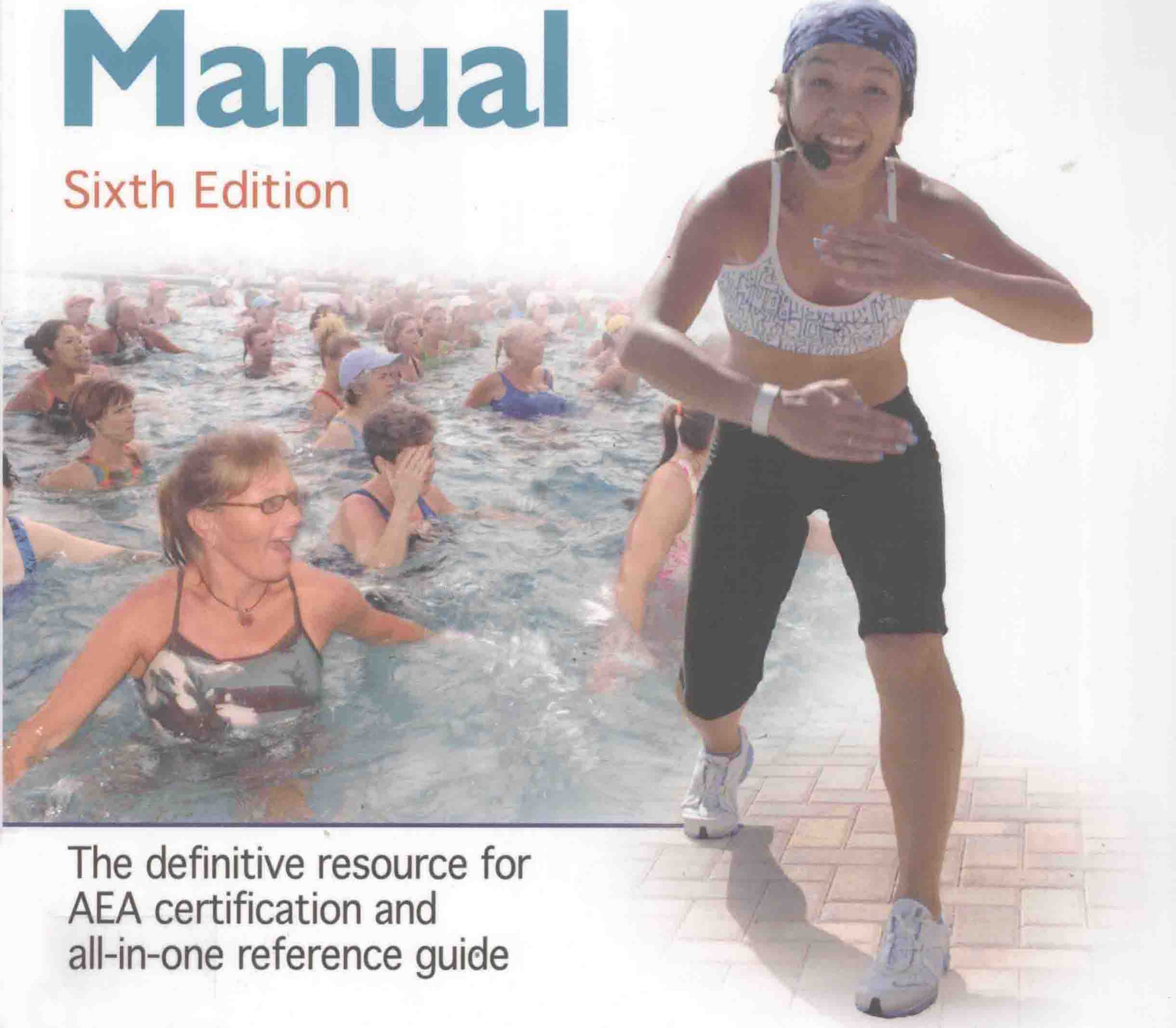
AEA
Aquatic Exercise Association

Aquatic Exercise Association

Aquatic Fitness Professional Manual

Sixth Edition



The definitive resource for AEA certification and all-in-one reference guide

Aquatic Exercise Association

Aquatic Fitness Professional Manual

Sixth Edition

Aquatic Fitness Professional Manual - 6th Edition	水上运动专业健身手册 － 第六版

Human Kinetics

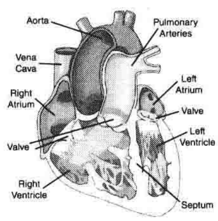
Library of Congress Cataloging-in-Publication Data

Aquatic fitness professional manual / Aquatic Exercise Association. -- 6th ed.
p. cm.
Includes bibliographical references and index.
ISBN-13: 978-0-7360-6767-6 (soft cover)
ISBN-10: 0-7360-6767-1 (soft cover)
1. Aquatic exercises. I. Aquatic Exercise Association.
GV838.53.E94A68 2010
613.7'16--dc22
2009046262

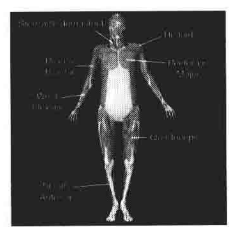
ISBN-10: 0-7360-6767-1
ISBN-13: 978-0-7360-6767-6

The Web addresses cited in this text were current as of October 2009, unless otherwise noted.

Acquisitions Editor: Jill E. White; **Developmental Editor:** Ragen E. Sanner; **Assistant Editor:** Anne Rumery; **Copyeditor:** John Wentworth; **Indexer:** Sharon Duffy; **Permission Manager:** Dalene Reeder; **Graphic Designer:** Joe Buck; **Graphic Artist:** Tara Welsch; **Cover Designer:** Keith Blomberg; **Photographers (cover):** Troy Nelson and Lissa Funk, Alpine Aperture; **Photographer (interior):** Photos from AEA: photographer Troy Nelson, unless otherwise noted; **Art Manager:** Kelly Hendren; **Associate Art Manager:** Alan L. Wilborn; **Illustrator:** Figures 3.7, 3.8, 5.3, 7.12, and 13.2 by Tammy Page. Figure 2.20: © Human Kinetics Artist Jason McAlexander. Figure 13.1 by U.S. Department of Agriculture and the U.S. Department of Health and Human Services or USDA and DHHS. All other illustrations and graphics provided by:



© LifeART®



Selected Images provided by: Primal Pictures, Ltd., *Interactive functional anatomy,* 2004. www.primalpictures.com

Printer: United Graphics

Printed in the United States of America 10 9 8 7 6 5 4 3 2 1

The paper in this book is certified under a sustainable forestry program.

Human Kinetics
Web site: www.HumanKinetics.com

United States: Human Kinetics
P.O. Box 5076
Champaign, IL 61825-5076
800-747-4457
e-mail: humank@hkusa.com

Canada: Human Kinetics
475 Devonshire Road Unit 100
Windsor, ON N8Y 2L5
800-465-7301 (in Canada only)
e-mail: info@hkcanada.com

Europe: Human Kinetics
107 Bradford Road
Stanningley
Leeds LS28 6AT, United Kingdom
+44 (0) 113 255 5665
e-mail: hk@hkeurope.com

Australia: Human Kinetics
57A Price Avenue
Lower Mitcham, South Australia 5062
08 8372 0999
e-mail: info@hkaustralia.com

New Zealand: Human Kinetics
P.O. Box 80
Torrens Park, South Australia 5062
0800 222 062
e-mail: info@hknewzealand.com

E3995

Introduction

Welcome to the field of aquatic fitness—a vast array of programming options to enhance health and well-being for all ages and abilities. Although water exercise can encompass a wide variety of activities, this manual specifically targets vertical exercise in both shallow and deep water.

Exciting new trends are emerging in the fitness industry, and aquatic fitness is at the forefront with reduced-impact yet challenging options for group exercise, small-group fitness, and personal training. The properties of water further enhance the benefits of many popular fitness formats, such as kickboxing, yoga, body sculpting, Pilates, walking and jogging, circuits, intervals, and sport-specific training. No longer targeting just the senior population, safe and effective programs can be found for all age groups, including parents and infants, children, teens, young adults, and the "new" seniors, the baby boomers.

This manual provides an excellent resource for fitness professionals and students seeking knowledge in aquatic fitness applications, education, and training. AEA sincerely hopes that the following pages inspire you to review, learn, and update those skills necessary to effectively share the benefits of aquatic fitness with others. May we all work together in the pursuit of a healthier global community.

AEA Mission Statement and Purpose

OUR MISSION

The Aquatic Exercise Association (AEA) is a not-for-profit educational organization committed to the advancement of aquatic fitness worldwide.

OUR PURPOSE

AEA is committed to increasing awareness, education, and networking opportunities to benefit professionals as well as the general public. With AEA, achieving healthy lifestyles through aquatic fitness is a team effort, supported globally.

AEA desires to embrace cultural diversity in our industry to assure that individuals worldwide can enjoy and employ the benefits of aquatic fitness programs regardless of age, ability, goals, or interests.

PURPOSE OF CERTIFICATION

The aquatic fitness professional certification was developed to increase public health, safety, and confidence in aquatic fitness programming led by certified professionals.

The aquatic fitness professional certification is designed to test a standard level of theoretical and practical competence and skill for aquatic fitness professionals to assure the highest level of programming and implementation to a wide range of participants.

The aquatic fitness professional certification offers certified professionals confidence and security through superior standards and current research implementation.

Acknowledgments

The Aquatic Exercise Association acknowledges that education is a continuous process. Additionally, knowledge must be shared in order for it to expand and develop. Fitness is a dynamic field that is ever-changing and expanding and thus requires an open mind and a willingness to never stop learning.

This manual is dedicated to aquatic fitness professionals in every country who continue to share their time, talent, and passion to achieve the common goal of global health and quality of life.

AEA thanks everyone who has supported aquatic fitness, especially those who have been instrumental in making this educational manual possible.

Contents

chapter 1

Physical Fitness

Introduction

This chapter highlights the components of physical fitness. Physical fitness describes physical activity with a purpose: the desire to maintain or improve functional capacity or a predetermined fitness level. Guidelines are outlined for the recommended quantity and quality of exercise for developing and maintaining overall fitness in healthy adults. The benefits of regular exercise and moderate-intensity physical activity are discussed as well as their impact on overall health and prevention of chronic disease.

Key Chapter Concepts

- What are the five primary components of fitness?
- What is the most effective and safest way for the average person to stretch?
- What guidelines should be followed to improve cardiorespiratory endurance, muscular fitness, and flexibility?
- Why is an exercise heart rate usually lower in the water than on land?
- What is the heart rate response in continuous and interval training?
- How does exercise benefit the average person?
- What are the guidelines for physical activity as set by the US Department of Health and Human Services?

COMPONENTS OF PHYSICAL FITNESS

Physical fitness is broadly defined as the ability of the body's physical parts to function, and is measured by the level at which these physical parts are capable of functioning. A person possessing a high fitness level would have a body capable of functioning physically at optimal levels. A person possessing a poor fitness level would have physical weaknesses or limitations that would affect the body's ability to function at optimal levels. Measurement of functional capacity and fitness level are discussed in chapter 14.

Physical fitness is achieved through regular exercise. When developing or participating in an exercise program, it is essential to consider all the components necessary for optimal physical fitness.

There are five major components of physical fitness:

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

A fitness instructor must understand all the components that affect a person's fitness level and be able to design a program that promotes or enhances all five components.

Cardiorespiratory Endurance

Cardiorespiratory endurance is defined as the capacity of the cardiovascular and respiratory systems to deliver oxygen to the working muscles for sustained periods of energy production. **Cardiorespiratory fitness** describes the body's physical capacity to perform large muscle movement over a prolonged period of time. Large muscles are found in the legs, trunk, and arms and are responsible for gross motor movement. Cardiorespiratory fitness is often termed "aerobic fitness."

Research clearly indicates that the aquatic environment is suitable for increasing and maintaining cardiorespiratory fitness, as long as you adhere to the American College of Sports Medicine (ACSM) guidelines for aerobic exercise.

Muscular Strength

Muscular strength is defined as the maximum force that can be exerted by a muscle or muscle group against a resistance. The muscle is expected to exert this maximum force one time or in one effort. Resistance of some kind is needed to train for muscular strength. Free weights and weight machines are commonly used on land to train for muscular strength. When training for strength gains, a routine is employed that utilizes heavy weight lifted for fewer repetitions. Although no optimal number of sets and repetitions has been found to elicit maximal strength gains, the accepted range indicated by research appears to be somewhere between two and five sets of 2 to 10 repetitions at an all-out effort (Fleck and Kraemer 2003). Some people are unable to train for muscular strength because of orthopedic or structural problems that make it difficult or impossible to meet the demands placed on the musculoskeletal system. Some people avoid strength training because of common misconceptions, such as the concern about building too much muscle girth or a fear that they may find such training physically uncomfortable.

Muscle **hypertrophy** is the term used to describe an increase in the size or girth of muscle tissue. Muscle **atrophy** is the term used to describe the loss or wasting of muscle tissue through lack of use or disease.

Equipment is used for strength training in the water to maximize or increase resistance just as on land. On land, the resistance is usually determined by the amount of weight being lifted. In the water, resistance is determined by the amount of buoyancy, drag, or weight the equipment provides, as well as the velocity or speed at which the movement is performed (see chapter 7).

Muscular Endurance

Muscular endurance is defined as the capacity of a muscle to exert force repeatedly or to hold a fixed or static contraction over time. Assessment is made by measuring the length of time the muscle can hold a contraction or by counting the number of contractions performed in a given length of time.

Once again, there is no optimal number of sets and repetitions for building muscular endurance. As with strength gains, programs should be individualized and varied to achieve the best results. When focusing on endurance gains, multiple repetitions are usually prescribed in sets of 20 repetitions or more (Van Roden and Gladwin 2002). These sets differ in intensity from the all-out effort in strength training. By the end of the set, the muscle should feel fatigued but not necessarily exhausted. Using the resistance of the water is an excellent way to promote and maintain muscular endurance. Resistance can be progressively increased by applying more force against the water's resistance, increasing the surface area or lever length, or by adding equipment.

Although it is possible to train specifically for muscular strength or endurance, these two components of fitness are not independent of each other.

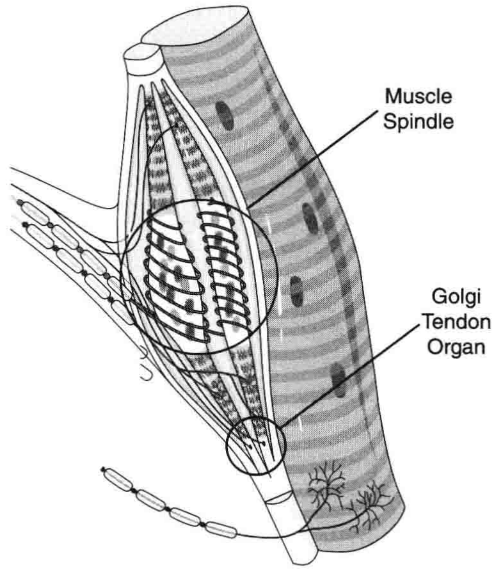


Figure 1.1 Muscle spindle and golgi tendon organ.

Flexibility

Flexibility is defined as the ability of limbs to move at the joints through a complete range of motion. Having a reasonable amount of joint flexibility is important in the reduction of risk of injury as well as for general body mobility. Loss of flexibility can lead to impaired movement and an inability to perform **activities of daily living (ADLs).** Loss of flexibility occurs as a natural part of the aging process or as the result of sedentary lifestyles, trauma, injury, or surgery. In order to maintain flexibility, the joints must be taken through their full range of motion on a regular basis.

Exercise is a series of muscle contractions, which will leave a muscle shortened unless it is intentionally stretched after an exercise session. Immediately following an exercise program is the best time to stretch to maintain and improve flexibility because the muscles are warm and pliable and pumped with oxygenated blood. Stretching after exercise is critical for every type of exercise program, including aquatic fitness programs.

It is also imperative to stretch correctly. **Ballistic stretching** (bouncing, tugging, or overstretching the muscle) can cause the muscle to tighten instead of relax. Ballistic stretching activates the **muscle spindle,** a specialized receptor in the muscle known as a proprioceptor, which monitors muscle length change and the speed of length change (figure 1.1). The muscle **stretch reflex** arc is a neurological loop that actually tightens (contracts) the muscle or increases muscle tension. It is an involuntary response designed to help protect muscle tissue from tearing when being overstretched. Ballistic stretching can oppose the desired effect of stretching by tightening rather than lengthening the muscle.

Static stretching involves stretching to the point of mild discomfort and holding the elongated position. Holding a static stretch for 15 to 60 seconds is most beneficial during the poststretch. Proper static stretching does not activate the stretch reflex, and therefore muscles relax and lengthen. Static stretching is the preferred method for enhancing flexibility for the general population.

Although generally recommended as a safe and effective option, intense static stretching has been shown to reduce maximum force production for up to one hour after the static stretch (Evetovich, Nauman, Conley, and Todd 2003; Young and Behm 2003). Thus, static stretching prior to training or competition might hinder athletic performance in activities that require maximum power, although it would remain acceptable after exercise.

Rhythmic or dynamic stretching is moving body parts through the full range of motion in a slow, controlled manner. Instead of stopping and holding a static stretch, you may pause briefly in an extended or stretched position before continuing through the full range of motion. For example, a slow front kick with a pause in front will help to lengthen the gluteal and hamstring muscles. Participants need to respect their normal range of motion and not overstretch to avoid activating the stretch reflex arc. Rhythmic stretching is generally preferred over static stretching prior to the main segment of the workout. In the pool, adequate heat can be generated to keep participants comfortable and maintain warmth in muscle tissue during the warm-up stage of the workout.

Another proprioceptor, the **Golgi tendon organ,** is found in the tendons of your muscles. The Golgi tendon organ is a proprioceptive sensory receptor that monitors tension in the muscle (figure 1.1). If the Golgi tendon organ senses that too much tension is being created in the muscle, and that the tension generated might damage related soft tissue, the muscle responds by relaxing. This involuntary response produces the desired effect of releasing tension or relaxing the muscle to avoid excessive or dangerous tension. The Golgi tendon organ safeguards you from lifting excessive loads that you might not be conditioned to safely execute (Baechle and Earle 2004).

Body Composition

Body composition is defined as the body's relative percentage of fat as compared to lean tissue (bones, muscles, and organs). Body composition is discussed in chapter 14. As body composition is a primary component of fitness, it is important to understand its role in overall physical health. It is desirable to build and maintain a reasonable level of lean muscle tissue. Adequate levels of muscle tissue increase stamina and strength and boost metabolism. Having too high a relative percentage of fat increases your risk of heart disease, cancer, and other metabolic diseases. Storing excess subcutaneous fat can also impair physical performance and inhibit quality of life (see chapter 11).

The water is a wonderful environment in which to develop a favorable body composition and overall physical fitness. Aerobic exercise in the aquatic environment promotes fat loss while working against the three-dimensional resistance of the water builds lean tissue or muscle mass (Colado et al. 2009, Gappmaier et al. 1986, Kieres and Plowman 1991, Kravitz and Mayo 1997).

Skill-Related Components of Fitness

In addition to the five major components of physical fitness, there are several **skill-related components of fitness** as well. These include balance, coordination, speed, power, agility, and reaction time (Sova 2000).

- **Balance:** the maintenance of equilibrium while stationary (static balance) or moving (dynamic balance)
- **Coordination:** the integration of many separate motor skills or movements into one efficient movement pattern
- **Speed:** the rate at which a movement or activity can be performed
- **Power:** a function of strength and speed; the ability to transfer energy into force at a quick rate
- **Agility:** the ability to rapidly and fluently change body positioning during movement
- **Reaction time:** the amount of time elapsed between stimulation and acting on the stimulus

The average exerciser may not be overly concerned with developing these skill-related components; however, these are important components of everyday life and should be included in an exercise program. Athletes train for these components primarily to enhance performance in their sport. The skill-related components usually improve with regular exercise even though you may not be specifically training for them. Many of these components are employed during an aquatic fitness class, during transitions, in pace changes, in one-footed moves, and so on, and are developed and improved through practice and repetition. Skill training (also called **functional training),** which incorporates all of the skill-related aspects of physical fitness, is becoming more popular as a method of training to improve quality of life and enhance activities of daily living.

GUIDELINES FOR EXERCISE

Lifestyle diseases have become prevalent in many developed countries due to the population becoming more sedentary and physically inactive, adopting poor eating habits, and being exposed to more environmental hazards. Several long-term or epidemiological research studies starting in the 1940s and continuing through the present have been and are being conducted in the United States to attempt to discover which lifestyle factors increase or decrease the risk of various diseases. One of the most famous epidemiological studies is the Framingham Study, in which several generations of families in the town of Framingham, Massachusetts, have been studied to monitor risk factors for disease—cardiovascular disease, in particular.

A sedentary lifestyle, or physical inactivity, was determined to elevate risk for cardiovascular disease and cancer as well as contribute to elevating risk for many other diseases. (Risk factors are further discussed in chapter 14 on health risk appraisal and physical screening.) Research studies were then conducted collecting metabolic and other data to determine the amount and type of exercise necessary to significantly lower risk of disease. The guidelines developed by the American College of Sports Medicine (ACSM), printed initially in 1975 and revised several times since, have emerged as the primary guidelines used by the exercise profession. These guidelines are very similar to what is published by the American Medical Association and the American Heart Association.

ACSM makes the following recommendations for the quantity and quality of training for developing and maintaining cardiorespiratory fitness, body composition, flexibility, neuromuscular training, and muscular strength and endurance in the healthy adult (ACSM 2010).

Mode of Training

Mode describes the type of exercise being performed. Activities that use large muscle groups, that can be maintained continuously, and that are rhythmical and aerobic in nature are recommended for improving cardiorespiratory endurance. Aerobic activities include walking and hiking, running and jogging, cycling, cross-country skiing, dancing, rope skipping, rowing, stair climbing, swimming, deep-water running, many shallow-water activities (e.g., kickboxing), skating, and some endurance sport activities. Selected activities should reflect the individual's interests and goals and be selected to accommodate his or her level of fitness and skill.

For all adults, ACSM (2010) recommends a resistance training program that includes a combination of multi-joint exercises that use more than one muscle group and targets both the agonist and antagonist muscles. Single-joint exercises may also be included in the resistance training program.

Frequency of Training

Frequency is how often you exercise or train. Although cardiorespiratory fitness improvements might be seen in deconditioned individuals with exercise two times per week, training fewer than two days per week does not generally show a meaningful change in functional capacity. For most adults to achieve and maintain fitness benefits, ACSM (2010) recommends moderate-intensity cardiovascular exercise at least five days a week, or vigorous-intensity training at least three days per week, or a weekly combination of three to five days a week blending moderate and vigorous activities.

Resistance training two to three days per week for each major muscle group is recommended by ACSM. Additionally, at least 48 hours should separate the training sessions for each muscle group to allow adequate recovery and muscle development.

Intensity of Training

Intensity is how hard you exercise and can be measured in several ways. Fitness instructors should understand all the ways in which intensity can be measured, although only one or two ways might be employed in class.

Maximal oxygen uptake ($\dot{V}O_2max$) is determined with specialized equipment that measures the amount of oxygen the subject exhales. The difference between the amount of oxygen inhaled and exhaled is the amount of oxygen being used by the body. To find the maximum amount of oxygen a subject can use, the subject runs on a treadmill until he or she reaches exhaustion. At this point of exhaustion, the maximum amount of oxygen the body is capable of using is determined. Intensity measurement by using a percentage of $\dot{V}O_2max$ is not practical for use in an exercise class but is important to fitness instructors for understanding research and medical studies.

In research and medical settings, cardiorespiratory fitness is often measured as a percentage of maximal oxygen uptake. An intensity level of between 40-50 to 85 percent of oxygen uptake reserve ($\dot{V}O_2R$) is considered sufficient to elicit a cardiorespiratory response. ACSM (2010) guidelines recommend moderate intensity (40 to less than 60 percent $\dot{V}O_2R$ that noticeably increases heart rate and breathing), vigorous intensity (greater than or equal to 60 percent $\dot{V}O_2R$ that substantially increases heart rate and breathing), or a combination of both moderate and vigorous intensity training for most adults.

More common ways to measure exercise intensity use a percentage of a person's **maximal heart rate** (HRmax) or **heart rate reserve** (HRR). A person's maximal heart rate is determined the same way a $\dot{V}O_2$max is determined. A person runs on a treadmill with a heart monitor until exhaustion, at which point a maximal exercise heart rate is determined. Because measuring maximal heart rate in this manner is not practical, we use an estimated maximal heart rate instead. The equation 220 minus age is generally accepted in the exercise profession as a reasonably accurate estimate of maximal heart rate. An intensity range of 64-70 to 94 percent of estimated HRmax (220 minus age) is recommended for aerobic training.

A more accurate way to measure intensity by using heart rate is to use the heart rate reserve method, also known as **Karvonen's formula.** Karvonen's formula personalizes heart rate measurement by factoring in the individual's resting heart rate. A true **resting heart rate** (HRrest) is found by taking your heart rate for 60 seconds on three mornings before rising and then averaging the three. Karvonen's formula is calculated by taking 220 minus age, minus resting heart rate, multiplying by the desired percentage, and then adding back the resting heart rate.

A fitness instructor should be aware that several factors can affect training heart rate. These factors include stress, caffeine, medication, general health, and environmental factors. In the aquatic environment, heart rate can be additionally affected by the water's temperature, compression, reduced gravity, partial pressure, the dive reflex, and reduction of body mass (table 1.1). It is recommended that a 6-second heart rate count be used in the water. Informal data collected indicates that a 10-second heart rate might not be as accurate because of the speed at which the water can cool the body, thereby more quickly lowering exercise heart rate. Research clearly indicates a reduced heart rate in the water as compared to the same intensity of exercise on land. Water submersion also affects resting heart rate and can affect your calculations for aquatic heart rates using Karvonen's formula. Additional research has indicated that the aquatic suppression of heart rate is dependent on the factors listed in table 1.1, as well as on fitness level and age.

For years the aquatic fitness community has been working to determine the best way of calculating an aquatic target heart rate. McArdle and colleagues (1971) suggested a deduction of 13% taken at the end of Karvonen's method or the maximal heart rate equation. In the early days of the Aquatic Exercise Association, a 17-beat-per-minute deduction (Sova, 1991) was recommended to be subtracted at the end of the Karvonen's method or the maximal heart rate equation. Use of a standard deduction can over- or underestimate both maximum heart rate and calculated percentages of maximum for a given individual due to a number of factors, including fitness level.

Recent research in Brazil and the United States indicates that a standard percent or a standard number of beats per minute may not be as accurate as a deduction in determining aquatic heart rate calculations. Dr. Luiz Fernando Martins Kruel's research group in Brazil conducted several studies comparing physiological responses for land and water that included hundreds of people (Kruel 1994; Coertjens et al. 2000; Kruel et al. 2002; Alberton et al. 2003). Many of these studies compared heart rates taken at two positions out of the water and at two depths in the water. Conclusions indicate that two heart rate measurements are needed to determine an individual's aquatic deduction.

The following example shows how to implement the Kruel Aquatic Heart Rate Deduction with the Karvonen formula when determining an individual's target aquatic heart rate. The equation is based upon a 50-year-old individual with a