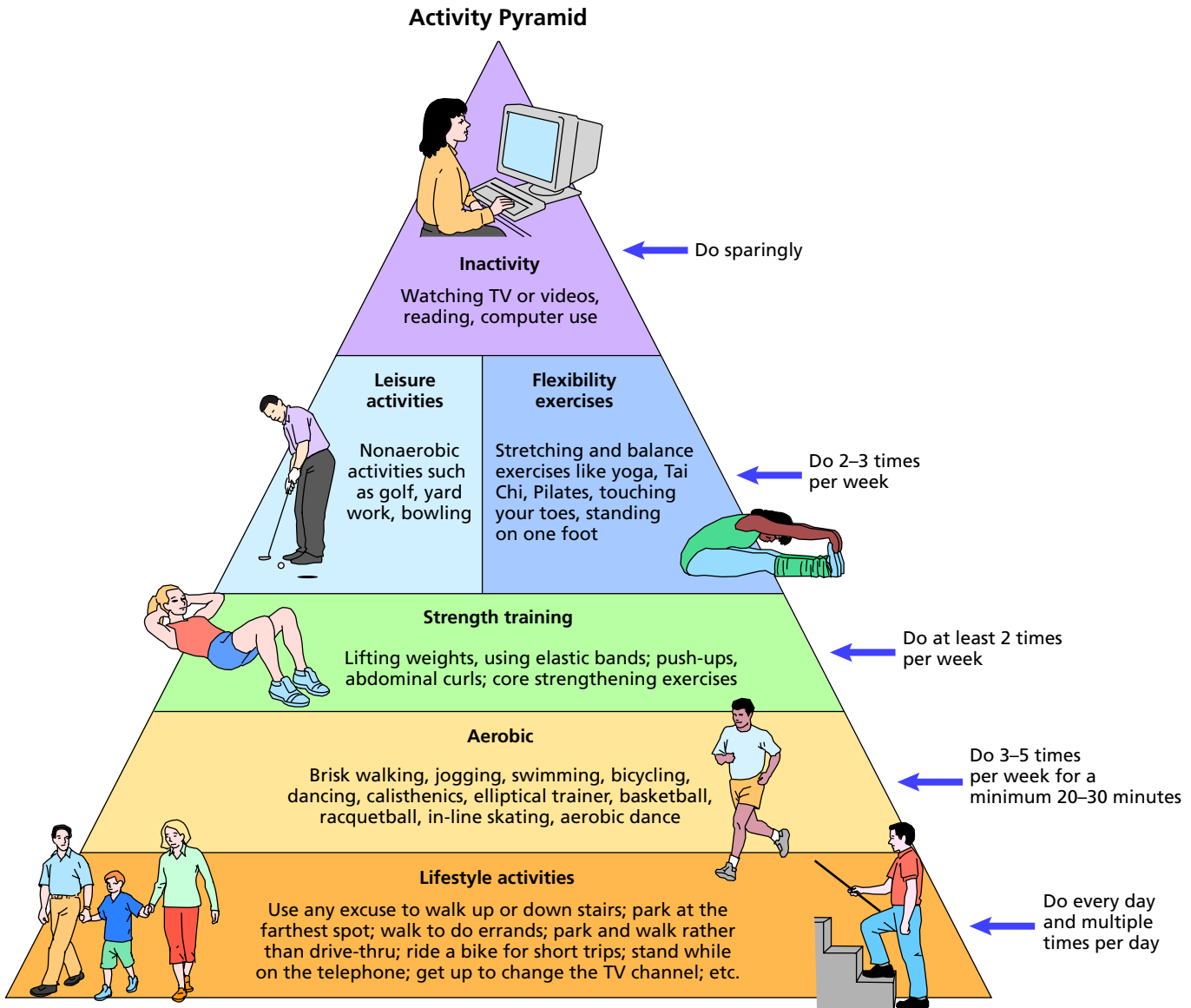


FIGURE 3-3 Activity pyramid.

and using the stairs more often, can be built into your everyday life. If you are currently sedentary, this is the place to start. If you are already moderately active, begin a formal exercise program (the second level of the pyramid) at least three times per week. Aerobic exercise is the most beneficial in promoting health benefits and cardiorespiratory fitness. Vigorous recreational sports also promote cardiorespiratory fitness. Extra healthful benefits can be achieved at the third level, which recommends strength exercises at least twice per week to build balanced fitness, especially if you already do aerobic exercise regularly. The fourth level adds flexibility and leisure activities two or three times per week. The top of the pyramid suggests what to do *least*, including sitting and watching TV.

You are faced with a tremendous challenge. Because you are our nation's future homemakers, parents, and leaders, the responsibility for the health and well-being of the next generation rests in your hands. You can make an enormous impact on the activity patterns of your children, family, friends, and neighbors by setting a good example. So go to it: Get up off the sofa, turn off the TV, and accept the challenge to enjoy exercise daily.

Encourage your friends and neighbors to get out and work in the garden, walk around the block, mow the lawn, walk the dog, participate in recreational sports (bowling, tennis, golf, softball), and go dancing. Anyone can begin the journey toward wellness with a single step and begin reaping health benefits immediately.

TOP 10 LIST

Ways to Exercise on the Go

When you travel for business or pleasure, fitting in exercise presents a special challenge. As much as possible, plan ahead when/where you will fit in exercise during your trip. Pack your exercise clothes and a small towel so that you will be ready to go. Here are some suggestions for incorporating exercise into your travel plans.

1. Pack an exercise band and instructions (see the back cover of this book). Exercise bands are lightweight and take very little space in the suitcase. They are inexpensive and allow a wide variety of exercises for different muscle groups.
2. Lace up your shoes and walk for both sightseeing and exercise. You can often get route directions and maps from hotel personnel or a city guidebook. Walk wherever and whenever possible, avoiding cars and cabs. If the weather is extreme and you would rather walk indoors, combine a trip to a mall with a 30-minute walk. Try to go early when the mall is least crowded.
3. Before you leave home, check the Internet for a list of gyms close to your destination and call or check online for classes (yoga, spinning, kickboxing) that you would like to try.
4. Use the Internet or a guidebook to check out local activities that you can incorporate into your trip like kayaking, climbing, swimming, and horseback riding.
5. With a laptop or portable DVD player, you can work out with an exercise DVD. A morning exercise program on TV may also be an option.
6. Pack two large empty plastic water bottles. When at your destination, fill the bottles with water to use as hand weights for upper-body exercises.
7. An inexpensive exercise mat is easy to pack and can be used for stretching and calisthenics as shown in Chapters 5 and 6.
8. If you have a few hours between flights, use them to walk the airport, stretch, or do a few exercises with your exercise band. Some airports have a fitness facility that you can use for a small fee. You can also stretch and use the exercise band for sitting exercises while on the plane.
9. If you would rather exercise indoors, take a jump rope. It can provide you with a way to do an aerobic workout in a small area.
10. If you are spending time on the beach, take a Frisbee and plan to be active rather than lying in the sand all day.

While moderate activity can improve health, physical fitness requires more vigorous exercise to cause long-term beneficial physiological changes. Specific

activity examples are given in Figure 3-1. Next, we look at the components of physical fitness and basic principles of fitness development.

WHAT IS PHYSICAL FITNESS?

Physical fitness is the ability of the body to function at optimal efficiency. The fit individual is able to complete the normal routine for the day and still have ample reserve energy to meet the other demands of daily life—recreational sports and other leisure activities—and to handle life's emergency situations. Physical fitness involves skill-related and health-related components, which are listed below. The *skill-related* components of fitness are important to athletic success and are not crucial for health. The five *health-related* components of fitness are important for health and performance of daily functional activities.

Skill-Related

- ✓ Speed
- ✓ Power
- ✓ Agility
- ✓ Balance
- ✓ Reaction time
- ✓ Coordination

Health-Related

- ✓ Cardiorespiratory endurance
- ✓ Muscular strength
- ✓ Muscular endurance
- ✓ Flexibility
- ✓ Body composition

HEALTH-RELATED COMPONENTS OF FITNESS

Cardiorespiratory Endurance

Probably the most important fitness component is **cardiorespiratory endurance (CRE)**, the ability of the heart, blood vessels, and lungs to deliver oxygen and essential nutrients to the working muscles and remove waste products during vigorous physical activity. Your life depends on the efficient functioning of your cardiorespiratory system. Research shows that vigorous exercise is needed to keep your heart healthy and prevent heart disease. Good CRE is also needed if you want to enjoy running, swimming, cycling, and other vigorous activities to live at the peak of health and enjoy a full life. For more information on CRE, see Chapter 4.

Muscular Strength

Muscular strength is the ability of a muscle to exert one maximal force against resistance. Short-duration, high-intensity efforts such as moving furniture, lifting a heavy suitcase, and lifting a 100-pound weight one time are examples. Strength is important in sports whether you are hitting a tennis ball, running, jumping, or

throwing. Weight training (Chapter 6) is the best way to enhance strength and provides health benefits needed across the life span.

Muscular Endurance

Muscular endurance is the ability of a muscle to exert repeated force against resistance or to sustain muscular contraction. It is characterized by activities of long duration but low intensity, such as doing repetitions of push-ups or sit-ups. Muscular endurance is essential in everyday activities such as housework, yard work, and recreational sports. Muscular strength and endurance tend to decline with age along with activity levels, making it difficult to perform daily activities such as getting in and out of a car and standing up from the floor. This loss can be delayed and muscular fitness can be maintained by participating in a resistance training program.

Flexibility

Flexibility is movement of a joint through a full range of motion. Flexibility is essential to smooth, efficient movement and may help prevent muscle strains. It is specific to each joint; you may have flexible shoulders but tight hip flexors or vice versa. Can you sit and touch your toes without bending your knees? This requires hamstring flexibility. You need arm and shoulder flexibility to scratch your back. Women usually have more joint flexibility than men because men have bulkier skeletal muscles. Older adults may have trouble performing routine tasks such as turning to watch traffic while driving and dressing when clothes fasten at the back because flexibility diminishes with age. This loss can be countered if stretching is part of your lifetime exercise program. Chapter 5 has more information about flexibility.

Body Composition

Body composition is the amount of body fat in proportion to fat-free weight. The ratio between body fat and fat-free weight is a better gauge of fatness than is body weight alone. There are various ways to measure body composition, and all are superior to the height/weight chart method. For instance, a height/weight chart may label a 6-foot, 210-pound football player as overweight, when in reality he has only 10 percent body fat, as measured with skinfold calipers. On the other hand, a sedentary person may look okay, but when body composition is analyzed, it is calculated to be 30 percent body fat. Have your body composition analyzed by a professional. Obesity is both unhealthy and uncomfortable and is associated with increased risk for heart disease, diabetes, high blood pressure, cancer, and joint and lower back problems.

PHYSICAL FITNESS AND WELLNESS

Becoming physically fit is a positive health habit that has a major impact on all dimensions of wellness (Table 3-1). It is one area where you can assume control of your lifestyle.

THREE-PART WORKOUT

An exercise session includes three parts: a warm-up, a conditioning bout, and a cool-down.

TABLE 3-1 *Benefits of Physical Fitness on Wellness Dimensions*

Physical	Slows the aging process; increases energy; improves posture and physical appearance; helps control weight; improves flexibility; improves muscular strength and endurance; strengthens bones and reduces osteoporosis; reduces risk for coronary heart disease.
Emotional	Relieves tension; aids in stress management; improves self-image; evens emotional swings; provides time for adult play; promotes psychological well-being.
Social	Enhances relationships with family and friends; increases opportunity for social contacts.
Intellectual	Develops concepts of mind and body oneness; increases alertness; enhances concentration; motivates toward improved personal habits (smoking cessation, reducing drug and alcohol use, better nutrition); stimulates creative thoughts.
Occupational	Decreases absenteeism; increases productivity; decreases disability days; lowers medical-care costs; lowers job turnover rate; increases networking possibilities.
Spiritual	Develops appreciation of body-mind connection; enhances appreciation for healthy environment; builds compassion for those less able.
Environmental	Develops appreciation for healthy air and water; increases concern for recycling and preservation of natural resources; increases interest in eliminating toxins and chemicals from food chain.

Warm-Up

The **warm-up** is an important beginning to an exercise session. Two important physiological changes occur during the warm-up. The internal temperature of the muscles increases, enhancing their elasticity. Heart rate and respiration increase, thus providing greater blood flow to the exercising muscles. The warm-up prepares the body physically and mentally for the conditioning bout and may reduce the chance of injury while exercising. There is no set length of time for the warm-up, although 5 to 15 minutes is adequate. On cold days or when you feel sluggish, the warm-up may take longer. When you're feeling energetic or when the temperature is warm, the warm-up period may be shorter. A good method of gauging whether you have had an adequate warm-up is to pay attention to how you feel. Do you feel ready to exercise vigorously? If you still feel stiff and sluggish, you need a longer warm-up. A slight sweat, reflecting an increase in deep muscle temperature, is a good indication of an adequate warm-up.

Three activities may be included in the warm-up: calisthenics (such as jumping jacks), mild stretching exercises, and a short period of task-specific activity. Stretching during a warm-up is mainly preparation for the activity, not for flexibility. Gentle **static stretching**, in which a stretch is held for 10 to 30 seconds, is best.



Everybody benefits from physical activity.

Ballistic stretching, with jerking and bouncing movements, should not be used because it can strain cold muscles. See Figures 5-1 and 5-2 for more information on types of stretching and specific exercises. Most experts agree that the best time to stretch for flexibility is during the cool-down phase because the muscles are warmer and more elastic.

The **task-specific activity** is an exercise using the same muscles that will be used in the conditioning bout but at a lowered intensity level (lower heart rate). For example, joggers should include a short period of walking or slow jogging before increasing to normal intensity.

Conditioning Bout

The **conditioning bout** is the main part of the workout: 20 to 30 minutes or more. It may include a variety of activities for building cardiorespiratory endurance, muscular strength and endurance, or flexibility, depending on your goals. Gradually increase the frequency, time, and intensity of your exercise sessions until you reach a maintenance level. Progress slowly and listen to your body. If the exercise is at an appropriate level, you should recover within an hour. If you are too tired afterward or if the fatigue lingers until the next day, ease back on the workout time, intensity, or frequency to find an appropriate level. Your goal is a lifetime of exercise. Select one or more activities you will enjoy. Depending on your age, current fitness level, and physical abilities, enjoy walking, cycling, weight training, or any other vigorous activity you prefer.

Cool-Down

The **cool-down** is the final segment of the exercise session. The purpose of the cool-down is to ease your body back to its resting state. It will usually take 5 to 15 minutes to reduce the intensity of exercise. It should begin with the same activity performed in the conditioning bout, but at a lowered intensity. For example, if you jog, reduce the pace and end with a period of walking. Failure to cool down may allow the muscles to tighten further, potentially causing soreness and stiffness. Another problem with an inadequate cool-down is the possibility of venous blood pooling in the lower extremities, resulting in faintness and dizziness. The cool-down should continue until the heart rate is approximately 100 to 110 beats per minute or less. In the cool-down, spend a few minutes stretching while the muscles are thoroughly warm and elastic. Use the stretching exercises illustrated in Figures 5-1 and 5-2. Greater flexibility is achieved when stretching occurs in the cool-down segment of the workout.

PRINCIPLES OF FITNESS DEVELOPMENT

When a person begins an exercise program, the body adapts over time to the demands placed on it. The beneficial long-term changes that occur with regular exercise depend on several factors. To put together an effective exercise program, it is important to understand several principles of fitness development, including overload, specificity, reversibility, and individual differences.

Progressive Overload

Progressive overload is a gradual increase in physical activity, working a muscle group or body system beyond accustomed levels. Overload is perhaps the most important factor in developing physical fitness. When the amount of exercise is gradually increased, the muscle group or system, such as the cardiorespiratory system, gradually adapts, resulting in improved physiological functioning. In addition, a decrease in the severity and a delay in the onset of fatigue occur. If there is insufficient overload, there is no fitness improvement, but too much overload can cause injury. The key to gradual overload is to increase slowly.

To progress in cardiorespiratory exercise, gradually increase the frequency of workouts, starting with three and progressing to five workouts per week, adding one workout each week. Second, increase time. Start with workouts of 20 minutes (or less, if your fitness is very low), and lengthen the workouts by no more than 10 percent per week. For example, if the conditioning bout is 20 minutes, the next week's workout can be 22 minutes. Third, increase the workout intensity by no more than 10 percent per week. See Chapter 4 for further information on developing cardiorespiratory fitness.

The old saying "No pain, no gain!" is inappropriate advice for fitness exercisers. To increase your level of fitness and minimize the risk of overuse injury, follow the prescription factors in the correct order and listen to your body. Don't rush to get into shape in a few weeks. Exercise is for a lifetime.

Specificity

The **principle of specificity** means that only the muscles or body systems being exercised will show beneficial changes. To improve the cardiorespiratory system, exercise the heart and lungs through aerobic activities; to improve flexibility, do stretching exercises; and to improve muscular strength, lift weights. You cannot strengthen the muscles of the arms by jogging or increase cardiorespiratory fitness by doing yoga. This principle also helps explain why you are "wiped out" after swimming 10 minutes even though you can run for 30 minutes.

Reversibility

The **principle of reversibility** states that changes occurring with exercise are reversible and that if a person stops exercising, the body will decondition and adapt to the decreased activity level. Rate of fitness loss varies, but if a person stops exercising, a gradual loss of fitness begins within 48 hours. All fitness improvements can be lost within 2 to 4 months. If a person must decrease activity, the greatest benefits can be retained by maintaining intensity while decreasing the frequency or time of exercise. For example, if a person is traveling for 2 weeks and doesn't have time for the regular 30-minute run, 5 days a week, dropping to 20 minutes or 3 days a week at the usual target heart rate (THR) will help maintain training effect benefits.

Individual Differences

The **principle of individual differences** states that people vary in their ability to develop fitness components. Some people find that it is relatively easy to build strength, but they have to work hard to maintain their desired body composition. Others find that it is easier to increase their cardiorespiratory endurance than their flexibility. We differ in our genetic endowment, and there are limits on our ability to improve any particular fitness component. Some have estimated that maximal oxygen uptake can be improved by only about 15 to 30 percent with aerobic exercise. Even that amount of increase can make a tremendous difference in quality of life. Within our genetic endowment, we have potential for improvement. You don't have to be an Olympic athlete to gain the health benefits of physical activity.

Cross Training

Cross training involves participating in two or more types of exercise in one session or in alternate sessions for balanced fitness. An easy way to start is to vary activities; for example, you could add one swimming session and two weight training days to a three-times-per-week jogging program and stretch daily. Or within one exercise bout you may spend a few minutes warming up on a treadmill, lift weights, do stationary cycling for 20 minutes, and finish with stretching. See Table 3-2 for cross-training activities. Cross training provides several advantages for the health/fitness exerciser:

- ✓ It adds variety to your exercise sessions, preventing boredom and making it easier to stick to an exercise program.
- ✓ It provides a greater variety of fitness benefits than does any single activity alone. For example, weight training improves muscular strength and endurance but does little for cardiorespiratory endurance or flexibility. Running increases

TABLE 3-2 *Activities for Cross Training*

Exercise Goal	Activity
Cardiorespiratory endurance	Running, fitness walking, aerobic dance, bench and stair stepping, rope jumping, cross-country skiing, swimming, cycling, water exercise, in-line skating, ice skating, full-court basketball, ultimate Frisbee, soccer
Flexibility	Stretching, yoga, Tai Chi, Pilates
Muscular strength	Resistance training with weight machines, free weights, elastic bands, gymnastics
Muscular endurance	Calisthenics (push-ups, pull-ups, abdominal curls), weight training with light weights and high repetitions
Body composition	Cardiorespiratory endurance exercises burn calories at the highest rate per minute. Resistance training builds muscle, which increases metabolic rate for a greater calorie burn 24 hours a day.

cardiorespiratory endurance but does little for upper-body strength. Cross training can be used to develop all five fitness components.

- ✓ It reduces the risk of injury because the bones, joints, and muscles are not subjected to the same repetitive stresses of one activity, which leads to overuse injuries (e.g., shin splints from excessive impact).
- ✓ Changing activities utilizes muscles differently, promoting muscle symmetry, a balance of strength, and flexibility in opposing muscle groups. Using only one activity tends to cause some muscles to grow strong and their opposing muscles to grow disproportionately weak.
- ✓ You may continue to train while allowing an injury to heal by using activities that do not stress the injured area.
- ✓ It develops balanced fitness, because optimal performance in any activity usually requires more than one fitness component. For example, a distance runner may benefit from greater strength and anaerobic fitness to run uphill or sprint to the finish line.

ASSESSING PHYSICAL FITNESS

Physical fitness tests are often divided into two categories: health-related and skill-related. Skill-related tests, such as a vertical jump or shuttle run, are

performance-based and are related to athletic ability. Health-related tests are related to functional well-being in the areas of cardiorespiratory endurance, muscular strength and endurance, flexibility, and body composition. These areas of physiological functioning can be improved or maintained through regular exercise and offer protection against the negative effects of a sedentary lifestyle.

Do you know how fit you are? We seem to have a natural curiosity about how we compare to others. The purpose of fitness testing is to help you identify your current fitness levels in several health-related categories. Such an evaluation should tell you whether your current lifestyle is effective in developing and maintaining a level of fitness conducive to optimal wellness. Your results can be used as a basis for setting personal fitness goals; for developing an appropriate individualized exercise prescription; and finally, for measuring the effectiveness of your fitness program in reaching your goals. *Note:* Many different tests are provided as options. Do one or more, but do not feel that you must do all of them!

The remainder of this chapter gives norms that enable you to compare your fitness levels with those of other students. Norms reflect achievements of thousands of people who have completed a 12- to 15-week fitness course. When evaluating your fitness and setting goals, keep in mind that scoring in the “low” category does not reflect negatively on you. People often score in this category if they have not previously been exercising. While “superior” is an attainable goal for some, relatively few people achieve this level in one or more areas of fitness. *Health-related fitness benefits can be experienced at the “average” fitness level.* Bodies are different. Your current fitness level does not indicate your potential. Physical capacity to achieve any particular level of fitness is partially genetically determined. You may find that you gain strength easily but must constantly work on flexibility or vice versa.

Also keep in mind that all tests are subject to some measurement variability. Results of tests of aerobic capacity and muscular fitness are influenced by a person’s level of motivation. If you don’t try hard, your fitness will be underestimated. Use these norms as guidelines. Finally, testing should not dominate your program but help you measure its effectiveness. You may wish to measure at the beginning of your program and remeasure 8 to 12 weeks into the program to see how you are progressing.

A *Personal Fitness Profile* is located in Lab Activity 3-3. When completed, it will indicate areas of fitness you can maintain and areas needing improvement. It will help you decide where to begin in your fitness program. Norms for fitness tests are given in Table 3-3 and detailed instructions are given in Labs 3-4 through 3-10 at the end of this chapter.

TABLE 3-3 Fitness Test Norms*

1.5-Mile Run								
Age	18–29		30–39		40–49		50–59	
	F	M	F	M	F	M	F	M
Superior	<12:34	<8:26	<13:34	<9:10	<14:34	<9:55	<15:34	<10:40
Good	12:34–13:40	8:26–10:24	13:34–14:40	9:10–11:10	14:34–15:40	9:55–12:00	15:34–16:40	10:40–12:50
Average	13:41–14:45	10:25–12:31	14:41–15:45	11:11–13:45	15:41–16:45	12:01–14:55	16:41–17:45	12:51–16:05
Fair	14:46–16:00	12:32–14:49	15:46–17:00	13:46–16:00	16:46–18:00	14:56–17:15	17:46–19:00	16:06–18:30
Low	>16:00	>14:49	>17:00	>16:00	>18:00	>17:15	>19:00	>18:30

1.0-Mile Walk								
Age	18–29		30–39		40–49		50–59	
	F	M	F	M	F	M	F	M
Superior	<12:34	<11:39	<13:34	<12:40	<14:34	<13:40	<15:34	<14:10
Good	12:34–13:40	11:39–12:59	13:34–14:40	12:40–14:00	14:34–15:40	13:40–14:40	15:34–16:40	14:10–15:20
Average	13:41–14:45	13:00–14:21	14:41–15:45	14:01–15:20	15:41–16:45	14:41–15:55	16:41–17:45	15:21–16:25
Fair	14:46–16:00	14:22–15:43	15:46–17:00	15:21–16:15	16:46–18:00	15:56–16:45	17:46–19:00	16:26–17:25
Low	>16:00	>15:43	>17:00	>16:15	>18:00	>16:45	>19:00	>17:25

3.0-Mile Bicycle Ride								
Age	18–29		30–39		40–49		50–59	
	F	M	F	M	F	M	F	M
Superior	<9:18	<8:24	<9:54	<9:00	<10:30	<9:36	<11:06	<10:12
Good	9:18–10:06	8:24–9:12	9:54–10:42	9:00–9:42	10:30–11:06	9:36–10:12	11:06–11:36	10:12–10:42
Average	10:07–11:06	9:13–10:12	10:43–11:42	9:43–10:48	11:07–12:18	10:13–11:24	11:37–12:54	10:43–12:00
Fair	11:07–12:00	10:13–11:06	11:43–12:30	10:49–11:35	12:19–13:00	11:25–12:06	12:55–13:30	12:01–12:48
Low	>12:00	>11:06	>12:30	>11:35	>13:00	>12:06	>13:30	>12:48

500-Yard Swim								
Age	18–29		30–39		40–49		50–59	
	F	M	F	M	F	M	F	M
Superior	<7:05	<6:12	<7:35	<6:30	<8:05	<7:00	<8:35	<7:30
Good	7:05–8:49	6:12–7:44	7:35–9:19	6:30–8:14	8:05–9:49	7:00–8:44	8:35–10:19	7:30–9:14
Average	8:50–10:34	7:45–9:19	9:20–11:04	8:15–9:49	9:50–11:34	8:45–10:19	10:20–12:04	9:15–10:49
Fair	10:35–12:19	9:20–10:51	11:05–12:49	9:50–11:22	11:35–13:19	10:20–11:52	12:05–13:49	10:50–11:22
Low	>12:19	>10:52	>12:49	>11:22	>13:19	>11:52	>13:49	>11:22

500-Yard Water Run								
Age	18–29		30–39		40–49		50–59	
	F	M	F	M	F	M	F	M
Superior	<7:59	<6:53	<8:30	<7:20	<9:00	<7:50	<9:30	<8:20
Good	7:59–8:38	6:53–7:44	8:30–9:08	7:20–8:15	9:00–9:38	7:50–8:45	9:30–10:08	8:20–9:15
Average	8:39–9:18	7:45–8:38	9:09–9:48	8:16–9:05	9:39–10:18	8:46–9:35	10:09–10:48	9:16–10:05
Fair	9:19–9:58	8:39–9:32	9:49–10:28	9:06–10:00	10:19–10:58	9:36–10:30	10:49–11:28	10:06–11:00
Low	>9:58	>9:32	>10:28	>10:00	>10:58	>10:30	>11:28	>11:00

*Norms reflect the achievements of thousands of people who have completed a 12- to 15-week fitness course. Norms are revised yearly.

(continued)

GUIDELINES FOR MEDICAL CLEARANCE

According to American College of Sports Medicine guidelines, it is generally safe for men under age 40 and women under 50 to begin a vigorous exercise program if they are healthy and have had a satisfactory medical

checkup in the last 2 years. Also, if you have been exercising regularly, it is probably safe to continue progressing gradually from your current activity level. Prior to participation, you should complete the *Student Precourse Health Assessment* form found in Lab Activity 3-1 to identify any potential health concerns.

If you are over these age guidelines or if, regardless of age, you have had health concerns noted on the *Student*

TABLE 3-3 *Fitness Test Norms (continued)*

1-Minute Abdominal Curls									
Age	18–29		30–39		40–49		50–59		
	F	M	F	M	F	M	F	M	
Superior	>88	>93	>70	>78	>56	>65	>45	>49	
Good	75–88	79–93	60–70	62–78	48–56	53–65	38–45	42–49	
Average	60–74	64–78	47–59	51–61	37–47	42–52	29–37	35–41	
Fair	45–59	50–63	35–46	40–50	27–36	36–41	21–28	28–34	
Low	<45	<50	<35	<40	<27	<36	<21	<28	

1-Minute Push-Ups									
Age	18–29		30–39		40–49		50–59		
	F	M	F	M	F	M	F	M	
Superior	>54	>64	>43	>54	>33	>43	>23	>33	
Good	44–54	51–64	32–43	41–54	26–33	32–43	18–23	26–33	
Average	32–43	37–50	22–31	27–40	17–25	22–31	11–17	17–25	
Fair	20–31	23–36	13–21	18–26	8–16	13–21	6–10	8–16	
Low	<20	<23	<13	<18	<8	<13	<6	<8	

Sit and Reach (inches)									
Age	18–29		30–39		40–49		50–59		
	F	M	F	M	F	M	F	M	
Superior	>8.5	>7.0	>8	>6	>7	>5	>6	>4	
Good	6.5–8.5	4.0–7.0	5–8	3–6	4–7	2–5	3–6	1–4	
Average	4.0–6.4	1.0–3.9	3–4.9	0–2.9	2–3.9	–1–1.9	1–2.9	–3–0	
Fair	1.0–3.9	–2.0–0.9	0–2.9	–3––0.1	–1–1.9	–4––1.1	–2–0.9	–5––3.1	
Low	<1.0	<–2.0	<0	<–3	<–1	<–4	<–2	<–5	

Leg Press (max/body weight)									
Age	18–29		30–39		40–49		50–59		
	F	M	F	M	F	M	F	M	
Superior	>1.97	>2.39	>1.67	>2.19	>1.56	>2.01	>1.42	>1.89	
Good	1.68–1.97	2.13–2.39	1.47–1.67	1.93–2.19	1.37–1.56	1.82–2.01	1.25–1.42	1.71–1.89	
Average	1.50–1.67	1.97–2.12	1.33–1.46	1.77–1.92	1.23–1.36	1.68–1.81	1.10–1.24	1.58–1.70	
Fair	1.37–1.49	1.83–1.96	1.21–1.32	1.65–1.76	1.13–1.22	1.57–1.67	.99–1.09	1.46–1.57	
Low	<1.37	<1.83	<1.21	<1.65	<1.13	<1.57	<0.99	<1.46	

Bench Press (max/body weight)									
Age	18–29		30–39		40–49		50–59		
	F	M	F	M	F	M	F	M	
Superior	>1.00	>1.62	>.79	>1.34	>.76	>1.19	>.67	>1.04	
Good	.80–1.00	1.32–1.62	.70–.79	1.12–1.34	.62–.76	1.00–1.19	.55–.67	.90–1.04	
Average	.70–.79	1.14–1.31	.60–.69	.98–1.11	.54–.61	.88–.99	.48–.54	.79–.89	
Fair	.59–.69	.99–1.13	.53–.59	.88–.97	.50–.53	.80–.87	.44–.47	.71–.78	
Low	<.59	<.99	<.53	<.88	<.50	<.80	<.44	<.71	

SOURCES: For norms in 1.5-mile run, 1.0-mile walk, 3.0-mile bicycle ride, 500-yard swim, 500-yard water run, 1-minute abdominal curls, 1-minute push-ups, and sit and reach: E. Keener et al. "Undergraduate Student Physical Fitness Assessment," Muncie, IN: Ball State University (originally published Spring 1989; latest compiled data shown here); source for norms in leg press and bench press: based on norms from the Cooper Institute for Aerobics Research, Dallas, TX, revised 2000, used with permission.

Precourse Health Assessment form, it is important to check with your physician before taking a cardiorespiratory fitness test or participating in vigorous exercise. The *Physician-Approved Exercise Clearance Form* in Lab Activity 3-2 is designed for individuals with special health concerns to assist your instructor in individualizing your fitness

program according to your physician's recommendations. You may need to have a medical checkup and a diagnostic exercise test. If you smoke cigarettes, have been sedentary over the last several months, are pregnant, have diabetes, are 20 or more pounds overweight, or have family members who have positive risk factors for heart disease, it is

particularly important that you see your physician and ask him or her to fill out the *Physician-Approved Exercise Clearance Form*. Also, check with your physician if you are unsure or have concerns about your health.

CARDIORESPIRATORY ENDURANCE TESTS

High-level wellness is inextricably tied to a physically active lifestyle. If you want to be an active participant in life—not just a spectator—cardiorespiratory fitness is essential. A person with a high level of cardiorespiratory fitness can do more work with less fatigue than can a person with low cardiorespiratory fitness. Increased cardiorespiratory fitness can enhance quality of life by increasing the rate of energy production during physical activity. Low levels of cardiorespiratory fitness may result in a limited lifestyle due to low energy reserves, quick exhaustion after moderate exertion, and resulting inability to participate in vigorous, oxygen-demanding activities. The ability of your heart and lungs to supply oxygen during activity is one of the best indicators of overall physical fitness. There are several ways to measure your body's ability to use oxygen. The most accurate method is an **exercise tolerance test** on a treadmill or on a bicycle ergometer in a laboratory (see Figure 3-4). In an exercise tolerance test, a person exercises strenuously while heart rate and oxygen consumption are measured. This, however, is complex, expensive, and time-consuming and requires elaborate equipment and trained personnel. It is impractical for testing large numbers of people.

Cardiorespiratory fitness can also be measured in field tests conducted out of the laboratory setting. What these tests lose in accuracy they make up in the practicality of self-testing or testing many people at the same time. Field tests of cardiorespiratory endurance are generally based on physiological performance (distance or time tests) or a parameter such as pulse rate (step test).

A field test used to estimate oxygen consumption measures the time it takes you to jog 1.5 miles. Studies have shown that time on the 1.5-mile run correlates well with your maximal ability to utilize oxygen. The faster you cover the distance, the more efficient your heart and lungs are at their job of supplying oxygenated blood and nutrients to the working muscles. Field tests make it easy for you to measure your fitness and detect progress as you train. Keep in mind that if you retest within a few weeks, early improvements may be due to a “learning effect” rather than true cardiovascular changes. That is, you will learn to pace yourself better throughout the distance. It will take 8 to 12 weeks for significant cardiovascular improvement to occur. You should take the *1.5-Mile Run Test* only if you are conditioned for it. It is best if you have been building up to the distance gradually



FIGURE 3-4

Exercise tolerance test on a bicycle ergometer.

for several weeks prior to taking the test. Other field tests that measure cardiorespiratory endurance are the *1-Mile Walk Test*, the *3-Mile Bicycling Test*, the *500-Yard Swim Test*, the *500-Yard Water Run Test*, and the *3-Minute Step Test*. You can choose the test most appropriate for your chosen physical conditioning activity. Detailed instructions for these tests are in Labs 3-4 through 3-6.

Pretest Instructions

For any of the cardiorespiratory endurance tests, you will need comfortable clothes appropriate for the activity and a stopwatch or a watch with a second hand.

- ✓ If possible, avoid taking the test under conditions of extreme heat or cold, particularly if you are not accustomed to exercising under those conditions.

- ✓ Do not eat a heavy meal, consume alcohol, take caffeine, or smoke for up to 3 hours prior to the test.
- ✓ Drink plenty of fluids the day before testing.
- ✓ Rest from vigorous exercise at least 1 day prior to taking the test.
- ✓ Get adequate sleep (7 to 9 hours) the night before testing.
- ✓ Warm up and stretch before taking the test and then cool down and restretch afterward.
- ✓ If at any point during the test you begin to feel ill, dizzy, faint, or extremely short of breath, stop! Your body is telling you that you are not ready for this level of exertion.

Do not be ashamed of stopping before completing the test, especially if you are unfit. Test performance may be limited by local muscular endurance or by aerobic capacity. You may record the amount of time in the test you were able to complete and work toward a fitness level that will enable you to complete the test.

1.5-Mile Run Test

The *1.5-Mile Run Test* requires six laps around a standard quarter-mile track, or it can be done on a measured section of road that has few stoplights. Consider taking this test only if you have been exercising previously. The *1-Mile Walk Test* may be more appropriate for you if you are over 35 years of age or 20 or more pounds overweight or if you have been out of shape for some time but are otherwise in good health. See Lab 3-4 for detailed instructions.

1-Mile Walk Test

For those who are starting a walking program or for whom the *1.5-Mile Run Test* may be too vigorous, the *1-Mile Walk Test* is an option. You will need a 1-mile measured course (four laps of a quarter-mile track), your walking shoes, and a watch with a second hand. See Lab 3-4 for detailed instructions.

3-Mile Bicycling Test

If your main fitness activity is bicycling, you can test your cardiorespiratory fitness with a timed 3-mile bicycle ride. This test can be done on a bike track or on a measured section of road with few stoplights or stop signs. See Lab 3-4 for detailed instructions.

500-Yard Swim Test

If your fitness program consists primarily of swimming, you will find a swimming endurance test useful. A regulation 25-yard pool is recommended, and you will need a friend to time you. You may swim any stroke, although best results will be obtained with the front crawl. See Lab 3-5 for detailed instructions.

500-Yard Water Run Test

The *500-Yard Water Run Test* was designed for those involved in aerobic water exercise programs in which swimming skills are not required. It can be done lengthwise in a pool of constant depth or widthwise across the shallow end of a pool of variable depth. It helps to work in pairs, with one partner on deck counting completed laps for the other. For the most accurate results, runners should carve their own paths through the water and avoid drafting in the wake of other runners. Runners should use their arms to pull as they run but must maintain a vertical body position. No swimming is allowed. See Lab 3-5 for detailed instructions.

3-Minute Step Test

A variety of step tests are useful for testing cardiorespiratory fitness indoors. They involve stepping on and off a bench for a 3- to 5-minute period and measuring the heart rate recovery. The step test is based on the fact that the heart rate of a person who is physically fit is lower at any workload and recovers faster than does the heart rate of a person who is unfit. Although it is not the best measure of cardiorespiratory fitness, it is a quick and simple way to evaluate the heart's response to exercise. It is easy to administer to an individual or to large groups, requires no special skill to perform, and requires little equipment. See Lab 3-6 for detailed instructions.

MUSCULAR STRENGTH AND ENDURANCE TESTS

Muscular strength and endurance are assets in the ability to perform daily activities—lifting, carrying, pushing, pulling—without strain or undue fatigue. Strength and endurance of the abdominal muscles are particularly important for good posture and lower back health. Muscular fitness activities add shape and firmness to muscles, resulting in a trim, well-toned appearance.

Muscular strength and muscular endurance tests have been used as a measure of physical fitness for years. Physical conditioning activities require and can develop both components. Strength is best developed by weight training and is often measured by one maximal lift with weights. Muscular endurance can be measured without special equipment by using the tests provided in Lab 3-7.

Muscular strength and muscular endurance are measured by different tests. You can assess the strength of major muscle groups by taking the *Leg Press Strength Test* and the *Bench Press Strength Test* using the guidelines provided in Lab 3-8.

Abdominal Curls and Push-Ups

Abdominal curls are perhaps the best way to assess the endurance of the abdominal muscles. The traditional *Bent-Knee Sit-Up Test* requires use of the thighs and hip flexors as well as abdominals and may put the back at risk. Abdominal curls isolate and test only abdominal muscles, decreasing risk to the lower back. Push-ups test the muscular endurance of the arms and upper-body muscles. Directions and norms for abdominal curls and push-ups are given in Lab 3-7.

Leg Press Strength Test

The best measure of strength is one single maximal lift (one-rep max). This should be attempted only after several sessions of weight training, emphasizing proper lifting form for safety, as the risk of injury is high for an inexperienced lifter. If you have knee, ankle, or lower back problems, check with your physician before attempting a maximal lift. As there is no industry standard for resistance levels on weight machines, “70 pounds” will give a slightly different resistance level on a Universal, Cybex, or Nautilus. Strength testing using a machine is encouraged as it is safer than using free weights. You will need a leg press machine and a weight scale. Detailed instructions are given in Lab 3-8.

Bench Press Strength Test

If you have shoulder problems, check with your physician before attempting a maximal lift. While free weights may be used, strength testing using a machine is encouraged because it is safer than using free weights. You will need a bench press machine and a weight scale. See Lab 3-8 for detailed instructions.

FLEXIBILITY TESTS

Flexibility is a valuable asset in daily activities or in any type of vigorous exercise program. The ability to move joints through a full range of motion without stiffness or tightness makes exercise more comfortable and may decrease the risk of injury. The tests included in this section will indicate whether you have a normal range of motion in the lower back and other important areas.

Quick Checks for Flexibility

The quick checks for flexibility in Lab 3-9 are easy ways of measuring the flexibility of major muscle groups often shortened and tightened in daily activities. Each quick check is also a stretch, so if your range of motion is limited or if you feel excessive tightness in a joint or muscle group, use the same position to improve flexibility in

that area (see Chapter 5 for basic fitness flexibility guidelines). Note that the hamstring flexibility test (Lab 3-9) eliminates the problem of arm-leg length discrepancy found in the traditional sit and reach test.

Sit and Reach Test

The *Sit and Reach Test* (Lab 3-9), which measures back and hamstring flexibility, can be done with a flex box. If you do not have a flex box, the test can be performed with a ruler on a bench or on the ground with feet flexed. Norms are given using the soles of the feet as the 0 inches mark.

Sit and Reach Wall Test

The *Sit and Reach Wall Test* is a self-check for flexibility and can quickly be performed by a large number of people. All you need is a wall. See Lab 3-9 for detailed instructions.

BODY COMPOSITION TESTS

A certain amount of body fat is essential to good health. Fat acts as an insulator, conserving body heat. It pads bones and cushions internal organs, and it stores and supplies energy for later use.

In a diet-obsessed society in which both obesity and eating disorders abound, few people realize that excessive leanness can be as unhealthy as excessive fatness. For young adults, an average range of body fat for women is 21 to 24 percent, and for men it is 14 to 17 percent (Table 3-4). Keep in mind that each of us has inherited a certain body build and fat distribution; it is natural for some bodies to carry more fat than others do. It is also natural to increase body fat slightly as we age.

While weight scales can tell you how much you weigh, they cannot tell you how much of your body is composed of fat or lean tissue. A sedentary individual may maintain a normal weight for height but increase fat and lose **lean body mass** (muscle tissue) over time. A body builder may be “overweight” according to height-weight charts, but this is due to the development of muscle and bone rather than fat. Being overweight due to having a substantial amount of lean muscle tissue is not the same as being overweight due to excess fat tissue. People who have a muscular build may think they are too heavy when the weight is mainly lean tissue. They could jeopardize their health trying to lose weight unnecessarily. On the other hand, sedentary people who are satisfied with their weight may be shocked to discover that their body fat percentage is over 30 percent, high enough to pose a health risk. In the early stages of a fitness program, excess fat will often be lost and lean muscle weight will increase as fitness improves. Even if no significant weight change occurs, the exerciser

is leaner and appears trimmer because a pound of muscle is denser than a pound of fat.

Body fat is measured by using several different techniques. Laboratory tests include DEXA and hydrostatic weighing. Nonlaboratory tests that use indirect techniques to estimate body composition include bioelectrical impedance, skinfold assessment, and measurements of circumference. While these tests are not 100 percent accurate, they are useful for assessing change in body composition.

Dual energy X-ray absorptiometry (DEXA) is a laboratory test that uses very low-dose X-ray energy to measure body fat, muscle, and bone mineral. It is considered to be more accurate and valid than underwater weighing. When having the scan done, a person lies still on the DEXA table for about 12 minutes as the computer produces an estimate of body fat, muscle, and bone mineral. Two drawbacks are that it is an expensive test and is not readily available to fitness participants.

Underwater (hydrostatic) weighing is based on Archimedes' principle, which states that when a body is submerged in water, there is a buoyant counterforce equal to the weight of the water that is displaced. A person's weight on land and weight in water are compared. Because bone and muscle are denser than water, a person with a larger percentage of **fat-free tissue** is heavier in the water and records a lower percentage of body fat. However, fat floats, and so a large amount of fat mass will weigh less in the water. This technique reports an accuracy of ± 2 percent and has been used by research laboratories to assess body composition for decades. The drawbacks are that it requires elaborate equipment, trained personnel, and about 30 minutes to test each person. Also, emptying the lungs of air (since air makes the body float) and repeatedly submerging underwater may be difficult for some individuals.

Bioelectrical impedance analysis (BIA) is based on the principle that an electrical current travels through fat-free tissue (all parts of the body except fat) with its high water and electrolyte content more readily than it does through fat. By measuring resistance to the current (which is too mild to be felt), the machine estimates body fat. Machines are inexpensive, are easy to use, and include handheld devices and weight scales with built-in electrodes (see Figure 3-5). However, the results vary with differences in hydration, placement of electrodes, and type of machine. BIA tends to overestimate lean individuals and underestimate those who are obese. Hydration plays an important role in BIA and can cause inaccurate results. Dehydration, which can be caused by exercising before testing, not drinking enough fluids, diuretics, illness, and drinking alcohol or caffeine, will cause overestimation of fat percentage. If these variables are controlled, BIA gives a fairly good estimate of body fat, with accuracy reported as ± 2 to 5 percent.



FIGURE 3-5

Bioelectrical impedance devices estimate body fat percentage.

Another technique for measuring body composition involves the use of **skinfold calipers**. A caliper is a device that compresses the skin at a pressure determined by a spring. Skinfold measurements can be used to assess your proportion of fat to lean tissue because about 50 percent of your fat is **subcutaneous fat**—located directly under the skin between the skin and the underlying muscle. The amount of subcutaneous fat you have correlates highly with total body fat. An experienced measurer can assess body fat with skinfold calipers to within a range of plus or minus 2 to 5 percent. An inexperienced tester may be less accurate. Two or more body sites may be measured, and accuracy increases with the number of sites sampled. Accuracy diminishes at the ends of the scale—for the very obese and the very lean—but for the average individual, skinfolds are reliable.

A self-test of body composition, though considerably less accurate than skinfold caliper measurements, involves body girth measures of body fat. Keep in mind that greater fitness is not guaranteed by low body fat, and what constitutes a healthy fat percentage for you is an individual matter.

Body Composition Assessment Using Skinfold Calipers

Goal: To measure subcutaneous body fat accurately.

Directions: Have a person trained in the use of skinfold calipers perform the following steps.

1. Measure skinfolds on the right side of the body by using a skinfold caliper.
2. Grasp a fold of skin between thumb and forefinger, pulling it away from the underlying muscle.



Skinfold measuring technique.

3. Apply the calipers about 0.25 inch below the fingers holding the skinfold.
4. For men, take triceps and thigh measurements on a vertical skinfold. For women, take subscapular and suprailiac measures on a slight lateral slant along the natural fold of the skin.
5. Measure twice. Take readings to the nearest half millimeter. If the readings do not match, take a third measurement and average the closest two measurements.
6. Skinfold sites for women are the following:
 - a. Triceps. Measure a vertical skinfold on the back of the arm midway between the shoulder and the elbow.
 - b. Suprailiac. Measure a slightly lateral fold at the middle of the side of the body just above the hip bone (iliac crest).
7. Skinfold sites for men are the following:
 - a. Subscapular. Measure a diagonal fold just under the right shoulder blade (scapula).
 - b. Thigh. Measure a vertical fold on the front of the thigh midway between the inguinal fold (where the hip bends in front) and the top of the patella (knee cap).
8. Mark your two skinfold measurements on the *Percent Body Fat Nomogram* (Figure 3-7) and connect the marks with a straight line. Read your percent of fat on the center scale. See Table 3-4 for your body composition evaluation. If your body fat is not on the nomogram, use the following formula (Sloan-Weir):

Female (percent body fat formula)

$$\% \text{ Body fat} = [(4.57 \div (1.0764 - (0.00081 \times \text{suprailiac skinfold, mm}) - (0.00088 \times \text{triceps skinfold, mm}))) - 4.142] \times 100$$



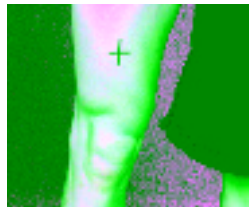
Triceps.



Suprailiac.



Subscapular.



Thigh.

Male (percent body fat formula)

$$\text{Percent body fat} = [(4.57 \div (1.1043 - (0.00133 \times \text{thigh skinfold, mm}) - (0.00131 \times \text{subscapula skinfold, mm}))) - 4.142] \times 100$$

Example: A male with thigh skinfold = **10 mm** and subscapular skinfold = **10 mm**

$$\begin{aligned} \text{Percent body fat} &= [(4.57 \div (1.1043 - (0.00133 \times 10 \text{ mm}) - (0.00131 \times 10 \text{ mm}))) - 4.142] \times 100 \\ &= [(4.57 \div (1.1043 - 0.0133 - 0.0131)) - 4.142] \times 100 \\ &= [(4.57 \div 1.0779) - 4.142] \times 100 \\ &= .0977 \times 100 \\ &= 9.77\% \text{ body fat} \end{aligned}$$

Body Girth Measures

Many people begin a fitness program because they are concerned about their physical appearance. Basic body build is an inherited characteristic, and less than 5 percent of the population can aspire to the current cultural “ideal” of model-like proportions. Take a look at your parents and grandparents to get an idea of your genetic endowment and what is realistic for you. While your basic structure cannot be altered, as fitness improves, fat may be lost from deposit areas and muscles will become firmer, enhancing body contours. You may notice a loss of unwanted inches from the waist, hips, or thighs or a desirable reshaping of body contours before noticing any weight change. Body girth measures will help you set goals to work for a trim, healthy body shape.

Goal: To measure body girths.

Directions: Recruit a partner to measure you. You will need a measuring tape. For each measurement, pull the tape snugly, but do not indent the flesh. Take the measurements at the following sites (Figure 3-6):

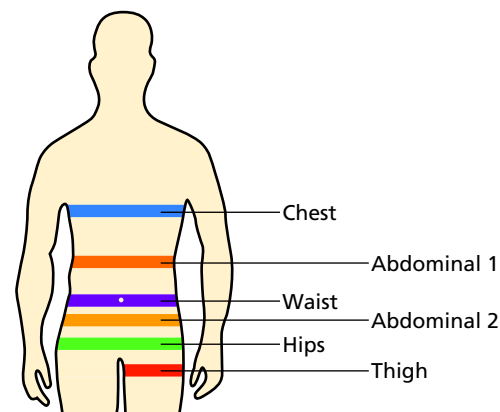


FIGURE 3-6

Body girth measurement sites.

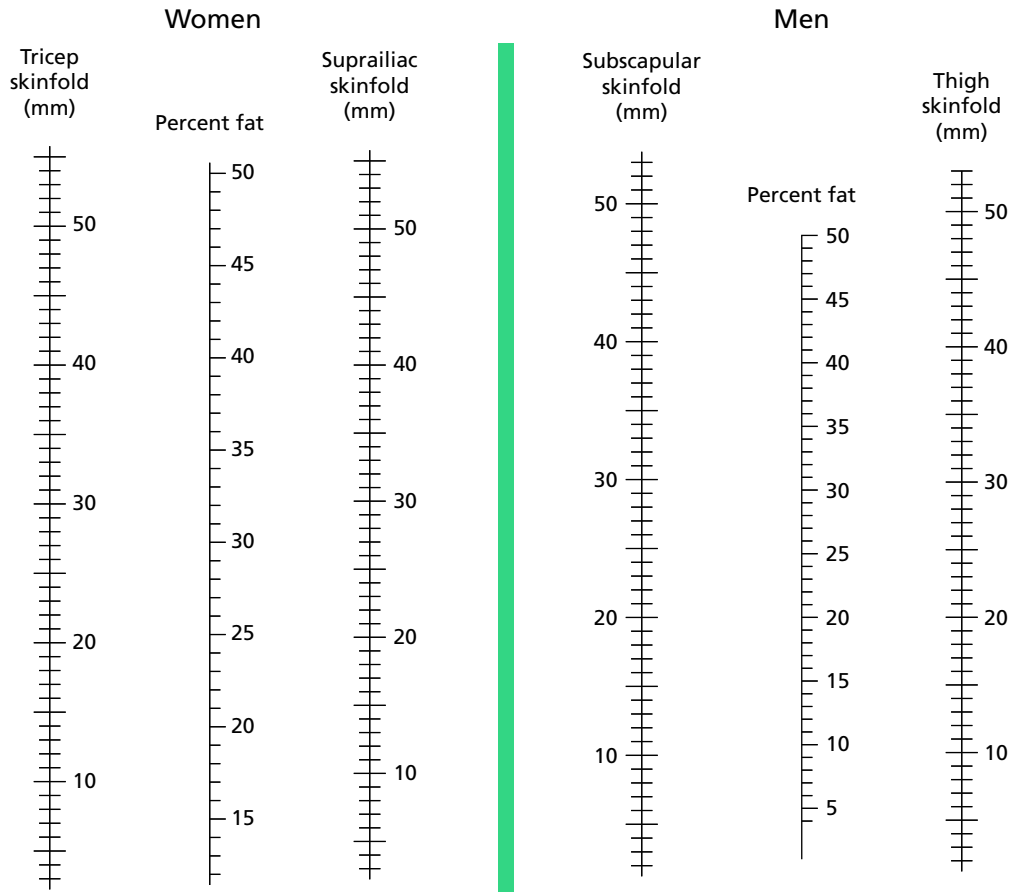


FIGURE 3-7

Percent body fat nomogram. SOURCE: A. W. Sloan and J. Weir, "Nomograms for Prediction of Body Density and Total Body Fat from Skinfold Measurements."

Journal of Applied Physiology 28:2 (1970): 221–222. Reprinted by permission of the American Physiological Society.

TABLE 3-4 *Body Fat Norm Percentages*

Ages	18–29		30–39		40–49		50+	
	F	M	F	M	F	M	F	M
Very low fat	<17	<10	<18	<11	<19	<13	<20	<15
Low fat (trim)	17–20	10–13	18–20	11–16	19–21	13–18	20–22	15–19
Average	21–24	14–17	21–24	17–19	22–24	19–21	23–25	20–22
Above average (fat)	25–27	18–20	25–27	20–22	25–27	22–23	26–28	23–24
High fat	28–30	21–25	28–30	23–25	28–30	24–25	29–31	25–26
Obese	>30	>25	>30	>25	>30	>25	>31	>26

SOURCE: E. Keener et al. "Undergraduate Student Physical Fitness Assessment." Muncie, IN: Ball State University (originally published Spring 1997; latest compiled data shown here).

- ✓ *Chest*: across the nipple line at the midpoint of a normal breath
- ✓ *Abdominal 1*: across the floating ribs, halfway between the chest and waist, at the midpoint of a normal breath
- ✓ *Waist*: the narrowest point, across the navel
- ✓ *Abdominal 2*: across the iliac crest (hip bones), midway between waist and hips
- ✓ *Hips*: with feet together, across the pubic bone in front and across the widest part in back
- ✓ *Thigh*: right side, widest part, 1 inch below the crotch

TABLE 3-5 *Waist-to-Hip Ratio, Waist Girth, and Health Risk**

Waist-to-Hip Ratio	High Risk	Waist Circumference	High Risk
Men	.95 or greater	Men	over 40 inches
Women	.80 or greater	Women	over 35 inches

*Risk of cardiovascular disease, hypertension, and type 2 diabetes

Body Girth Measures of Body Fat

Body girth measures of fatness have greater variability than do other measures of body fat, such as skinfolds. However, their advantage is that they do not require special equipment or training and can be done with a measuring tape at home.

Directions:

1. Men should measure waist girth at the navel, and women should measure hips at the widest point. Pull the tape so it is snug but does not indent the skin.
2. Remove shoes. Men should measure their weight without clothing. Women should measure their height.
3. Mark the measurements on the appropriate circumference chart and connect them with a straight line (Figure 3-8).

Waist-to-Hip Ratio and Waist Girth

Investigations have begun pointing to the location of excess fat as a risk factor for heart disease and certain cancers. Fat distributed in the abdominal area is linked to increased health risks; hip/thigh fat is not as risky. As a result, the waist-to-hip ratio has become a common assessment for health-risk identification. To compute this ratio, divide the waist measurement by the hip measurement.

$$\frac{29 \text{ in. waist}}{38 \text{ in. hip}} = 0.76 \qquad \frac{42 \text{ in. waist}}{36 \text{ in. hip}} = 1.17$$

Studies indicate that health problems are increased for women whose ratio is 0.80 or higher and for men whose ratio is 0.95 or higher. You may also use waist girth alone. Health risks are higher for women with a waist measurement over 35 inches, and for men with one over 40 inches. (See Chapter 12 for more information on waist-to-hip ratio as a health-risk factor.)

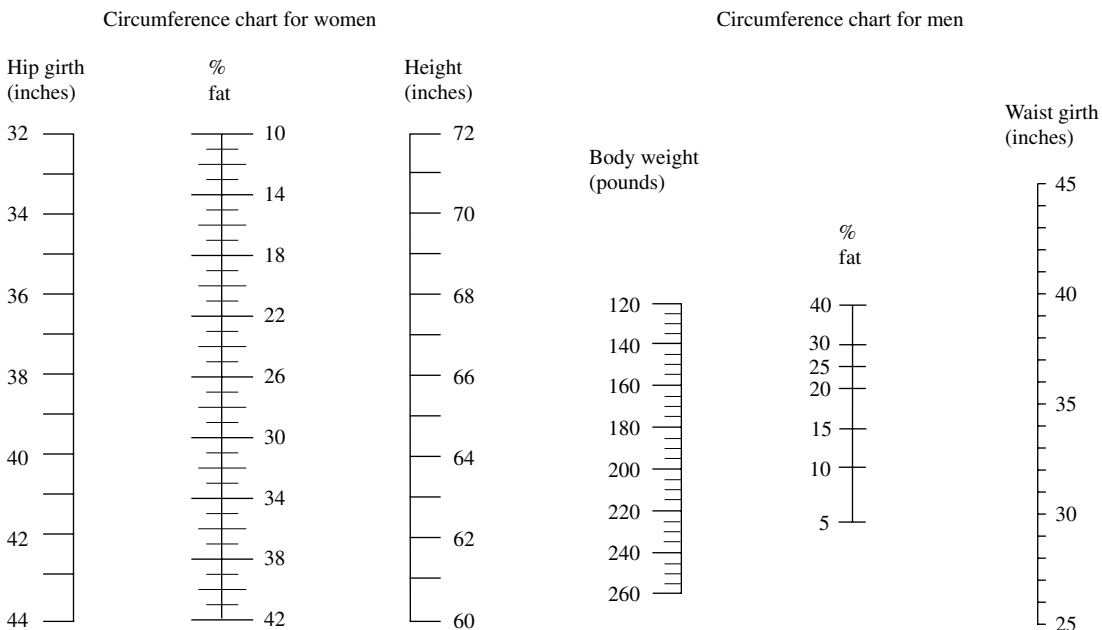
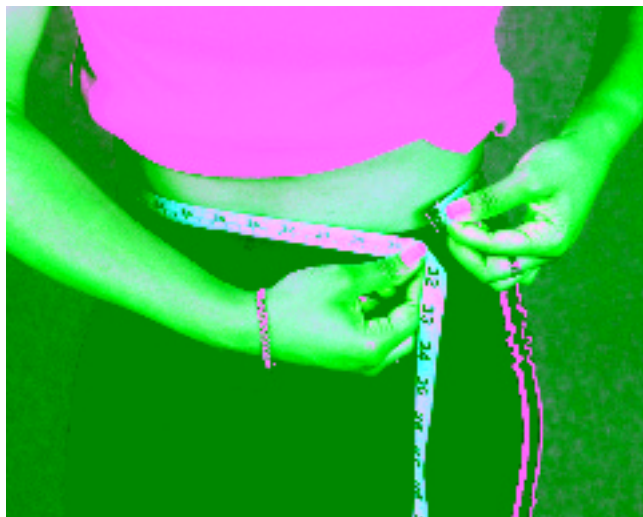


FIGURE 3-8

Circumference charts. SOURCE: Nomograms developed by Jack Wilmore, University of Texas. Used by permission.



Waist-to-hip ratio or waist girth alone can identify health risk.

PRESCRIPTION FOR ACTION

R You've read the chapter. Now go do one or more of these.

- ✓ Write down three reasons your last exercise program did not work and a solution for each.
- ✓ Schedule exercise on your calendar for a specific time 3 to 5 days this week.
- ✓ Take a 15-minute study break and go for a walk.
- ✓ Get to your job 30 minutes earlier and walk before starting work.
- ✓ Pack a sack lunch and take a 30-minute walk on your lunch break.
- ✓ Call a friend and make a date to bicycle or play tennis.
- ✓ Jump rope or use a stationary cycle while watching the news.



Frequently Asked Questions

- Q. I want to exercise, but after a full day of work and classes I feel too tired, plus exercise makes me more tired. What should I do?**
- A. Schedule a time that works for you. Some people have more energy in the morning and get up a half hour early for a brisk walk. Others take time during their lunch hour. Still others schedule a class (like aerobics or spinning) at the end of the day. Whatever time you choose, schedule it in like an appointment. Some days you will start with more energy, and other days less, but generally, if the intensity is appropriate, you will find yourself invigorated rather than exhausted at the end of the workout. Use the “talk test” to judge if you are exercising at the correct intensity. It may also help if you exercise with a friend; that way it will seem more like fun and less like work. Review the Top 10 “Ways to Stick with Exercise” in Chapter 4 for more tips on maintaining your exercise program.
- Q. How many calories do I burn while walking or jogging a mile?**
- A. Caloric expenditure is based on body weight. You burn about 62 calories per 100 pounds per mile whether walking or jogging. It's a principle of physics. It takes a certain amount of energy to move weight a certain distance. If you weigh 150 pounds, you burn $62 \times 1.50 = 93$ calories per mile.
- Q. I want to lose weight. Is it better to exercise for a longer time at a lower intensity or for a shorter time at a higher intensity?**
- A. If your main goal is weight control, the most important factor, besides a low-fat, nutritious diet, is to be consistent about working aerobic exercise—of any length and intensity—into your daily schedule. Work out at least 5 days per week. Total calories expended is more important than intensity of activity in maximizing weight loss. One or two weight-training sessions per week also lead to weight control. Moderate-intensity exercise is recommended because it allows you to exercise longer, accumulate more total work, and thus burn more calories, and it is less likely to cause discomfort or injury. Moderate-intensity activity can also help you keep off lost weight. If your goal is high-level fitness, exercise at a higher intensity is necessary.
- Q. I swim/cycle regularly and feel like I'm in pretty good shape. Why did I score only “average” on the 1.5-mile walk/run?**
- A. It's the rule of specificity. Your aerobic fitness will show best if you use the test specific to your activity. Swimmers should use the 500-yard swim, cyclists the 3-mile ride, for results that better reflect their aerobic fitness level. Likewise, someone who usually runs for exercise would find a cycling or swimming test more difficult.
- Q. I had my body fat tested by skinfold calipers and bioelectrical impedance. They gave different results. Which is more accurate?**
- A. Both are reasonably accurate when used by an experienced tester, with average errors of 2 to 5 percent. Skinfold calipers are more accurate if

multiple sites are measured to get a better picture of total fat distribution. Bioelectrical impedance can overestimate fat percentage if you are dehydrated,

and results vary depending on where the electrodes are placed and the type of machine used.

Summary

The sedentary lifestyle of most Americans is seriously undermining the health and welfare of our nation. We are fast becoming overfat and underfit, resulting in reduced levels of well-being. From the information you have acquired in this chapter, you now have the necessary tools to develop a personalized physical fitness program, based on sound scientific principles and using your age, resting heart rate, interests, and abilities. You have also gained a better understanding of the health benefits that can be achieved by incorporating moderate levels of physical activity into your daily life. By applying the concept of a three-segment workout and finding ways to increase daily activity, you can be on your way to a lifetime of improved health, fitness, and wellness.

Assessment is a critical tool in developing any dimension of wellness. It helps you understand your

strengths and weaknesses and decide whether your current levels of cardiorespiratory endurance, muscular endurance, flexibility, and body fat are conducive to optimal wellness. With this knowledge, you can set reasonable fitness goals, establish a starting point for a fitness program, and develop a plan of action. Specific workout programs for different aerobic activities can be found in Chapter 4. A *Student Precourse Health Assessment* form and a *Personal Fitness Profile* are also available in the Lab Activities section of this chapter.

As you progress in your fitness program, it may be useful to retest occasionally. While testing should not dominate your program, it will allow you to monitor your progress and can give you additional motivation to continue regular exercise.



Internet Resources

American Academy of Family Physicians

www.familydoctor.org

Promotes healthy behaviors with fact sheets on many health topics, including exercise and fitness.

American College of Sports Medicine

www.acsm.org/sportsmed

Information on sports research, health and fitness, and aerobic exercise guidelines, along with a quarterly fitness newsletter. “Current Comments” gives information on a variety of exercise topics of recent interest.

American Council on Exercise

www.acefitness.org/fitfacts/

Features 100 fitness fact sheets, free e-newsletters, and a variety of different fitness activities from bicycling to swimming.

American Heart Association

www.americanheart.org

Health tools include an exercise diary and body mass calculator. Information includes exercise and fitness promotion for women, children, seniors; information on how exercise affects heart health; exercise tips; and a healthy heart workout quiz.

Centers for Disease Control and Prevention

www.cdc.gov/nccdphp/dnpa/

Information on getting started in physical activity, exercise tips, links to other fitness resources, and health promotion

for increasing physical activity in your school or community.

Medline Plus

www.nlm.nih.gov/medlineplus

Consumer site with comprehensive information on many health topics, including physical fitness benefits, health, weight management, and fitness at any age.

National Center for Chronic Disease Prevention and Health Promotion

www.cdc.gov/nccdphp

Information on nutrition, physical fitness, and preventing chronic diseases such as diabetes and cancer.

National Institutes of Health

www.nhlbisupport.com/bmi

Calculate your body mass index, assess your risk, and find information and recipes for weight control.

President’s Council on Physical Fitness and Sports

www.fitness.gov

Information on fitness and health, weight control, exercise for kids and seniors, videos, and sports and fitness awards, along with fact sheets on fitness and health.

Shape Up America!

www.shapeup.org

Information and guidance on fitness, the 10,000 step program, weight management, plus a body fat lab.

LAB Activity

3-1

Name _____ Class/Activity Section _____ Date _____

Student Precourse Health Assessment

Student ID# _____ Age _____ Date of last medical checkup _____

Please answer all of the questions completely and honestly. This document is confidential between the student, instructor, and administration. This form is used to help you stay safe in courses that have physical activities. If at any time you do not feel well or experience an injury, please tell your instructor immediately. If you must leave the activity area to get water or use the restroom take a classmate with you. While your participation in this course may enhance your health and well-being, you are advised that participation in some activities may be extremely vigorous and have potential risks. Some sports have inherent risks associated with them. If you have any questions about the course or activities, please talk to your instructor. If you are over age 40 (for men) or 50 (for women), it is highly recommended that you see your personal physician before you begin this class. The presence of some of the following conditions may affect your performance. Please check any conditions listed that pertain to you.

- Cardiac/respiratory problems Asthma (any) High blood pressure (140/90 or above)
 Chest pain or discomfort Epilepsy (seizures/grand mal, 3+ min.) Pregnancy
 Severe allergic reactions Diabetes Severe headaches
 Fainting spells/sudden unconsciousness Family history of heart disease
 Other life-threatening conditions (please list): _____

- Knee injuries Shoulder injuries Ankle injuries
 Back injuries Neck/spinal injuries Foot injuries
 Scoliosis Smoker Allergies
 Epilepsy (seizures/petit mal) Other, please list below

Please list any other medical conditions or information you think should be brought to the attention of your instructor.

Please list all medications that you take regularly.

If during this class/course your physical health changes in regard to any of the listed or other conditions, please notify your instructor immediately. If you have concerns about your health, are sedentary, diabetic, pregnant, 20 or more pounds overweight, smoke, or have a family history of heart disease, it is important that you complete the *Physician-Approved Exercise Clearance Form*.

By signing this form I understand my responsibility toward staying safe in this course and informing my instructor that I am not withholding any information regarding my health status. (Please sign, date, and return this form to your instructor.)

Student Signature _____ Date _____

Student Phone Number _____

LAB Activity

3-2

Name _____ Class/Activity Section _____ Date _____

Physician-Approved Exercise Clearance Form

Student ID# _____ Age _____ Date of last medical checkup _____

This form is designed for individuals with special health concerns to assist your instructor in individualizing your fitness program according to your physician's recommendations.

This section is to be completed by the Lab Instructor:

(Name of student) _____ is presently enrolled in (name of course) _____ and he/she has identified the following health problems on the Student Precourse Health Assessment Form that may affect participation in the activities of this course.

This class/course will include the following activities:

The above information was provided by (**instructor's name**) _____ Date _____

This section is to be completed by the Physician:

NOTE TO PHYSICIAN: PLEASE REVIEW THE STUDENT PRECOURSE HEALTH ASSESSMENT FORM.

After reviewing the form, I recommend the following level of participation:

_____ Full participation _____ Modified participation as indicated _____ No participation*
(Please indicate below):

*If the student may not participate in this class, list the activities in which the student may participate:

Signature of Physician

Date (mm/dd/yy)

Physician's Printed Name

Physician's Fax Number

Physician's Phone Number

LAB Activity

3-3

Name _____ Class/Activity Section _____ Date _____

Personal Fitness Profile

	Pretest Date: _____	Posttest Date: _____
1. Resting heart rate	_____	_____
2. Cardiorespiratory endurance (Labs 3-4, 3-5, 3-6)		
1.5-mile run	_____	_____
1.0-mile walk	_____	_____
500-yard swim or water run	_____	_____
Other _____	_____	_____
Exercise pulse	_____	_____
3. Muscular endurance (Lab 3-7)		
Abdominal curls	_____	_____
Push-ups	_____	_____
4. Muscular strength (Lab 3-8)		
Leg press	_____	_____
Bench press	_____	_____
5. Flexibility (Lab 3-9)		
Sit and reach	_____	_____
6. Body girth measurements (Figure 3-6)		
Hips—biggest part	_____	_____
Thigh—1 inch below crotch	_____	_____
Chest—nipple line	_____	_____
Waist—smallest part	_____	_____
Abdominal 1—halfway between chest and navel	_____	_____
Abdominal 2—halfway between navel and pubic bone	_____	_____
7. Waist-to-hip ratio (Lab 3-10)	_____	_____
8. Body composition		
<i>Female</i> <i>Male</i>		
Triceps Subscapula	_____	_____
Iliac Thigh	_____	_____
Percent body fat (see nomogram in Figure 3-7)		
9. Weight	_____	_____
10. Height	_____	_____
Quick checks (pass or fail) (Figures 3-11 to 3-15)	P/F	P/F
a. Erector spinae	_____	_____
b. Iliopsoas	_____	_____
c. Quadriceps	_____	_____
d. Hamstrings	_____	_____
e. Gastrocnemius	_____	_____

LAB Activity 3-4

Name _____ Class/Activity Section _____ Date _____

Evaluating Your Cardiorespiratory Fitness: 1.5-Mile Run Test, 1.0-Mile Walk Test, and 3.0-Mile Bicycling Test

1.5-MILE RUN TEST

Equipment Needed:

A track or premeasured course of 1.5 miles
Stopwatch or a watch with a second hand

Procedure

1. Before taking the test, warm up with walking, stretching, and a slow jog.
2. This is a test of maximum capacity, so push yourself to cover the distance as quickly as possible without overdoing it. Try to maintain a continuous, even pace. Run as long as you can and then walk if necessary. When you complete the 1.5-mile distance, record your time.

Running time: _____

3. Cool down by walking slowly for several minutes and stretching.
4. Check the table below for your fitness rating.

Cardiorespiratory fitness rating: _____

Age	1.5-Mile Run							
	18–29		30–39		40–49		50–59	
	F	M	F	M	F	M	F	M
Superior	<12:34	<8:26	<13:34	<9:10	<14:34	<9:55	<15:34	<10:40
Good	12:34–13:40	8:26–10:24	13:34–14:40	9:10–11:10	14:34–15:40	9:55–12:00	15:34–16:40	10:40–12:50
Average	13:41–14:45	10:25–12:31	14:41–15:45	11:11–13:45	15:41–16:45	12:01–14:55	16:41–17:45	12:51–16:05
Fair	14:46–16:00	12:32–14:49	15:46–17:00	13:46–16:00	16:46–18:00	14:56–17:15	17:46–19:00	16:06–18:30
Low	>16:00	>14:49	>17:00	>16:00	>18:00	>17:15	>19:00	>18:30

1.0-MILE WALK TEST

Equipment Needed:

A track or premeasured course of 1.0 miles
Stopwatch

Procedure

1. Before taking the test, warm up with walking and stretching.
2. This is a test of maximum capacity, so push yourself to walk the mile as quickly as possible without overdoing it. Try to maintain a continuous, even pace. When you complete the 1-mile distance, record your time.

Walking time: _____

3. Cool down by walking slowly for several minutes and stretching.
4. Check the table below for your fitness rating.

Cardiorespiratory fitness rating: _____

1.0-Mile Walk

Age	18–29		30–39		40–49		50–59	
	F	M	F	M	F	M	F	M
Superior	<12:34	<11:39	<13:34	<12:40	<14:34	<13:40	<15:34	<14:10
Good	12:34–13:40	11:39–12:59	13:34–14:40	12:40–14:00	14:34–15:40	13:40–14:40	15:34–16:40	14:10–15:20
Average	13:41–14:45	13:00–14:21	14:41–15:45	14:01–15:20	15:41–16:45	14:41–15:55	16:41–17:45	15:21–16:25
Fair	14:46–16:00	14:22–15:43	15:46–17:00	15:21–16:15	16:46–18:00	15:56–16:45	17:46–19:00	16:26–17:25
Low	>16:00	>15:43	>17:00	>16:15	>18:00	>16:45	>19:00	>17:25

3.0-MILE BICYCLING TEST

If your main fitness activity is bicycling, you can test your cardiorespiratory fitness with a timed 3-mile bicycle ride.

Equipment Needed:

Bicycle
 Stopwatch
 A measured section of road with few stoplights or stop signs

Procedure

1. Warm up by riding for a few minutes and stretching.
2. Cycle 3 miles as quickly as you can. If you are doing this on the road, be careful to obey traffic rules.
3. Try to pace evenly. Time the ride with a stopwatch or a watch with a second hand. Record the time. Record your exercise pulse.
4. Cool down and stretch.
5. Check the table below for your fitness rating.

Cardiorespiratory fitness rating: _____

3.0-Mile Bicycle Ride

Age	18–29		30–39		40–49		50–59	
	F	M	F	M	F	M	F	M
Superior	<9:18	<8:24	<9:54	<9:00	<10:30	<9:36	<11:06	<10:12
Good	9:18–10:06	8:24–9:12	9:54–10:42	9:00–9:42	10:30–11:06	9:36–10:12	11:06–11:36	10:12–10:42
Average	10:07–11:06	9:13–10:12	10:43–11:42	9:43–10:48	11:07–12:18	10:13–11:24	11:37–12:54	10:43–12:00
Fair	11:07–12:00	10:13–11:06	11:43–12:30	10:49–11:35	12:19–13:00	11:25–12:06	12:55–13:30	12:01–12:48
Low	>12:00	>11:06	>12:30	>11:35	>13:00	>12:06	>13:30	>12:48

LAB Activity

3-5

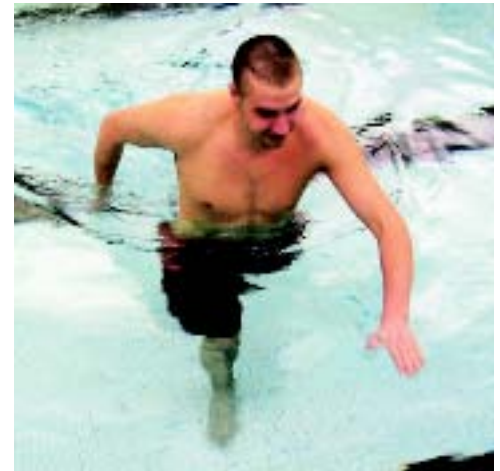
Name _____ Class/Activity Section _____ Date _____

Evaluating Your Cardiorespiratory Fitness: 500-Yard Water Run Test and 500-Yard Swim Test

500-YARD WATER RUN TEST

Equipment Needed:

- A regulation 25-yard pool
- Stopwatch
- Partner to time you
- Measuring tape to measure width of pool



Procedure

1. Measure pool width and calculate the number of widths required to cover 500 yards.
2. Have a partner on the deck to count laps and keep the time.
3. Before taking the test, warm up with a couple minutes of easy jogging in the water.
4. Select a starting point along the wall where the water level is at a midpoint between the runner's navel and nipple. Shorter runners will start in shallower water, taller runners in deeper water.
5. This is a test of maximum capacity, so push yourself to cover the distance as quickly as possible without overdoing it. Try to maintain a continuous, even pace. Run the necessary number of widths and record your time to the nearest second.

500-yard water run time: _____

6. Cool down by walking in the water for several minutes and stretching.
7. Check the table for your fitness rating.

Cardiorespiratory fitness rating: _____

500-Yard Water Run

Age	18-29		30-39		40-49		50-59	
	F	M	F	M	F	M	F	M
Superior	<7:59	<6:53	<8:30	<7:20	<9:00	<7:50	<9:30	<8:20
Good	7:59-8:38	6:53-7:44	8:30-9:08	7:20-8:15	9:00-9:38	7:50-8:45	9:30-10:08	8:20-9:15
Average	8:39-9:18	7:45-8:38	9:09-9:48	8:16-9:05	9:39-10:18	8:46-9:35	10:09-10:48	9:16-10:05
Fair	9:19-9:58	8:39-9:32	9:49-10:28	9:06-10:00	10:19-10:58	9:36-10:30	10:49-11:28	10:06-11:00
Low	>9:58	>9:32	>10:28	>10:00	>10:58	>10:30	>11:28	>11:00

500-YARD SWIM TEST**Equipment Needed:**

A regulation 25-yard pool
 Stopwatch
 Partner to time you

Procedure

1. Have a partner on the deck to count laps and keep the time. In a 25-yard pool, 500 yards is 20 lengths.
2. Before taking the test, warm up with a couple of easy laps.
3. This is a test of maximum capacity, so push yourself to cover the distance as quickly as possible without overdoing it. Try to maintain a continuous, even pace. Record your time to the nearest second.

500-yard swim time: _____

4. Cool down and stretch.
5. Check the table for your fitness rating.

Cardiorespiratory fitness rating: _____

500-Yard Swim

Age	18–29		30–39		40–49		50–59	
	F	M	F	M	F	M	F	M
Superior	<7:05	<6:12	<7:35	<6:30	<8:05	<7:00	<8:35	<7:30
Good	7:05–8:49	6:12–7:44	7:35–9:19	6:30–8:14	8:05–9:49	7:00–8:44	8:35–10:19	7:30–9:14
Average	8:50–10:34	7:45–9:19	9:20–11:04	8:15–9:49	9:50–11:34	8:45–10:19	10:20–12:04	9:15–10:49
Fair	10:35–12:19	9:20–10:51	11:05–12:49	9:50–11:22	11:35–13:19	10:20–11:52	12:05–13:49	10:50–11:22
Low	>12:19	>10:52	>12:49	>11:22	>13:19	>11:52	>13:49	>11:22

LAB Activity

3-6

Name _____ Class/Activity Section _____ Date _____

Evaluating Your Cardiorespiratory Fitness: 3-Minute Step Test

Equipment Needed:

A 15-inch bench or 16-inch roll-out bleacher step
Stopwatch
Metronome or recorded music at a tempo of 96 beats per minute

Procedure

1. Before taking the test, warm up with easy stepping and stretching.
2. You will need to step up and down at a tempo of 96 counts per minute (24 cycles of up-up-down-down). Step up with your right foot, and then your left foot, and then step down with your right and then your left. Continue for 3 minutes. Straighten your knees as you step up on the bench. To prevent leg soreness, you may want to switch lead legs about halfway through the test.

Pulse rate: _____

3. Stop at the end of 3 minutes and sit down. Five seconds after completing the test, the tester should count the partner's pulse for 15 seconds. The tester can check the partner's carotid pulse by lightly pressing against the neck under the jawbone. The partner being tested can double-check his or her own pulse at the radial artery, located on the thumb side of the wrist. The partners' pulse counts should not vary more than one or two beats if counting is accurate.
4. Record the pulse.
5. Cool down by walking slowly for several minutes and stretching.
6. Check the table below for your fitness rating.

Cardiorespiratory fitness rating: _____

3-Minute Step Test Norms

	Men	Women
Superior	<31	<37
Good	31–37	37–41
Average	38–41	42–44
Fair	42–45	45–49
Low	>45	>49

SOURCE: F. W. Kasch and J. L. Boyer. *Adult Fitness: Principles and Practices*. Mountain View, CA: Mayfield, 1968. Used by permission.



LAB Activity

3-7

Name _____ Class/Activity Section _____ Date _____

Evaluating Your Muscular Endurance: The Abdominal Curls Test and Push-Ups Test

THE ABDOMINAL CURLS TEST

Equipment Needed:

- Ruler
- Adhesive tape
- Mat
- Stopwatch or watch with a second hand



Procedure

1. Tape a 3-inch-wide strip on a mat or the floor and lie on your back with your fingertips at the edge of the strip. Bend your knees, and bring your heels as close as possible to your buttocks.
2. Curl forward until your fingertips have moved forward across the 3-inch strip and then curl back until your shoulder blades touch the floor. Your shoulders should lift from the floor with each curl, but the lower back should stay on the ground.
3. Complete as many curls as possible in 1 minute, then check the results in the table below.

Number of abdominal curls: _____

Muscular endurance rating: _____

1-Minute Abdominal Curls

Age	18-29		30-39		40-49		50-59	
	F	M	F	M	F	M	F	M
Superior	>88	>93	>70	>78	>56	>65	>45	>49
Good	75-88	79-93	60-70	62-78	48-56	53-65	38-45	42-49
Average	60-74	64-78	47-59	51-61	37-47	42-52	29-37	35-41
Fair	45-59	50-63	35-46	40-50	27-36	36-41	21-28	28-34
Low	<45	<50	<35	<40	<27	<36	<21	<28

THE PUSH-UPS TEST

Equipment Needed:

- Mat
- Stopwatch or watch with a second hand

Procedure

1. Start in an “up” position with your weight on your hands and toes (men) (Figure 3-9) or knees (women) (Figure 3-10).
2. Lower yourself until your elbows form a right angle and your upper arms are parallel to the floor. Be sure to keep your abdominals tight, hips slightly piked, and your back straight to protect your lower back.
3. Complete as many push-ups as possible in 1 minute; record, then check the results in the table below.

Number of push-ups: _____

Muscular endurance rating: _____

Age	1-Minute Push-Ups							
	18–29		30–39		40–49		50–59	
	F	M	F	M	F	M	F	M
Superior	>54	>64	>43	>54	>33	>43	>23	>33
Good	44–54	51–64	32–43	41–54	26–33	32–43	18–23	26–33
Average	32–43	37–50	22–31	27–40	17–25	22–31	11–17	17–25
Fair	20–31	23–36	13–21	18–26	8–16	13–21	6–10	8–16
Low	<20	<23	<13	<18	<8	<13	<6	<8



FIGURE 3-9

Push-up—standard position. (Note the 90-degree elbow angle.)



FIGURE 3-10

Push-up—modified position.

LAB Activity

3-8

Name _____ Class/Activity Section _____ Date _____

Evaluating Your Muscular Strength: Leg Press Strength Test and Bench Press Strength Test

LEG PRESS STRENGTH TEST

Equipment Needed:

Leg press machine If free weights are used, the following equipment is needed:
 Weight scale Weight scale Barbell
 Squat rack Assorted weight plates
 One or two spotters

Procedure

1. If you have a history of ankle, knee, hip, or lower back injuries, check with your physician before doing this test.
2. Before taking the test, warm up with several light lifts and stretching.
3. Set the leg press machine for a weight that is lighter than the amount you think you can press one time. Press to full extension. If you can press the weight to extension, add more weight and try again. Rest a few minutes between attempts. It may take several attempts to find your maximum lift.
4. Stop when you reach a weight that you cannot move through a full range of motion. The heaviest weight that you can move through a full range of motion is your max.
5. Divide your max by your body weight.

Max: _____ Body weight: _____

Max / Body weight = _____

Check the table below for your fitness rating.

Muscular strength rating: _____

Leg Press (max/body weight)

Age	18-29		30-39		40-49		50-59	
	F	M	F	M	F	M	F	M
Superior	>1.97	>2.39	>1.67	>2.19	>1.56	>2.01	>1.42	>1.89
Good	1.68-1.97	2.13-2.39	1.47-1.67	1.93-2.19	1.37-1.56	1.82-2.01	1.25-1.42	1.71-1.89
Average	1.50-1.67	1.97-2.12	1.33-1.46	1.77-1.92	1.23-1.36	1.68-1.81	1.10-1.24	1.58-1.70
Fair	1.37-1.49	1.83-1.96	1.21-1.32	1.65-1.76	1.13-1.22	1.57-1.67	0.99-1.09	1.46-1.57
Low	<1.37	<1.83	<1.21	<1.65	<1.13	<1.57	<0.99	<1.46

SOURCE: Based on norms from the Cooper Institute for Aerobics Research, Dallas, Texas, revised 2000, used with permission.

BENCH PRESS STRENGTH TEST**Equipment Needed:**

Bench press machine	If free weights are used, the following equipment is needed:	
Weight scale	Weight scale	Barbell
	Flat bench	Assorted weight plates
	One or two spotters	Weight scale

Procedure

1. If you have a history of shoulder, wrist, or lower back injuries, check with your physician before doing this test.
2. Before taking the test, warm up with several light lifts and stretching.
3. Set the bench press machine for a weight that is lighter than the amount you think you can press one time. Press to full extension. If you can press the weight to extension, add more weight and try again. Rest a few minutes between attempts. It may take several attempts to find your maximum lift.
4. Stop when you reach a weight that you cannot move through a full range of motion. The heaviest weight that you can move through a full range of motion is your max.
5. Divide your max by your body weight.

Max: _____ Body weight: _____

Max / Body weight = _____

Check the table below for your fitness rating.

Muscular strength rating: _____

Bench Press (max/body weight)

Age	20–29		30–39		40–49		50–59	
	F	M	F	M	F	M	F	M
Superior	>1.00	>1.62	>.79	>1.34	>.76	>1.19	>.67	>1.04
Good	.80–1.00	1.32–1.62	.70–.79	1.12–1.34	.62–.76	1.00–1.19	.55–.67	.90–1.04
Average	.70–.79	1.14–1.31	.60–.69	.98–1.11	.54–.61	.88–.99	.48–.54	.79–.89
Fair	.59–.69	.99–1.13	.53–.59	.88–.97	.50–.53	.80–.87	.44–.47	.71–.78
Low	<.59	<.99	<.53	<.88	<.50	<.80	<.44	<.71

SOURCE: Based on norms from the Cooper Institute for Aerobics Research, Dallas, Texas, revised 2000, used with permission.

LAB Activity 3-9

Name _____ Class/Activity Section _____ Date _____

Evaluating Your Flexibility: Sit and Reach, Sit and Reach Wall Test, and Flexibility Quick Checks

SIT AND REACH

Equipment Needed:

Flex box
Mat



Procedure

1. Warm up with walking or light calisthenics.
2. Sit with your feet flat against the flex box about 5 inches apart.
3. Place your hands together. Without bending your knees, reach as far forward as possible, extending fingertips along the box. Hold the position for 3 seconds.

Sit and reach score: _____ inches

4. Check the table below for your flexibility rating.

Flexibility rating: _____

Age	Sit and Reach (inches)							
	18–29		30–39		40–49		50–59	
	F	M	F	M	F	M	F	M
Superior	>8.5	>7.0	>8	>6	>7	>5	>6	>4
Good	6.5–8.5	4.0–7.0	5–8	3–6	4–7	2–5	3–6	1–4
Average	4.0–6.4	1.0–3.9	3–4.9	0–2.9	2–3.9	–1–1.9	1–2.9	–3–0
Fair	1.0–3.9	–2.0–0.9	0–2.9	–3––0.1	–1–1.9	–4––1.1	–2–0.9	–5––3.1
Low	<1.0	<–2.0	<0	<–3	<–1	<–4	<–2	<–5

SIT AND REACH WALL TEST

Equipment Needed:

Wall
Mat

Procedure

1. Warm up by walking and static stretching.
2. Remove shoes, sit facing a wall, and keep your feet flat against the wall and your knees straight.
3. Reach forward as far as possible to touch your fingertips, knuckles, or palms to the wall and hold the position for 3 seconds.

Result: _____

4. Check your flexibility evaluation in the accompanying table.

SIT AND REACH WALL TEST SCORES	
Result	Flexibility
Cannot touch wall	Low
Fingertips touch wall	Average
Knuckles touch wall	Good
Palms touch wall	Superior

FLEXIBILITY QUICK CHECKS

Equipment Needed:

Mat

Procedure

1. Warm up with walking or light calisthenics.
2. Complete the flexibility quick checks shown in Figures 3-11 through 3-15. Record the results (*pass* or *fail*).

	Pass	Fail
Low back flexibility test	_____	_____
Hip flexor flexibility test	_____	_____
Quadriceps flexibility test	_____	_____
Hamstring flexibility test	_____	_____
Calf flexibility test	_____	_____



FIGURE 3-11

Low back flexibility test.
Muscle: Erector spinae (lower back)
Test: Lying on your back, pull thighs to chest.
Passing: Thighs should touch chest.



FIGURE 3-12

Hip flexor flexibility test.
Muscle: Iliopsoas (hip flexor)
Test: Lying on your back, pull one knee to chest, keeping other leg fully extended on the floor.
Passing: Calf of extended leg must remain on the floor; knee must not bend.



FIGURE 3-13

Quadriceps flexibility test. Caution: Avoid if you have or experience knee problems.
Muscle: Quadriceps (front of thigh)
Test: Lying face down with knees together, pull heel toward buttocks.
Passing: Heel should comfortably touch buttocks.



FIGURE 3-14

Hamstring flexibility test.
Muscle: Hamstring (back of thigh)
Test: Lying on your back, lift one leg, keeping other leg straight on the floor without bending either knee.
Passing: The raised leg must be vertical (90 degrees).



FIGURE 3-15

Calf flexibility test.
Muscle: Gastrocnemius (calf)
Test: Standing without shoes, raise one forefoot off floor, keeping knees relaxed and heels down.
Passing: Ball of foot should clear floor by height equal to width of two fingers.

LAB Activity 3-10

Name _____ Class/Activity Section _____ Date _____

Body Composition Assessment

Equipment Needed:

Measuring tape
Skinfold calipers
Height/weight scales

Read about body composition tests in Chapter 3 for more information about these assessments.

WAIST-TO-HIP RATIO

1. Measure your waist at the smallest circumference and hips at the greatest circumference. Record the results.

Hips: _____ inches Waist: _____ inches

2. Divide your waist measurement by your hip measurement and check your rating.

Waist/Hip = _____ Rating: _____

Waist-to-Hip Ratio

Men

Women

High Risk

.95 or higher

.80 or higher

WAIST GIRTH

Measure your waist at the smallest circumference and record the results.

Waist: _____ inches Rating: _____

Waist Circumference

Men

Women

High Risk

over 40 inches

over 35 inches

BODY MASS INDEX

1. Measure your height and weight and record the results.

Height: _____ feet _____ inches Weight: _____ pounds

2. Check your BMI using Table 12.1 on page 395.

BMI: _____ Rating: _____

BODY FAT PERCENTAGE

1. Read the section in Chapter 3 on body composition assessment using skinfold calipers.
2. Measure skinfolds on the right side of the body using a skinfold caliper and record the results.
3. Check the results on the nomogram in Figure 3-7 and Table 3-4.

Female: Triceps _____
 Suprailiac _____
 Percent body fat _____

Male: Subscapula _____
 Thigh _____
 Percent body fat _____

DESIRABLE WEIGHT

1. Percent body fat \times weight (lbs) = Fat weight (lbs)

_____ \times _____ = _____ lbs

2. Weight (lbs) $-$ fat weight = lean body weight (lbs)

_____ $-$ _____ = _____ lbs

3. Desirable weight for females (at 18%):
 lean body weight $\div .82$ = desirable weight

_____ $\div .82$ = _____ lbs

4. Desirable weight for males (at 12%):
 lean body weight $\div .88$ = desirable weight

_____ $\div .88$ = _____ lbs

LAB Activity

3-11

Name _____ Class/Activity Section _____ Date _____

Fitness Goals

Looking at the results of your fitness tests, evaluate yourself and set some realistic, personal goals.

	Test score time/number	Date of test	Fitness rating	Goal time/number	Fitness rating	By what date?
Cardiorespiratory Tests						
1.0-mile walk	_____	_____	_____	_____	_____	_____
1.5-mile run	_____	_____	_____	_____	_____	_____
500-yard swim	_____	_____	_____	_____	_____	_____
Other _____	_____	_____	_____	_____	_____	_____
Muscular Fitness Tests						
1-minute abdominal curls	_____	_____	_____	_____	_____	_____
1-minute push-ups	_____	_____	_____	_____	_____	_____
Sit and reach	_____	_____	_____	_____	_____	_____
Leg press	_____	_____	_____	_____	_____	_____
Bench press	_____	_____	_____	_____	_____	_____
Other Tests						
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____

Comments (i.e., Was this your best effort? Is this a realistic assessment of your abilities? Any surprises?) _____

