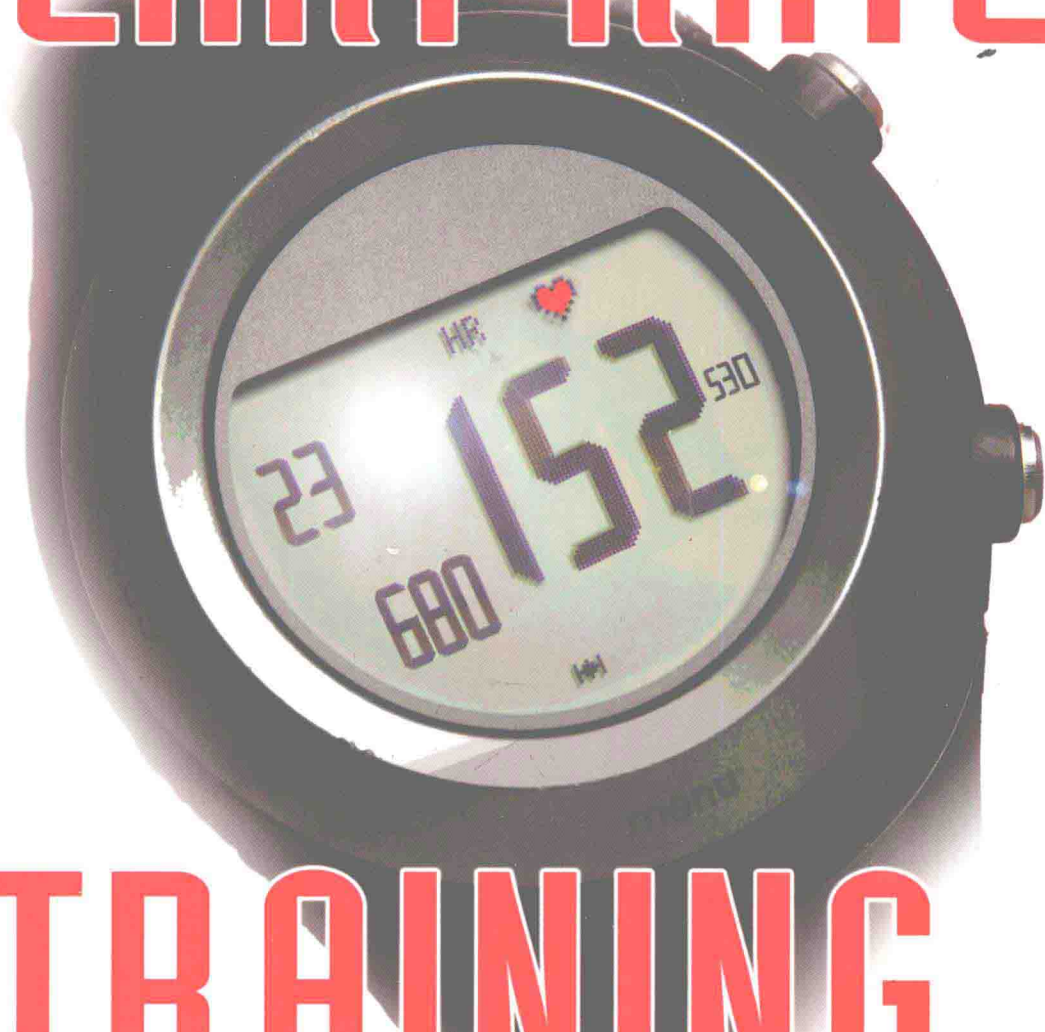


# HEART RATE



# TRAINING

---

Increase endurance,  
raise lactate threshold,  
and boost power

---

ROY BENSON • DECLAN CONNOLLY

# HEART RATE TRAINING

ROY BENSON  
DECLAN CONNOLLY



Human Kinetics

## Library of Congress Cataloging-in-Publication Data

Benson, Roy.

Heart rate training / Roy Benson, Declan Connolly.

p. cm.

Includes index.

ISBN-13: 978-0-7360-8655-4 (soft cover)

ISBN-10: 0-7360-8655-2 (soft cover)

1. Cardiovascular fitness. 2. Heart rate monitoring. I. Connolly, Declan, 1965- II. Title.

QP113.B46 2011

616.1'05--dc22

2010046982

ISBN-10: 0-7360-8655-2 (print)

ISBN-13: 978-0-7360-8655-4 (print)

Copyright © 2011 by Running, Ltd., and Vermont Fit

All rights reserved. Except for use in a review, the reproduction or utilization of this work in any form or by any electronic, mechanical, or other means, now known or hereafter invented, including xerography, photocopying, and recording, and in any information storage and retrieval system, is forbidden without the written permission of the publisher.

**Acquisitions Editor:** Laurel Plotzke Garcia; **Developmental Editor:** Cynthia McEntire; **Assistant Editor:** Elizabeth Evans; **Permission Manager:** Martha Gullo; **Copyeditor:** Patsy Fortney; **Indexer:** Dan Connolly; **Graphic Designer:** Bob Reuther; **Graphic Artist:** Tara Welsch; **Cover Designer:** Keith Blomberg; **Photo Asset Manager:** Laura Fitch; **Art Manager:** Kelly Hendren; **Associate Art Manager:** Alan L. Wilborn; **Illustrations:** © Human Kinetics; **Printer:** McNaughton & Gunn

Human Kinetics books are available at special discounts for bulk purchase. Special editions or book excerpts can also be created to specification. For details, contact the Special Sales Manager at Human Kinetics.

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](http://www.HumanKinetics.com)

*United States:* Human Kinetics

P.O. Box 5076

Champaign, IL 61825-5076

800-747-4457

e-mail: [humank@hkusa.com](mailto: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](mailto:info@hkcanada.com)

*Australia:* Human Kinetics

57A Price Avenue

Lower Mitcham, South Australia 5062

08 8372 0999

e-mail: [info@hkaustralia.com](mailto:info@hkaustralia.com)

*New Zealand:* Human Kinetics

P.O. Box 80

Torrens Park, South Australia 5062

0800 222 062

e-mail: [info@hknewzealand.com](mailto:info@hknewzealand.com)

*Europe:* Human Kinetics

107 Bradford Road

Stanningley

Leeds LS28 6AT, United Kingdom

+44 (0) 113 255 5665

e-mail: [hk@hkeurope.com](mailto:hk@hkeurope.com)

E4932

Cheers, Dr. Z.

Dr. Z is a diligent scientist, an engaging scholar, a fitness enthusiast, a critical thinker, and a compassionate and understanding man. He epitomizes a mentor. Thank you, Dr. Z. We hope our work here reflects both your work and humor.

# ACKNOWLEDGMENTS

To the runners I've coached, to those who have come to my camps, to the readers I've informed, and to Polar Electro and Nike who used my advice, a thousand thanks for your feedback and your trust. Thanks to my wife, Betty, for her patience and support. And thanks to the great Coach in the sky for allowing me to enjoy many happy heart beats.

—Roy Benson

To my wife, Shannon, whose tireless effort with our family has allowed me the time to work on this project. Her flexibility and pride in motherhood has given me great freedom, and I am grateful. Thanks to the rugrats—Kieran, Fiona, Cillian, and Nuala—who have put my work in perspective. To my parents, Charlie and Geraldine, who gave me the freedom to pursue my goals at the four corners of the globe, “You might have a good day.” Finally thanks to my exercise friends who provided me the constant opportunity for tinkering and exploring.

—Declan Connolly

## ***A Special Dedication***

Timing, chance, luck of the Irish? Call it what you want but the writing of this book is the result of one guy's tutelage and mentoring. Your authors may be separated by 30 years or so (Benson was already coaching when Connolly was in diapers), but their career paths were carefully guided by a higher force. One day they were chatting about regulating exercise intensity. As they chatted, they realized an eerie similarity in their philosophy. Unbeknownst to them, they had both been mentored by Dr. Zauner, or Dr. Z. Although they were some 30 years apart, the experience of being taught by Dr. Z was lasting and profound. Their paths took very different routes, but Dr. Z's influence was ever apparent.

In 1969, after six years coaching military and high-school track and cross-country teams, Benson concluded that, if life was going to be about paperwork, he'd rather write training plans than lesson or business plans. A masters degree in physical education would give him a chance to do that full-time as a college coach. In the fall of 1969, he began working toward a MPE at the University of Florida. Although his BA was in geography, exercise physiology was already a favorite subject through self-study. The University of Florida did not have much of a graduate program in exercise physiology, but it did

have an outstanding professor, Dr. Christian Zauner, to teach the courses it offered. Dr. Zauner also happened to coach a young group of swimmers in his backyard pool. One day in class, Dr. Z mentioned how he used their heart rates to determine their recoveries during an interval workout. This was an immediate eureka experience for Benson. At that time, Benson also was a graduate assistant coach with the University of Florida varsity distance runners. He quickly raised his hand and asked how Dr. Z was doing this. His process of measuring effort by counting heart rates made great sense. It had always been a battle to get the runners to stop acting so tired at the end of each repeat and asking if the workout was finally over. It was even harder to get them going again after each arbitrary distance of jogging recovery as they begged for more time. What wonderful tools their pulses became for revealing the truth about their efforts and recoveries.

That one serendipitous moment led to Benson's work and study of cardiac response to exercise. But his education really expanded when Dr. Z became his mentor and they started a hospital-based business, Fitness Incorporated, that offered fitness rehabilitation services. Their program was designed around heart rate measurements taken in the days before monitors. After several years, they sold the business to the hospital, and it served as the cornerstone of one of the first hospital wellness centers in the southeastern United States. Not long after, they both moved away from Gainesville and lost touch. Then while visiting a friend in Corvallis, Oregon, Benson learned that Dr. Z was living just a few blocks down the street. Benson renewed his friendship with his mentor, the one person who had the most influence on his professional life.

Connolly's career also benefitted from the tutelage of Dr. Z. In June 1987, Connolly graduated with a degree in sports studies from the University of Ulster, Northern Ireland. In the summer of 1990, he graduated from the University of Rhode Island with a MS in exercise science. While working as a camp counselor, he applied to graduate schools around the country looking for funding. He spoke to the chair of exercise science at Oregon State University, Dr. Christian Zauner, who said he might be able to find work for Connolly but not enough for a doctorate degree. Connolly drove across the country and appeared on Dr. Z's doorstep. After explaining who he was, Connolly was given funding until Christmas, though Dr. Z told him if he didn't work out, he was outta there. By the fall, Dr. Z increased Connolly's funding support, gave him odd jobs to earn a few more dollars, and shared his insights in the field. Dr. Z was widely travelled and understood the challenges facing foreign students. He'd invite them over for holidays, find them summer work, and impart worldly wisdom over Oregon's finest microbrews. He'd host their parents when they visited, allow them to call home from his phone. Above all Dr. Z mentored them about what was needed to be successful. Dr. Z took a chance on an Irish kid who didn't have much to offer and nowhere else to go. For that, Connolly is eternally grateful.

# INTRODUCTION

**C**ongratulations! You're about to learn why heart rate monitoring is one of the most convenient and most effective ways to train. You're on your way to becoming better conditioned in a more time-efficient manner. When you understand your heart rate, learn how to measure it, and have a reliable monitor, you are on your way to a scientifically designed exercise program, individualized just for you, that will guarantee results.

The main problem with most exercise programs is that they are not based on your unique body shape, size, physiological response, and most important, current fitness level. They aren't designed just for you. In fact, it's likely these exercise programs have little to do with you. For the most part, they are generic programs based on basic exercise physiology. They come in the form of classes, training groups, clubs, or books written by self-styled experts. But despite the quality of the teaching and the validity of the general principles, they don't answer the "What about me?" question. Often, you can't figure out how to apply the information to yourself. Everyone who wants to exercise, get in shape, or train has the same dilemma: "Should I run? Take a spinning class? Use the rowing machine? Just swim?" Once the choice is made, the next question is, "Yes, but what about *me*? How do I go about this? Now that I've picked something, how far, how fast, how hard, how often should *I* go?"

The *what* question is not hard to address. We hope that you've picked something that is convenient, looks like fun, or seems the easiest. The *how* question usually is the stumper.

Do what you want and call it what you will, but your effort has to be *individualized*. It must be based on your current fitness level, general ability, and goals. The simplest way to create an individualized program is to track your cardiac response to your body's movement of choice. Then you can observe the adaptations that reflect your responses and no one else's.

The good news is that modern technology has produced a wide selection of affordable heart rate monitors. They provide instant, reliable feedback about your body's response to your chosen exercise and intensity. Whether you are a beginner, intermediate, or advanced athlete, there is a heart rate monitor for you with all the bells and whistles you need.

*Heart Rate Training* will guide you through the necessary steps to help you realize three goals:

1. Find the best way to make a heart rate monitor work for you.
2. Learn to apply the principles of exercise physiology to get in the best possible shape.



3. Combine these two goals to benefit from training that is totally individualized to your ability, fitness level, and goals.

To help you meet the first goal, we share our collective wisdom from years of working with heart rate monitors and doing research. We offer tools and ideas we've developed. We show you how to be sure your numbers are reliable and how to interpret what they tell you about yourself.

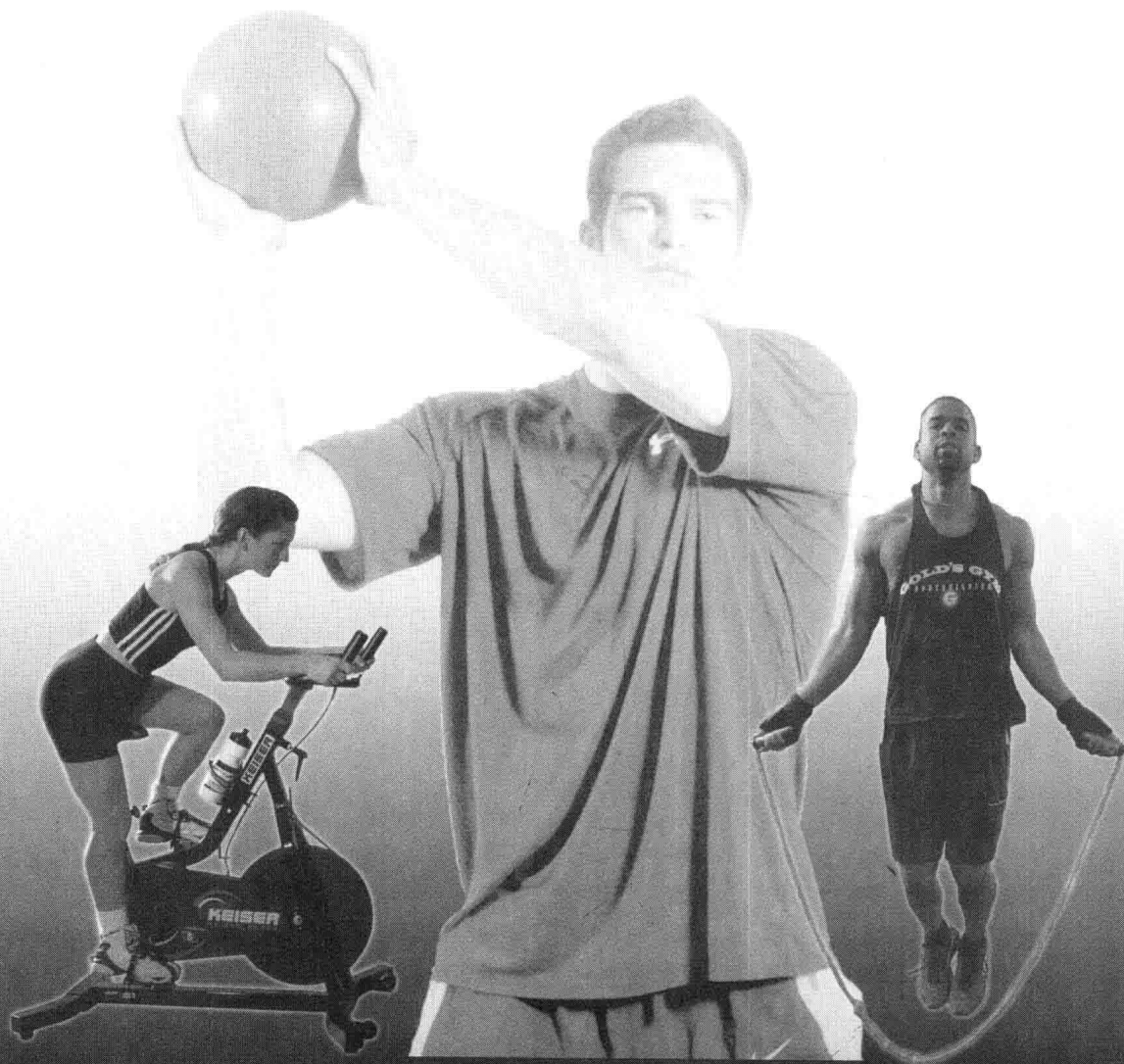
To help you meet the first and second goals, we dispel some of the confusion and answer the most common questions that come up regarding heart rate training. The first challenge to address is the confusion in the popular literature about heart rate training zones. One article may claim that to get in shape, you should train at a certain percentage of your maximum heart rate. The next article notes that you should work out in a certain percentage zone of your maximum oxygen uptake capacity, often expressed as percentage of  $\dot{V}O_2\text{max}$  or written out as a percentage of your maximum volume of oxygen uptake. Because both of these suggestions are valid, we combine them to make it as easy as possible to calculate your target heart rate. This solution appears in chapter 1.

A further challenge in meeting the second goal has to do with the lingo used in both the lab and the locker room. Unfortunately, no laws regulate the words used to communicate about exercise, physical fitness, or workouts. It is simply a matter of semantics, and unfortunately, neither academia nor the general population has reached unanimous agreement about the vocabulary. Rather than present lab vocabulary or dictionary definitions, we prefer to use the language most commonly found in the popular literature. First, we focus on just two aspects related to the response of your heart to the need for oxygen: aerobic and anaerobic conditioning. In addition, although many other terms are used by authorities, writers, and athletes to refer to and define other physical capacities developed while working toward peak shape, we talk primarily about four components of physical fitness: endurance, stamina, economy, and speed.

Accomplishing goal 3 is a cinch when you use a heart rate monitor because it allows you to perfectly individualize your training. The principles are broad, but your response is as narrow as your ability, shape, and goals require.

This book is organized progressively. First, it presents the relevant background and basic exercise science you need to know to understand training. Chapters 1 through 7 cover some basic physiological adaptations, equipment issues, and other information regarding your training and fitness. The next chapters progress into the various adaptation stages you'll go through. Finally, we present a selection of exercise programs for walking, jogging, running, cycling, triathlon, swimming, rowing, and cross-country skiing. The final chapter covers using heart rate in the training of team sport athletes. These programs contain different levels, or intensities, to cater to individual fitness abilities and goals.





You'll find other outstanding sports conditioning resources at

[www.HumanKinetics.com/sportsconditioning](http://www.HumanKinetics.com/sportsconditioning)

In the U.S. call 1-800-747-4457

Australia 08 8372 0999 • Canada 1-800-465-7301

Europe +44 (0) 113 255 5665 • New Zealand 0800 222 062



**HUMAN KINETICS**

*The Premier Publisher for Sports & Fitness*

P.O. Box 5076 • Champaign, IL 61825-5076 USA

**eBook**  
available at  
[HumanKinetics.com](http://HumanKinetics.com)

# CONTENTS

Acknowledgments **vii** • Introduction **ix**

<b>PART I</b>	<b>Foundations</b>	<b>1</b>
<b>CHAPTER 1</b>	Monitoring for Maximum Performance . . .	<b>3</b>
<b>CHAPTER 2</b>	Evaluating and Customizing Your Zones . .	<b>21</b>
<b>CHAPTER 3</b>	Getting the Most From Your Monitor. . . .	<b>37</b>
<b>PART II</b>	<b>Training</b>	<b>43</b>
<b>CHAPTER 4</b>	Targeting Sport-Specific Fitness With Heart Rate . . . . .	<b>45</b>
<b>CHAPTER 5</b>	Increasing Aerobic Endurance . . . . .	<b>53</b>
<b>CHAPTER 6</b>	Raising Anaerobic Threshold . . . . .	<b>67</b>
<b>CHAPTER 7</b>	Boosting Speed and Power . . . . .	<b>85</b>

<b>PART III</b>	<b>Programs</b>	<b>101</b>
<b>CHAPTER 8</b>	Designing an Effective Training Program . . . . .	<b>103</b>
<b>CHAPTER 9</b>	Walking . . . . .	<b>115</b>
<b>CHAPTER 10</b>	Jogging and Running . . . . .	<b>125</b>
<b>CHAPTER 11</b>	Cycling . . . . .	<b>143</b>
<b>CHAPTER 12</b>	Swimming . . . . .	<b>154</b>
<b>CHAPTER 13</b>	Triathlon . . . . .	<b>166</b>
<b>CHAPTER 14</b>	Rowing . . . . .	<b>178</b>
<b>CHAPTER 15</b>	Cross-Country Skiing . . . . .	<b>191</b>
<b>CHAPTER 16</b>	Team Sports . . . . .	<b>198</b>

Appendix: Heart Rate Training Zone Calculation Chart **203**

Index **205** • About the Authors **211**

**PART I**

# **FOUNDATIONS**



# Monitoring for Maximum Performance

**T**his chapter introduces the concept of heart rate monitoring and explains how to monitor it accurately to get the specific adaptations you want. The first step, then, is to identify those adaptations. They are the four main components of fitness: endurance, stamina, economy, and speed. Because these components are interdependent, they must be developed in a progressive manner. The heart rate approach will allow you to stay in the target zone for the correct amount of time and prevent you from the all-too-common problem of overreaching, or overtraining. Once you understand these components, you will find it easier to organize and design exercise programs. This chapter also offers insights into other factors that affect adaptations and describes the changes and feelings you can expect from the various intensity levels of fitness. After reading this chapter, you will know how to monitor your training, making the whole process more enjoyable and more accurate.

The beauty of heart rate training is that it relies on a system (your cardiovascular system) that reflects your overall state of stress 24 hours a day, 365 days a year. It reflects when you're tired, overtrained, sick, cold, or hot and therefore can guide you in making changes to your plan. More important from an exercise point of view, it provides immediate and consistent feedback about your stress level, intensity level, and rate of adaptation in terms of overall fitness.

Because heart rate reveals how you are adapting to training, it is a valuable monitoring tool for exercise. Once you understand how to monitor and interpret your heart rate response to any given exercise scenario, and how to respond (i.e., rest, increase intensity, or decrease intensity), you will be able to optimize your fitness adaptations.

This chapter provides information to help you monitor, understand, and interpret your heart rate, thereby giving you the independence to individualize your workouts. But before we go into details, we have some important background information to cover.

## Four Components of Physical Fitness

The four components of fitness—endurance, stamina, economy, and speed—are developed in phases. This is also their order of progression as you train. Figure 1.1, the basic model for training, shows these components schematically. Each develops at a specific intensity, and in the early stages of training is optimally developed within a very specific intensity range. Exercising above or below the intensity range will result in varied adaptations such as increased risk of injury, premature peaking, or staleness from overtraining, all of which result in poor performance. Each component has a zone with upper and lower limits. Heart rate is the simplest and most effective way to monitor intensity and therefore ensure training in the correct zone.

*Endurance* (phase I) is the ability to go from point A to point B no matter how much you have to slow down. In general, aerobic endurance is developed at heart rates of less than 75 percent of the maximum heart rate (percent MHR). Think of this phase of conditioning as getting into shape. If you wish to simply stay healthy, this is as hard as you have to work. Long, slow distances (LSD) are examples of endurance workouts.

*Stamina* (phase II) is the ability to go from point A to point B without slowing down. In general, stamina is developed in heart rate zones of 75 to 85 percent MHR. Consider this phase of conditioning as getting ready to race. The fitness emphasis in this phase is on preparing the cardiovascular and respiratory systems to work hard without overreaching. Steady-state workouts of 40 to 45 minutes are good examples of stamina workouts.

*Economy* (phase III) is the ability to go at race pace while using the least amount of oxygen and energy. In general, economy is developed in heart rate zones of 85 to 95 percent MHR. Think of this phase of conditioning as improving your racing fitness by adding more horsepower to your engine through workouts such as interval training, hill sprints, and fartlek running. (*Fartlek*, which literally means “speed play,” is a Swedish system of conditioning that features frequent changes in speed.) Good examples of economy workouts are those at moderate to high intensity for continuous tempo paces, or interval workouts featuring longer repetitions.

*Speed* (phase IV) is the ability to go at top speeds for short periods of time and to stay relaxed while tolerating increasing levels of lactic acid in the



muscle tissue. In general, speed is developed in heart rate zones of 95 to 100 percent MHR. The power training in this phase also will bring about final improvements in strength, flexibility, and coordination. Interval workouts of shorter, faster, and maximum-intensity repeats with long and full recoveries are the best examples of speed workouts.

These are not dictionary or laboratory terms, but are commonly used in the popular literature when discussing exercise and fitness. They are useful for identifying the heart rate ranges so you can safely progress up the training triangle all the way to championship shape, depending on your goal.

We start by identifying these concepts because they tie in well with the concept of oxygen usage, which, of course, is conveniently estimated (albeit indirectly) by your heart rate. When working on endurance, you will exercise in your aerobic effort zone. If you are focusing on improving speed, you will train in your anaerobic effort zone. Figure 1.1 is our version of the classic training triangle and offers a graphic representation of this approach.

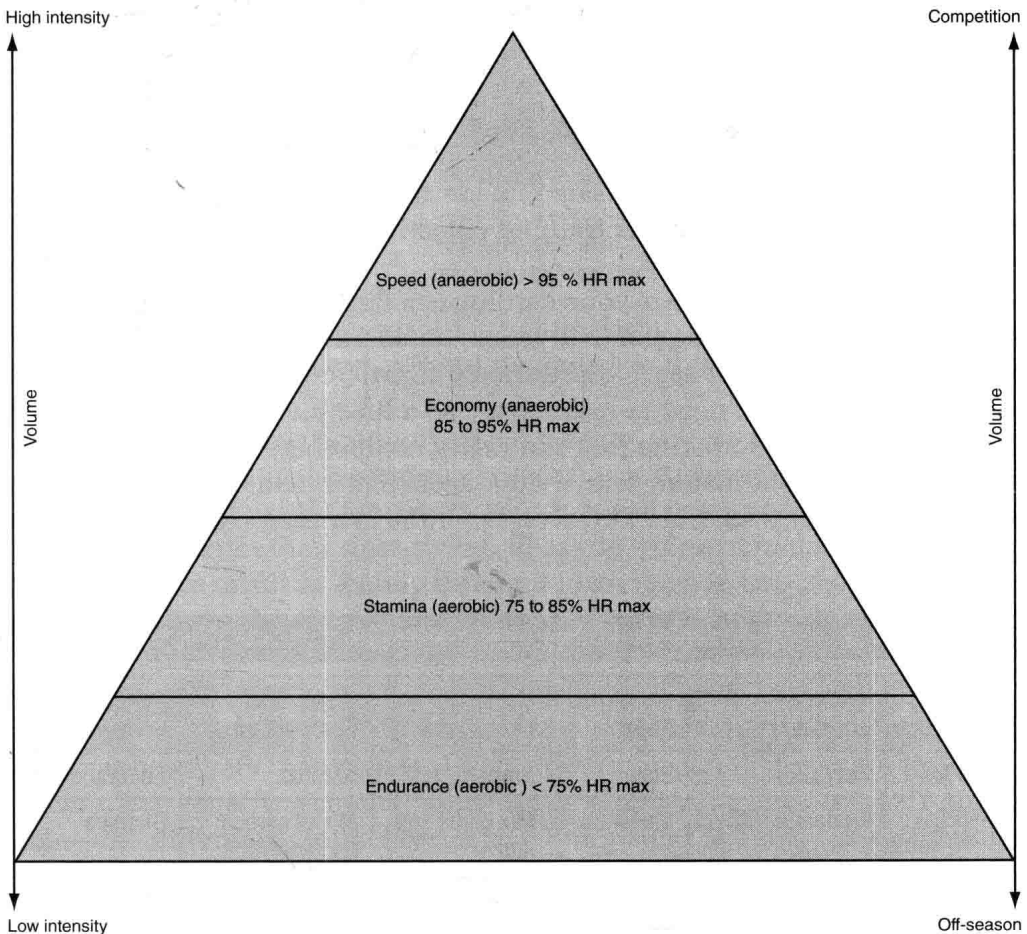


FIGURE 1.1 Basic model for training.

Activities in the lower, easier zone result in specific physiological and biomechanical adaptations, whereas those in the upper, harder zone have their own important biochemical and neurological adaptations. Developing speed requires fairly sophisticated training methods at even narrower effort zones within the anaerobic section of the triangle. These will be discussed in more detail in later chapters.

Table 1.1 illustrates another graphic way to express much of what we have covered so far and will talk about in later chapters.

Consider the categories in table 1.1 with a fair degree of open-mindedness because the zones range as wide as 10 to 15 percent. The reason for this is that, in our experience, people generally run more comfortably at higher heart rates than they bike, row, or swim. While running in your endurance zone, you might be closer to the 70 to 75 percent mark; whereas when swimming, you may be close to the 60 to 65 percent mark. When you become well trained, you will be able to perform more comfortably toward the upper level, which is the way we'd expect you to progress. An additional point about your maximum heart rate numbers: they will be different for each activity. Therefore, you will need a true maximum heart rate for each activity, especially if you're a triathlete. We will talk more about this in later chapters.

## Personal Considerations

Essentially, all people are the same, made from the same parts. However, important differences, such as training objectives, affect our responses and adaptations.

Do you want to improve your cardiovascular health and control your weight? If so, then we suggest that you exercise frequently and extensively at the very low levels of aerobic endurance effort, but don't expect dramatic short-term gains. You need to make exercise a lifestyle.

Does simply participating (but not really competing) in a 10K road race with the goal of just finishing with a smile seem like a good way to enjoy some social recreation? If so, then for several months to a year, patiently increase

**TABLE 1.1** Heart Rate Phases

HR zone	Effort index	Effort level	Pace	Fuel source	Fuel system	Fitness component
I	60–75%	Easy (EZ)	Slow	Primarily fats	Aerobic	Endurance
II	75–85%	Moderate (MO)	Moderate	Mix carbs and fats	Mix of aerobic and anaerobic	Stamina
III	85–95%	Difficult (FA)	Fast	Primarily carbs	Anaerobic	Economy
IV	95–100%	Very hard (VF)	Sprint	All carbs	ATP-PC	Speed