

# 5

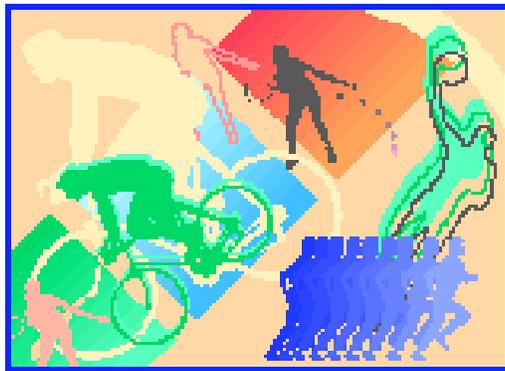
## Cardiorespiratory

### Training

In this chapter you will learn about:

- ◆ The physiology of the heart and lungs.
- ◆ Benefits of cardio-respiratory training.
- ◆ The FITT Principle guidelines for cardio-respiratory training.
- ◆ Aerobic training program design and progression.

**Cardiorespiratory** activities make up the bulk of the physical activities in Levels 1 and 2 of the Physical Activity Pyramid (Chapter 4, Figure 4-2). These activities improve health and fitness by increasing the work capacity of the heart and lungs. Other terms used to describe these activities include cardiovascular, cardiopulmonary, and aerobic exercise.



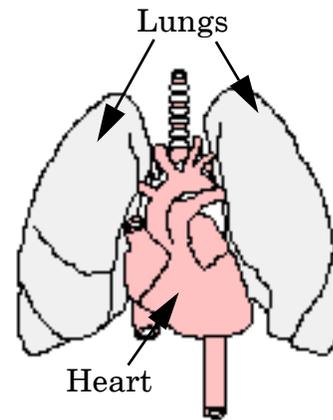
## Cardiorespiratory Physiology

The heart is a muscle that is required to contract continuously throughout your life to deliver oxygen to all organs in the body. Your lungs breathe in oxygen and breathe out carbon dioxide. Blood vessels connect the heart and lungs so that carbon dioxide can be removed from the blood and oxygen can be added to the blood. The heart then pumps this blood throughout the body. During exercise your heart must pump more often and more strongly to supply oxygen to your exercising muscles to make energy. In turn, you

breathe in more often and more deeply to increase the amount of oxygen you inhale and carbon dioxide that you exhale.

Therefore, the basis of cardiorespiratory training is to place greater demands on the heart (e.g., make the heart beat more times per minute) than what is required during rest. By regularly overloading the heart in this fashion, it will become stronger. This results in pumping more blood and delivering more oxygen to the body per heart beat, and a lower resting heart rate.

How does lower resting heart rate affect aerobic capacity? Maximum heart rate is determined largely by genetics and age: view it as a fixed number of beats per minute. So, by lowering your resting heart rate, you increase the reserve capacity of your heart, or the number of beats between your resting and maximum heart rates. Therefore, if you decrease your resting heart rate by increasing your physical fitness, you will be able to perform more work above rest.



Since most daily activities are aerobic in nature, improving the delivery of oxygen to the muscles will improve your work performance. On the other hand, a sedentary lifestyle decreases the heart's ability to circulate blood and oxygen. So, view your heart as an aerobic muscle that must be conditioned for optimum functional health and fitness throughout your life. Even though some people are born with higher aerobic capacities than others, everyone will benefit from aerobic conditioning.

## Benefits of Aerobic Exercise

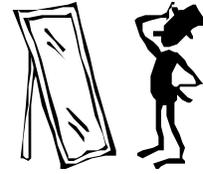
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The benefits of cardiovascular conditioning include:

- ◆ A stronger heart and lower resting heart rate.
- ◆ Fitness and performance benefits, such as increased aerobic capacity, increased muscle endurance, and a greater ability to perform high-intensity activities.
- ◆ Health benefits, such as maintenance of a healthy body weight and body fat percentage, management of stress, and decreases in blood cholesterol and fat (triglycerides) levels.



- ◆ Increased performance in physically-demanding jobs such as, load carriage and lift-and-carries.
- ◆ Cosmetic changes such as increased muscle tone, better posture and overall appearance.



## Aerobic Exercise Guidelines

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The FITT Principle guidelines discussed in [Chapter 4](#) and outlined in the Physical Activity Pyramid for cardiorespiratory training are:

- ◆ Frequency - 3-5 days per week.
- ◆ Intensity - 60% to 90% of maximum heart rate. ([Worksheet 5-1.](#))
- ◆ Time - 30-60 minutes within your target heart rate zone.
- ◆ Type - continuous, low resistance, high repetition activities.

The guidelines for aerobic exercise “intensity” and “type” can be ambiguous and will be outlined in greater detail in the next two sections.

## Intensity of Exercise

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The “I” in “FITT” refers to the intensity of the exercise. Intensity is the level of exertion at which an exercise is performed. There are several ways to measure exercise intensity, some of which are discussed below.

### Oxygen Consumption

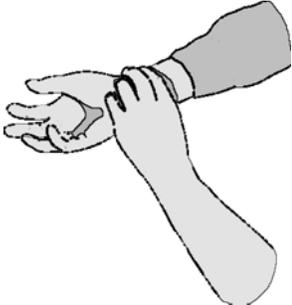
Oxygen Consumption is a measure of exercise intensity that describes how much oxygen is required to perform an activity. Maximal oxygen consumption, or maximal aerobic capacity, varies from person to person and is a measure of the maximum amount of oxygen a person can use to make energy per minute during exercise. The higher your maximum oxygen consumption, the greater your aerobic capacity.

### Target Heart Rate Zone

Measuring increases in heart rate is a quick and easy method to gauge the intensity of your workout. It is important to note, however, that the **increase in heart rate is not the training stimulus; it is only indicative of the oxygen consumption required during the exercise.** If an increase in heart rate was all that was needed to increase aerobic capacity, then watching a thrilling movie while sitting on your favorite couch would provide an aerobic training benefit!

To measure your heart rate during exercise, count your pulse at the carotid artery (neck) or the radial artery (wrist) for 10 seconds ([Figure 5-1](#)). Multiply this value by six to get your heart rate in beats per minute (bpm).

**Figure 5-1. Measuring Heart Rate at the Wrist**



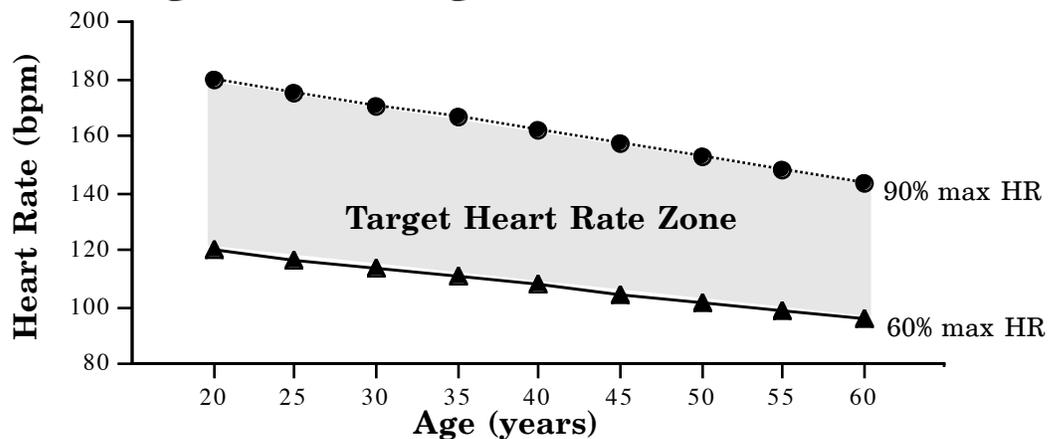
- ◆ Use your fingertips, not your thumb, to find your pulse at the radial artery (at your wrist, below your thumb).
- ◆ Count the beats for 10 seconds.
- ◆ Multiply this number by 6 to get your heart rate in beats per minute (bpm).

Once you measure your exercising heart rate how do you know whether you are exercising at the appropriate intensity?

- ◆ First calculate your age-predicted maximum heart rate (max HR):  
**Max HR (bpm) = 220 - your age (in years)**
- ◆ Second, multiply your max HR by 0.60 and 0.90 to determine 60% and 90% of your max HR, respectively. This range is your target heart rate zone.
- ◆ Your exercising heart rate should be in this zone. If it is not, increase or decrease your exercise intensity accordingly.

You may have seen the following figure displayed in gyms and fitness centers. Use this figure or [Worksheet 5-1](#) to find your target heart rate zone.

**Figure 5-2. Target Heart Rate Zones**



Note: Max HR is lower during swimming and arm exercises. For these activities, subtract 13 from Max HR before calculating your target training zone.

## Worksheet 5-1. Determine Your Target Heart Rate

Age-Predicted Max HR =  $220 - \text{your age} = \text{bpm}$ .

60% max HR =  $\text{max HR} \times 0.60 = \text{bpm}$ .

90% max HR =  $\text{max HR} \times 0.90 = \text{bpm}$ .

Target HR Zone =  $\text{to } \text{bpm}$ .

See “[Training Design and Progression](#)” on page 43 to determine what heart rates, within this range, you should aim for during exercise based on your level of physical fitness and your fitness goals.



## Calories

The term “Calorie” is very familiar to most people and is often used to gauge exercise intensity. Calories per hour is the amount of energy an exerciser expends when maintaining the same exercise intensity for an hour. This value is calculated by most exercise machines.

## Perceived Exertion

Ratings of Perceived Exertion, or RPE, are the subjective measures of exercise intensity perceived by the exerciser. Measurements are based on a twenty-point scale, “6” is no exertion and “20” is maximal exertion. These numbers were chosen because when multiplied by “10,” they are roughly equal to the resting and max HR values of 60 and 200 beats/min., respectively. Once accustomed to a particular exercise, you will be able to estimate your exercising heart rate based on your RPE. Most people should workout at a perceived exertion between 12 and 15 (moderate to hard). See [Table 5-1](#).

## Relationship Between Measures of Exercise Intensity

[Table 5-1](#) presents the relationship between %max HR, maximal aerobic capacity, and RPE. Performance of exercises classified as “moderate” (level 1 in the Physical Activity Pyramid) is recommended on a daily basis. If your goal is to maintain or improve general fitness (see [Figure 4-1 on page 29](#)), exercise at an intensity of “moderate” to “hard.” At this intensity you should be able to talk when exercising and take deep, comfortable breaths. If your goal is to maintain or increase performance-related fitness, occasionally exercise at an intensity of “hard” to “very hard.” Exercise intensities of “very,

very hard” to “maximal” should only be performed by individuals in extremely good aerobic condition who have been cleared by a physician to perform near maximal exercise. Exercise in this range cannot be sustained for long periods of time and is primarily performed to develop the anaerobic energy system and improve performance in activities such as sprints.

**Table 5-1. Relationship Between Measures of Intensity**

<b>% Max HR</b>	<b>% Max Aerobic Capacity</b>	<b>RPE</b>	
55	40	9	very light
65	50	12	moderate
70	55	13	somewhat hard
80	70	15	hard
90	85	17	very hard
95	90	19	very, very hard
100	100	20	maximal

↑ **Typical Training zone**  
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Chart adapted from the American College of Sports Medicine 1998 Position Stand: The Recommended Quantity and Quality of Exercise for Developing and Maintaining Cardiorespiratory and Muscular Fitness, and Flexibility in Healthy Adults, and from ET Howley and BD Franks (1992) *Health and Fitness Instructor's Handbook*.

## Other Measures of Exercise Intensity

Two other measures of exercise intensity that are used are **METs** and **Watts**. A MET, or metabolic equivalent, is a measure of the amount of energy needed to perform an activity and is expressed as a multiple of the energy required at rest (rest = 1 MET). For example, if you exercise at 5 METs you are using 5 times the energy you do at rest. A Watt is the amount of work (kcal) performed in a given period of time. Therefore, the greater the watts (kcal/min), the higher the intensity of the exercise.

## Type of Exercise

The last “T” in “FITT” refers to the type of exercise performed. To increase aerobic fitness, exercise should be a low-resistance, high-repetition activity (e.g., biking) that trains the heart and the muscles to use oxygen more efficiently. To choose the best exercises for you, consider the following:

- ◆ Training is exercise specific; what you practice, you perfect. Therefore, to improve your run time, you must run.

- ◆ As a general rule, exercises that involve several muscle groups and are weight bearing will require the greatest amount of Calories and oxygen to perform.
- ◆ Exercises that you enjoy the most are the best exercises for you.
- ◆ Alleviate boredom and decrease your risk for injuries by alternating the types of exercise you perform, i.e., **cross-train**.

**Table 5-2. Examples of Aerobic Exercise**

Activity	Advantages	Comments
Aerobic Classes	Group setting, variety of levels	Work at your own pace, ask instructor prior to class for any tips.
Bicycling	Low impact, good for cross-training	Bike at 70 rpms, with a slight bend in knee to best work the quadriceps muscles.
Climbing (Stairclimbing)	Weight bearing	Uses major muscles of lower body; weight-bearing (by not leaning arms on machine); Rock climbing strengthens upper body, too.
Cross-country Skiing	Low impact, good for cross-training	Uses most major muscle groups.
Jumping Rope	Can be performed in small quarters	Variety of styles, fast pace mimics running, wear good shoes and avoid cement surface.
Martial Arts	Group setting	Popular; many focus on flexibility, strength, and relaxation.
Rowing	Low impact	Works most major muscle groups.
Running	Minimal gear required	High impact, alternate with other exercises.
Swimming, water aerobics	No impact, can be a group setting	Uses most major muscle groups; great as primary, cross-training, or rehab. exercise.
Walking	Low impact, minimal gear	Uses most major lower body muscle groups; weight-bearing.

Variations of these basic types of exercise include kickboxing, treading, and spinning. Now that you are familiar with the different exercise choices, look over [Table 5-3](#) for descriptions of routines that you can use in your workout. If you are exercising for health and general fitness benefits rather than specific performance-related fitness, alternate the exercises and routines that you perform. For example, try biking for 10 minutes, stairclimbing for 10 minutes, and jogging for 10 minutes. As long as you keep your intensity within your target heart rate zone, add as much variety as you wish. This may help alleviate boredom too!

The benefits of performing routines listed in [Table 5-3](#) that increase your anaerobic capacity include enhanced performance in fast, short duration activities (like sprinting). These types of workouts increase the muscles'

ability to store and generate more energy via the anaerobic energy system. This is beneficial in sports such as basketball, baseball, tennis, and soccer that require several short bursts of speed throughout an entire game.

**Table 5-3. Various Training Strategies**

<b>Workout</b>	<b>Description</b>
Long and Slow	20 to 60 minutes at an easy pace. Use to improve and maintain health benefits and general fitness (see <a href="#">Figure 4-1</a> ).
Steady State	20 to 40 minutes at a pace which barely allows you to talk to someone; uses anaerobic and aerobic systems. Use to increase general fitness.
Intervals	Ratios of recovery to work; i.e., 3 minutes normal (recovery) pace, 1 minute sprint (work) pace (3:1); 30 second recovery to 15 second work (2:1), etc.; increases anaerobic and aerobic systems depending on ratios. Use to increase general fitness and performance fitness.
Fartleks (Speed Play)	Mix normal exercise pace with hard exercise pace in an unstructured pattern; increases anaerobic and aerobic systems. Use to increase general fitness and performance fitness.
Time Trial	Exercise for predetermined distance at a race pace. Use to establish baseline of performance fitness.
Pyramids	Exercise is divided in stages as follows: 1 minute (min) hard: 1 min rest, 3 min hard: 2 min rest, 5 min hard: 3 min rest, 7 min hard: 5 min rest, then work back down (5:3, 3:2, 1:1); increases anaerobic and aerobic systems. Use to improve general fitness and performance fitness.
Sprint	Maximum exercise effort lasting 5-10 seconds, followed by complete recovery; increases anaerobic system. Use to improve performance fitness.
Acceleration Sprint	Jog 100 yards (yds.), then sprint 100 yds., then walk 100 yds.; repeat this pattern for a given distance or time; increases anaerobic system. Use to improve performance fitness.

## Cross-Training

It is good idea to vary your workout routines to avoid overuse injuries which can be caused by the repetitive motions of your favorite exercise. The major benefit of **cross-training**, or altering the types of exercise you perform, lies in the prevention of injuries while maintaining cardiorespiratory fitness. Engaging in a variety of activities will provide a good aerobic base while using alternate muscle groups.

# Training Design and Progression

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Now you are ready to design your aerobic workout! When designing a cardiovascular routine there are a few questions you must answer. These are:

Questions	1. What are your goals?	Are you interested in health, general fitness, or performance benefits? Get more specific as you become more involved with your workout.
	2. What do you enjoy?	Do you prefer team or solitary activities? List at least three activities that you enjoy doing.
	3. What are your time limits?	Be realistic about the time you can devote to these activities.
	4. What gear do you need?	Plan to get the gear you need to participate in these activities.

You want to tailor your program to realistically meet your goals and time demands, so answer the questions honestly. (See [Chapter 17](#) for more information on setting goals.) If you have been sedentary, begin by increasing your physical activity by performing more daily activities, found in Level 1 of the Physical Activity Pyramid ([Figure 4-2](#)). Once you can easily perform these activities, add 5-10 minutes of Level 2 activities two to four days per week. Gradually increase the duration of the Level 2 activities by 10% per week until you can perform 20 to 60 minutes continuously. Your training intensity during these exercise sessions should be between 65% and 70% of your max HR (see [Worksheet 5-1](#)).

If you can already perform 30+ minutes of Level 2 activities and wish to maintain or increase your aerobic capacity, exercise between 65% and 80% max HR for 30 to 60 minutes three to four days per week. If you are interested in performance fitness benefits and are in excellent aerobic condition, consider adding 15-30 minutes of high-intensity (80% to 90% max HR) activities per week in addition to your aerobic training. This will increase your anaerobic energy system and increase your ability to sprint and recover more rapidly during sports such as basketball and soccer. For sport specific performance, some of your training sessions should mimic movements you perform during the sport.

## The golden rules of training progression are:

- ◆ Increase only one FITT component, i.e., frequency, intensity, time, or type, at a time.
- ◆ Increase your training by no more than 10% per week. Allow yourself time to adjust to this new routine before you increase your workout again. Increasing too fast will lead to injury and overtraining (see [Chapter 13](#)).

- ◆ Signs of overexertion include pain in your chest, breathlessness or gasping for breath, nausea, and dizziness. If you have any of these symptoms, stop exercising immediately!

Based on your answers to the questions above and your current fitness level, set up a weekly routine with moderate to hard workout days and rest days. You will add a strength training workout to this schedule in [Chapter 7](#).

