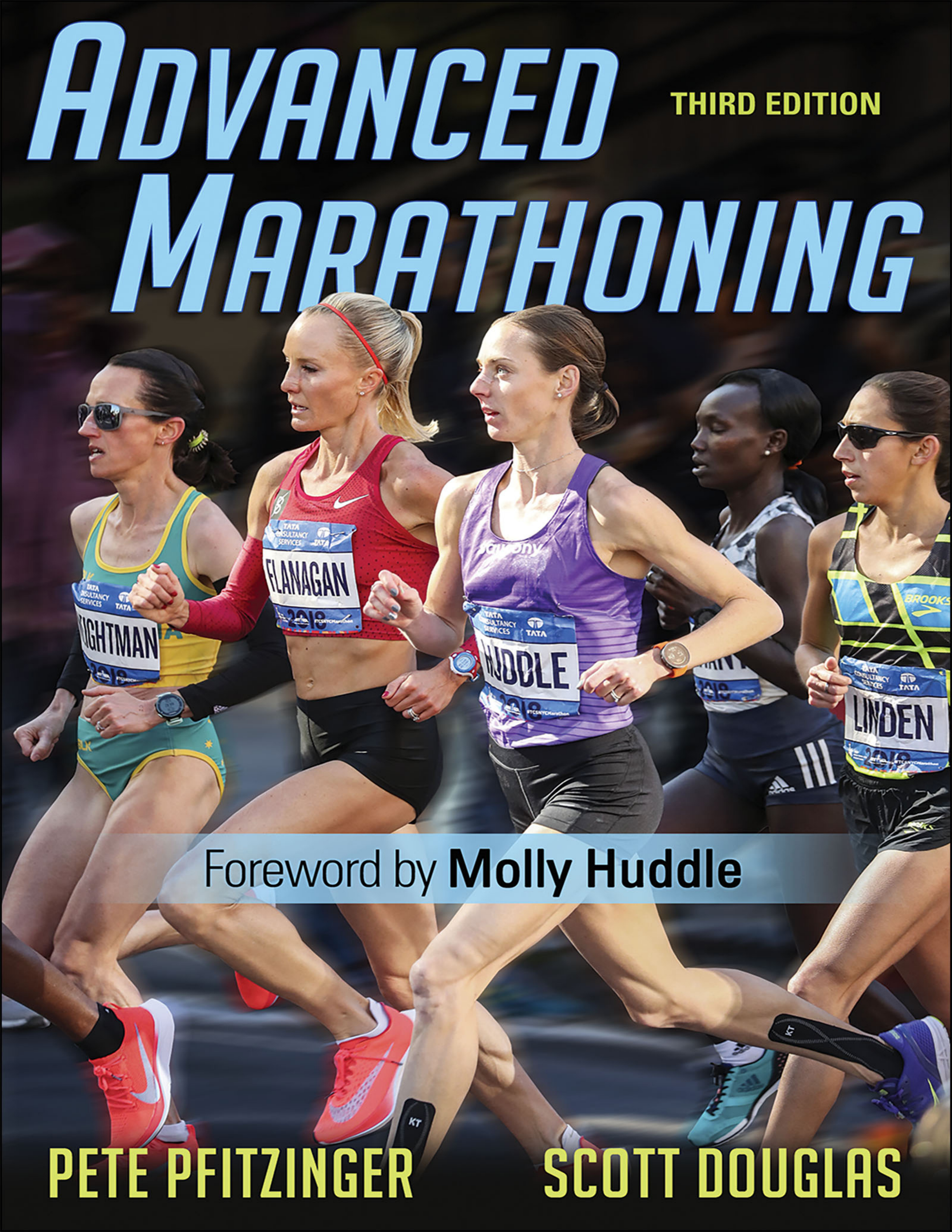
ADVANCED MARATHONING

THIRD EDITION



Foreword by **Molly Huddle**

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To all runners willing to work hard and intelligently.

—Pete Pfitzinger and Scott Douglas

Contents

Foreword

Running a marathon is one of life's transformative experiences. Unlike with a 5K or 10K, you have to train and prepare to complete the distance, which is set a smidge beyond human muscle glycogen capacity. (Fun!) It can be overwhelming to break down that long block of training so that in a few months you complete every workout you need to be fit enough for the event, but also show up rested, healthy, and with enough energy to race as your strongest self.

Before my first marathon, the thought of even a 23-mile long run was both exciting and daunting. By the time I got to the race, after completing shorter runs and workouts along the way, it felt like taking the next step rather than an enormous leap. I loved how when I looked at the weeks of training that my coach, Ray Treacy, had written neatly into little white calendar squares, every day had a specific purpose to focus on, so the thought of running 26.2 miles (as hard as you can! With hills! And wind!) was not too overwhelming either. It seemed like the final special event in a series of ever-increasing weekly workout accomplishments, each of which built confidence needed for race day. To be fair, some faith in your body to find its A game is still required for the race because the marathon is an event where you don't complete the full volume at goal pace in practice.

That's what Pete Pfitzinger and Scott Douglas bring to the table with *Advanced Marathoning*: a guide that provides a focused purpose every day so that you get to race day on time, fit enough, rested enough, and healthy enough to have a great experience. (Note: There are a range of marathon experiences—all of them transformative, but not all of them great.)

When my cousin Michelle told me she was running her first marathon and wanted advice, I gave her this book, because it addresses a range of marathon goals with really good advice on fueling, tapering, injury avoidance, and explanation and detail regarding workouts and rest days. She is new to the marathon world, but I would also recommend the book to my running friends like some of my former college cross country teammates who are trying to maximize their potential over the marathon distance and want to qualify for the U.S. Olympic Trials Marathon.

The marathon as an event will at once empower you, humble you, and inspire you. The weeks-long journey to get there will change you as well. You will not just reinforce your muscles and expand your heart and lungs; you'll also fortify your will and uncover your own unique mental superpowers. Just like on race day, when 26.2 miles starts with the first step off the line, your marathon journey starts with the first day of training, as humble a workout as it may seem. So enter your race and use these pages to craft your plan because with enough training, guidance, grit, and preparation, I believe anyone can run the marathon. I hope you take the challenge—in a few months, you will be better for it!

—Molly Huddle, American record-holder at 10,000 meters and half marathon, two-time Olympian, 2:26 marathoner

Preface

Guidelines for Advanced Marathoning

Welcome to the third edition of *Advanced Marathoning*. The positive reception to the first two editions, and the direct feedback about them that we're pleased to continually receive, only strengthens our belief that there are tens of thousands of readers out there eager to know how to conquer one of running's most challenging races.

The key to simply finishing a marathon isn't a secret: Train long to go long. But what about when you want to race a marathon? Then things aren't so simple.

Besides gaining enough baseline endurance to complete the distance, now your concerns turn to matters such as how fast to do your long runs, what types of interval sessions to do, how to manipulate your diet for maximum performance, how to schedule hard workouts to allow both progress and recovery, and so on. The best answers to these questions aren't so obvious, and they require a solid base of knowledge. You'll acquire that knowledge through this book.

If you've run a marathon and want to move beyond the basics, or if you're an accomplished runner at shorter distances planning a marathon debut, it's time to graduate to *Advanced Marathoning*. We hope you'll agree that this third edition—with a new chapter and expanded, updated information in every chapter—will become one of the most valuable resources in your running library.

ADVANCED MARATHONING

What do we mean by *advanced marathoning*? Simply this: that many runners aren't content with saying, "I finished." They want to run the marathon as they do shorter races—as fast as possible. That doesn't mean they're going to drop everything in their lives and do nothing but train, but it does mean they're committed to doing their best, taking into consideration such factors as their age and real-world commitments. The runners for whom we wrote this book have goals such as setting a personal best, qualifying for Boston, or running faster than they did 10 years ago.

Competing in the marathon, as opposed to completing the distance without regard for time, requires thorough, intelligent preparation. Being dedicated to improving your marathon performance requires knowing such things as how to incorporate race-pace segments into your long runs, how far and how fast your hard sessions should be, what to eat so that you're able to run as fast at mile 25 as at the start, and so on. Advanced marathoning has to be based on more than common sense and running folklore. *Advanced Marathoning*, therefore, is based on the application of sport science to marathon preparation and performance.

The training schedules in the second part of this book are based on a simple concept: Research in exercise physiology has revealed that the fastest marathoners have a few key attributes in common. These include an ability to store a large amount of glycogen (the stored form of carbohydrate) in their muscles, an ability to sustain submaximal speeds for prolonged periods, an ability to send large amounts of oxygen to muscles and have their muscles use that oxygen to produce energy, and excellent running economy (the ability to run faster than others using a given amount of oxygen). We know which of these attributes are most important for successful marathoning, and we know what types of training best improve these attributes. Marathon training, then, should be a matter of balancing these types of training with adequate recovery so your body's ability to sustain a relatively fast pace for 26.2 miles (42.2 km) improves as your goal race approaches.

We could, of course, simply present the training schedules found in the latter part of this book and say, "Just do what we tell you. Trust us." But we think that the more you understand why you're running a given workout, the more motivated you'll be to stick with your training and the better prepared you'll be to assess your progress toward your marathon goal. For that reason, before our training schedules are several chapters that explain the principles of successful marathon preparation. These chapters explain what is critical for marathon success and why. Digesting this information will help you be a better marathoner. Let's look at the contents of the first part of this book.

YOUR GUIDE TO UNDERSTANDING THE MARATHON

Chapter 1 is one of the longest chapters in this book. We don't expect that everyone will sit down and read it all at once; in fact, you could start on the training schedule of your choice right now and not have to worry that you haven't looked at chapter 1. Eventually, though, you'll want to read this chapter carefully and understand its key concepts because it explains how we applied sport science in constructing the training schedules.

Chapter 1 gives an in-depth examination of the physiological attributes needed for success in the marathon. These include a high lactate threshold, an ability to store a large amount of glycogen in your muscles and liver, a well-developed ability to use fat as fuel, a relatively high maximal oxygen uptake, and good running economy. (Don't worry if any of these concepts are unclear to you—you'll fully understand them and their relation to marathoning after reading chapter 1.) We look at the traits your body must have to run a good marathon, and then we detail how to train to provide the greatest stimulus for these traits to improve.

Understanding the concepts in chapter 1 is critical. Contrary to what some people think, training for a fast marathon doesn't mean simply running as many miles as possible as quickly as possible. Regardless of how inspired you are to run your best marathon, you most likely have to prepare for it while not neglecting those annoying little details such as your job. Your training, then, should provide the biggest return for the time you put into it. After you read chapter 1, you'll know why the targeted training the schedules call for is optimal for marathoning success.

Chapter 2 explains the crucial role that proper nutrition and hydration play in successful marathoning. What marathoners should eat and drink is the subject of much ill-informed discussion—perhaps almost as much as training is. We've synthesized the latest research and best practices in our updated recommendations. After reading chapter 2, you'll know what marathon training and racing require in terms of fuel and how your diet contributes to meeting your marathon goal. You'll also understand how dehydration can affect your performance and the strategies you can use in training and on race day.

As we said previously, intelligent marathon preparation means more than accumulating repeated days of hard mileage. Most of the time, you'll make more progress toward your goal by doing one of the key workouts described in chapter 1, allowing your body to absorb the benefits of that workout, and then doing another targeted session. In other words, you should allow your body to recover after an especially long or hard run. Chapter 3 shows how to maximize your recovery, including how far and how fast to run in the days following a long or hard session, what to eat and drink to refuel most quickly, and how to monitor your body's signs to stay healthy enough to reap the benefits of your hard work.

If you follow one of the training schedules in this book, your training will contain all the running elements you'll need for a fast marathon. But there are things you can do in your nonrunning hours that can help your overall improvement as a marathoner. In chapter 4, we detail the types of flexibility, core strength, resistance training, and aerobic cross-training activities that will contribute to making you the best marathoner. We also describe a few technique drills that will help improve your running form.

New to this edition of *Advanced Marathoning* is a chapter for older marathoners. Although the principles of preparing to race a marathon are the same for all runners, aging can affect how you implement those principles. Chapter 5 starts with a look at why we tend to get slower with age and then shows how to adapt training, nutrition, and recovery practices to best address age-related changes. Our recommendations might not get you a new lifetime personal best, but they will help you to be a smarter, more successful older marathoner.

What you do in the last few weeks before your marathon can have a profound effect on your finishing time. Because tapering your training before the marathon is both so important and so misunderstood, we've devoted a chapter to the topic of getting your final preparation right. In chapter 6, you'll learn how—and why—to reduce your mileage as the marathon approaches and what workouts to do just before the race to reach the start line with the optimal blend of being rested and ready.

The final background chapter details what to do on race day. Chapter 7 discusses race strategy with section-by-section pacing advice and presents information on other crucial matters such as what to eat on race day and how to drink on the run.

THE TRAINING SCHEDULES

Chapters 9 through 13 apply the principles detailed in chapters 1 through 7 to day-by-day training schedules leading to your marathon. They're preceded by chapter 8, which gives in-depth direction on how to follow the training schedule of your choice. You'll learn not only how fast to do each of the key types of workouts but also, based on reader feedback to earlier editions, how to alter the schedules as warranted by injury, illness, or other obstacles to following the schedules as written.

Chapters 9 through 12 are divided on the basis of weekly mileage. (The training schedules in these chapters, as well as in chapter 13, also describe each day's workout in terms of kilometers. Choose whichever unit of measurement you're more comfortable with.) Chapter 9 contains the schedules that call for the lowest weekly mileage; these peak at 55 miles (89 km) per week. Chapter 10 contains schedules that call for 55 to 70 miles (89-113 km) per week. Chapter 11's schedules range from 70 to 85 miles (113-137 km). Chapter 12 is for the real high-mileage folks—it includes weeks of just more than 100 miles (161 km).

The weekly mileage you follow is up to you. Making that decision should be based on your running history, your tendency toward injury above a certain level of mileage, what else will be going on in your life in the months before your goal race, and so on. Regardless of which schedule you follow, it will contain the workouts that will lead to the biggest gains in marathon-specific fitness for that level of mileage.

Chapters 9 through 12 present you with another decision to make. Each chapter contains a 12-week and an 18-week schedule. Although we recommend that most readers follow the 18-week schedule, we realize that sometimes you don't have the luxury of that amount of planning. The 12-week schedules are for these situations, and while they're more compact than is optimal, they nonetheless contain the workouts needed to make significant progress in a relatively short time.

The schedules are designed to be easy to read in a landscape format. Horizontally, they show you how your mileage and training emphases change as your marathon approaches. This helps you understand your key training goals for a given period. Looking at the schedules vertically enhances that understanding because you can quickly grasp the key workouts in a given week. The schedules specify the purpose of each day's workout. That way you can not only determine what you're trying to achieve on a certain day of the week, but you can also look down through the week to see your most important training goals for that week.

You'll note that the schedules specify what to do every day of the many weeks leading up to your marathon. We realize, of course, that it's the rare reader whose life will so perfectly coincide with such a detailed schedule. Again, looking at the schedules vertically and horizontally will prove helpful because you'll know what types of training are most important for wherever you are on the schedule. You'll know which workouts to emphasize if you need to juggle a few days around.

Chapter 13 is a bit different from the other training-schedule chapters, and it's for marathoners who themselves are a bit different. Chapter 13 is for multiple-marathon runners who want to run two or more marathons within 12 weeks or less. Following such a schedule usually isn't the way to run your fastest marathon, but it's not our place to say categorically that you should never attempt such a feat. (Otherwise, we'd be in the awkward position of telling the men's winner of the 2018 Boston Marathon, Yuki Kawauchi, that he's going about it all wrong by running so many marathons.) Chapter 13 acknowledges that some runners want to tackle this challenge, and it provides schedules that will maximize your chances of success in the second (or third or fourth) marathon in a given time period. Using the principles behind the other schedules, chapter 13 provides schedules for your best possible marathon 4, 6, 8, 10, and 12 weeks after another marathon.

Now that you know what's in this book and how to use it, let's get going on understanding the basics of successful marathoning.

PART I

Training Components

Chapter 1
Elements of Training

Jonathan Bachman/Getty Images for Rock 'n' Roll Marathon

The marathon demands respect. The physiological and psychological demands of the marathon are extreme; therefore, you must plan your preparation intelligently and thoroughly.

All of the advice and training schedules in this book stem from the need for intelligent, thorough preparation and execution. As students of the sport and lifetime runners, we've considered and integrated the knowledge and methods of the world's top coaches and marathoners, and paired that hard-earned wisdom with the latest sport science research. We know that runners will do almost anything for a faster marathon time. What you'll find in the pages that follow are the whys and hows of the most important aspects of marathon training and racing, all presented with the recognition that marathoning is just one of the things to which your time and energy are devoted.

Put another way, while running a marathon isn't easy, training for it should be relatively simple. Running a marathon requires specific physiological attributes. The task at hand is to run 26.2 miles (42.2 km) as fast as possible. The requirements for this feat in terms of fuel use, oxygen consumption, biomechanical requirements, and even psychological attributes are highly predictable. In this chapter, we look at the physiological demands of the marathon and how to train most effectively to meet those demands.

First we look at the physiological demands, such as having a high lactate threshold and the ability to store large amounts of glycogen in your muscles and liver. Then we look at the types of training that are most effective for improving marathon performance and explain why. Next we investigate how to structure your training so it progresses logically to your desired end point. Finally, we look at the importance of using shorter races as tune-ups for the marathon. After reading this chapter, you'll see the logic underpinning effective marathon training and will better understand which types of training to emphasize and why.

MARATHON PHYSIOLOGY

Successful marathoners have many factors in common. Most of these factors are determined by both genetics and training. Genetics determines the range within which you can improve; training determines where your current abilities fall within that range. In this section, we'll consider the physiological variables necessary for marathon success.

Successful marathoners have the following physiological attributes.

- *High proportion of slow-twitch muscle fibers*. This trait is genetically determined and influences most of the other physiological characteristics listed here.
- *High lactate threshold*. This is the ability to produce energy at a fast rate aerobically without accumulating high levels of lactate in your muscles and blood.
- *High glycogen storage and well-developed fat utilization*. These traits enable you to store enough glycogen in your muscles and liver to run hard for 26.2 miles (42.2 km) while enabling your muscles to rely more on fat for fuel.

- *Excellent running economy*. This is the ability to use oxygen economically when running at marathon pace.
- *High maximal oxygen uptake ($\dot{V}O_2max$)*. This is the ability to transport large amounts of oxygen to your muscles and the ability of your muscles to extract and use oxygen to produce energy.
- *Quick recovery*. This is the ability to recover from training quickly.

Remember, no one factor makes a successful marathoner. The first person to break 2:03 for the distance, Dennis Kimetto of Kenya, didn't start racing until his mid-20s but immediately focused on long road races. He ran no world-class times at distances shorter than the half marathon. Kimetto presumably has a superb lactate threshold and a high percentage of slow-twitch muscle fibers. Contrast him with someone like Eliud Kipchoge of Kenya, arguably the greatest male marathoner of the modern era. The 2016 Olympic champion came to the marathon relatively late in his career, after a distinguished career on the track that included world-class times at distances as short as 1,500 meters. It's the combination of several physiological factors in conjunction with biomechanical variables and psychological strength that determines marathoning success. Let's look more closely at each main physiological factor.

High Proportion of Slow-Twitch Muscle Fibers

Your hundreds of thousands of muscle fibers can be divided into three primary categories—slow-twitch, fast-twitch A, and fast-twitch B. The higher the percentage of slow-twitch fibers in your muscles, the greater your likelihood of marathon success. Slow-twitch muscle fibers are naturally adapted to endurance exercise. They resist fatigue and have a high aerobic capacity, a high mitochondrial and capillary density, and other characteristics that make them ideal for marathon running.

The proportion of slow-twitch fibers in your muscles is determined genetically. With endurance training, your fast-twitch muscle fibers—especially the fast-twitch A fibers—can gain more of the characteristics of slow-twitch fibers. These adaptations are beneficial because they allow your fast-twitch fibers to become better at producing energy aerobically. In addition, there is some evidence that the proportion of slow-twitch fibers may increase moderately over many years of endurance training.

A muscle biopsy is the most accurate method of determining your proportion of slow-twitch muscle fibers. In a biopsy, a small amount of tissue is cut out of your muscle and analyzed. Though it is interesting (and painful), this procedure is pointless—once you know your fiber-type distribution, there's nothing you can do about it.

High Lactate Threshold

A high lactate threshold (LT) may be the most important physiological variable for endurance athletes. Your LT pace most directly determines your running performance limit in any event lasting more than 30 minutes. Your marathon race pace is limited by the buildup of hydrogen ions in your muscles and blood, which is associated with accumulation of lactate (a by-product of carbohydrate metabolism). A close relationship exists between your LT and marathon performance because LT reflects the highest rate at which your muscles can sustain aerobic energy production. Successful marathoners typically race at a speed very close to their LT pace.

The average runner's LT occurs at about 75 to 80 percent of his or her $\dot{V}O_2max$. Successful marathoners generally have LTs of over 80 percent of $\dot{V}O_2max$; elite marathoners tend to have LTs of about 90 percent of $\dot{V}O_2max$. This means that elite marathoners can use a larger proportion of their maximal aerobic capacity before lactate accumulates in their muscles and blood.

Lactate is produced by your muscles and is used by your muscles, heart, liver, and kidneys. The lactate concentration in your blood represents a balance between lactate production and consumption. Even at rest, you produce a small amount of lactate. If your blood lactate were measured right now, you would have a lactate concentration of about 1 millimole. As you increase your effort from resting to walking to easy running, your rates of lactate production and lactate consumption increase, and your blood lactate concentration stays relatively constant. When you run harder than your LT, however, your lactate concentration rises because the rate of lactate clearance can no longer keep up with lactate production.

When you accumulate a high level of lactate, the hydrogen ions associated with lactate production inhibit the enzymes used to produce energy and may interfere with the uptake of calcium, thereby reducing the muscles' ability to contract. In other words, you can't produce energy as quickly, so you're forced to slow down. This explains why well-trained marathoners run the marathon at an intensity just below LT.

With the correct training, adaptations occur inside your muscle fibers that allow you to run at a higher intensity without building up lactate and the associated hydrogen ions in your muscles and blood. The most important of these adaptations are increased number and size of mitochondria, increased aerobic enzyme activity, and increased capillarization in your muscle fibers. These adaptations all improve your ability to produce energy using oxygen.

Increased Number and Size of Mitochondria

Mitochondria are the only part of your muscle fibers in which energy can be produced aerobically. Think of them as the aerobic energy factories in your muscle fibers. By fully utilizing your ability to produce energy without accumulating high levels of lactate, LT training increases the size of your mitochondria (i.e., makes bigger factories) and the number of mitochondria (i.e., makes more factories) in your muscle fibers. With more mitochondria, you can produce more energy aerobically and maintain a faster pace. This is a relevant adaptation for marathoners because more than 99 percent of the energy needed for running a marathon is produced aerobically.

Increased Aerobic Enzyme Activity

Enzymes in your mitochondria speed up aerobic energy production (i.e., increase the rate of production in your aerobic energy factories). LT training increases aerobic enzyme activity; this adaptation improves the efficiency of your mitochondria. The more aerobic enzyme activity in your mitochondria, the faster you are able to produce energy aerobically.

Increased Capillarization of Muscle Fibers

Oxygen is necessary to produce energy aerobically. Your heart pumps oxygen-rich blood to your muscles through a remarkable system of blood vessels. Capillaries are the smallest blood vessels and typically several border each muscle fiber. With marathon training, you increase the number of capillaries per muscle fiber. With more capillaries per muscle fiber, oxygen is more efficiently delivered where it's needed. Capillaries also deliver fuel to the muscle fibers and remove waste products such as carbon dioxide. A more efficient delivery and removal system provides a constant supply of oxygen and fuel and prevents waste products from accumulating in your muscles as quickly. By providing oxygen to the individual muscle fibers, increased capillary density allows the rate of aerobic energy production to increase.

High Glycogen Storage and Well-Developed Fat Utilization

Glycogen is the form of carbohydrate stored in the body, and carbohydrate is the primary fuel used when racing a marathon. Two ways to ensure that glycogen stores last throughout the marathon are to train your body to store a large amount of glycogen and to train your body to conserve glycogen at marathon pace.

A large supply of glycogen in your muscles and liver at the start of the marathon enables you to work at a high rate throughout the race without becoming carbohydrate depleted. During the marathon, you use a combination of carbohydrate and fat for fuel. When you run low on glycogen, you rely more on fat, which forces you to slow down because fat metabolism uses oxygen less efficiently. With the correct training, your muscles and liver adapt to store more glycogen. By designing your training so that you run very low on glycogen toward the end of certain workouts, you can provide a stimulus for your body to adapt by storing more glycogen in the future. (See chapter 2 for more on the train low/race high approach.)

Because your body can store only a limited supply of glycogen, it's an advantage to be able to use as much fat as possible at marathon race pace. Successful marathoners have developed their ability to use fat; this trait spares their glycogen stores and ensures that they make it to the finish line without becoming glycogen depleted. When you train your muscles to rely more on fat at marathon race pace, your glycogen stores last longer. In the marathon, that means that "the wall" moves closer and closer to the finish line and eventually disappears, especially when you take in the right amount of carbohydrates during the race. (The concept of the wall is really a reflection of improper marathon preparation, pacing, and carbohydrate intake before and during the marathon.) Later in this chapter, we'll look at how to train to improve glycogen storage and fat utilization. In chapter 2, we'll examine how your diet affects these adaptations and your performance.

Excellent Running Economy

Your running economy determines how fast you can run using a given amount of oxygen. If you can run faster than another athlete while using the same amount of oxygen, you're more economical. This concept is similar to the efficiency of an automobile engine—if a car can travel farther using a given amount of gasoline, it's more economical than another car.

Running economy can also be viewed as how much oxygen is required to run at a given speed. If you use less oxygen while running at the same speed as another runner, you're more economical. If you know how much oxygen a runner can use at LT pace, as well as that athlete's running economy, you can generally predict marathon performance fairly accurately.

Your running economy varies at different running speeds and gets worse with fatigue. For marathon performance, therefore, what matters is your running economy at marathon race pace and reducing the decline in economy as the race progresses.

Running economy varies widely among runners. While testing elite runners in the laboratory, Pete has found differences of more than 20 percent in running economy among athletes. Obviously, a large advantage exists in being able to use oxygen as economically as possible during the marathon—your aerobic system supplies nearly all of the energy for the marathon, and oxygen utilization is a limiting factor in the rate of energy production by the aerobic system.

For example, say two athletes with identical LT values of 54 mL/kg/min are racing at a pace of 5:55 per mile (per 1.6 km). Although it seems that they should be working equally hard, this often isn't the case. If Stacey has an oxygen requirement of 51 mL/kg/min at that pace and Christine requires 57 mL/kg/min, Stacey will be comfortably below LT and should be able to maintain a 5:55 pace. Christine will steadily accumulate lactate and hydrogen ions and will not be able to maintain that pace for long. Stacey has a faster pace at LT because she uses oxygen more economically to produce energy.

The primary determinants of running economy appear to be the ratio of slow-twitch to fast-twitch fibers in your muscles, the combined effect of your biomechanics, and your training history. The proportion of slow-twitch muscle fibers is important because they have more mitochondria and use oxygen more efficiently. One reason that successful marathoners tend to be more economical than slower marathoners is because they generally have more slow-twitch muscle fibers. Experienced runners with more years of training and more lifetime miles also tend to have better running economy than novice runners, likely due to adaptations that gradually allow fast-twitch muscle fibers to have more of the characteristics of slow-twitch fibers, as well as more efficient muscle fiber recruitment.

Running economy is also related to the interaction of many biomechanical variables, but no single aspect of biomechanics has been shown to have a large impact on economy. One of the problems in trying to improve biomechanics is that it's impossible to change one biomechanical variable without affecting others. Biomechanical factors that may improve running economy include optimizing your vertical motion and stride length and improving the ability of your muscles and tendons to store energy when you land and return energy into your next stride.

High Maximal Oxygen Uptake ($\dot{V}O_2max$)

Successful marathoners have high $\dot{V}O_2max$ values. This means they're able to transport large amounts of oxygen to their muscles, and their muscles are able to extract and use a large amount of oxygen to produce energy aerobically.

As you would expect, runners generally have higher $\dot{V}O_2max$ values than sedentary people, and better runners generally have higher values than their slower counterparts. Although successful marathoners tend to have high $\dot{V}O_2max$ values, they typically aren't as high as the $\dot{V}O_2max$ values found in elite 5,000-meter runners; this measure is relatively more associated with 5,000-meter performance. Women's $\dot{V}O_2max$ values tend to be about 10 to

15 percent lower than those for men because women have higher essential body fat stores and lower hemoglobin levels than do men.

The primary factors in increasing $\dot{V}O_2max$ appear to be related to improvements in the ability to transport oxygen to your muscles. This ability is related to four factors: your maximal heart rate, the maximal amount of blood your heart can pump with each beat, the hemoglobin content of your blood, and the proportion of your blood that is transported to your working muscles. We'll discuss hemoglobin in chapter 2. You can't influence the proportion of your blood transported to working muscles. That leaves maximal heart rate and the maximal amount of blood your heart can pump with each beat.

Your maximal heart rate is determined genetically. In other words, it doesn't increase with training. Successful marathoners don't have particularly high maximal heart rates, so it isn't a factor in determining success.

The maximal amount of blood your heart can pump with each beat is called *stroke volume*. If the left ventricle of your heart is large, it can hold a large amount of blood. Blood volume increases with training, resulting in more blood being available to fill the left ventricle. If your left ventricle is strong, it can contract fully so that not much blood is left at the end of each contraction. Filling the left ventricle with a large amount of blood and pumping a large proportion of that blood with each contraction result in a large stroke volume. Stroke volume increases with the correct types of training. In fact, increased stroke volume is the main training adaptation that increases $\dot{V}O_2max$.

Quick Recovery

Successful marathoners are able to recover quickly from training. This allows them to handle a larger training volume and a higher frequency of hard training sessions than those who recover more slowly. The ability to recover quickly is related to genetics, the structure of your training plan, your age, lifestyle factors such as diet and sleep, and your training history. (The 30th 20-miler of your life will probably take less out of you than your first one.)

Runners vary in how many workouts they can tolerate in a given time. Recovery runs and easy aerobic cross-training are an important element of your training, but they must be handled carefully. If you do your recovery runs or cross-training too hard, you run the risk of overtraining and reducing the quality of your hard training sessions. This is a common mistake among distance runners, particularly marathoners; many runners don’t differentiate between regular training runs and recovery runs. The purpose of your regular training runs is to provide an additional training stimulus to improve your fitness; the purpose of your recovery runs is to help you recover from your last hard workout so you’re ready for your next hard workout.

PSYCHOLOGY AND ENDURANCE

Most of this chapter deals with the physiological attributes that most directly determine your marathoning success. Traits such as your LT and running economy can be measured; if we were to gather 10 readers of this book and run them through a series of laboratory tests, we would have most of the information required to predict their order of finish in a marathon.

The final factor to make an accurate prediction would be which of those runners have the mental toughness to come closest to reaching their physiological potential. Just as there are wide variations among runners in attributes such as percentage of slow-twitch muscle fibers, so too are there great ranges in mental toughness. We all know midpack runners who have a reputation for thrashing themselves in races; at the same time, most followers of the sport could name a few elite runners who often seem to come up short when the going gets tough. Fortunately, with experience and conscious effort, you can improve your ability to persevere despite challenging conditions.

Several studies have shown that endurance athletes have higher pain tolerance than nonathletes despite having similar pain thresholds. In other words, the endurance athletes and nonathletes both felt pain at a similar level, but the endurance athletes had a greater tolerance to withstand that pain over time. From their regular experience of dealing with duress, the endurance athletes knew how to tolerate temporary discomfort to reach a goal. This trait is invaluable—during a given difficult run, during a tough stretch of training when the urge to be a normal person for a few days is overwhelming, and, of course, on race day.

Simply getting fitter has been shown to improve mental toughness. Studies with sedentary people have found significant increases in pain tolerance from just six weeks of moderate exercise. The greater volume and intensity of marathon training provides that much more practice in persisting.

Having the right goal for your marathon—one that's challenging but reasonable, and personally meaningful—also helps build psychological strength. If your goal truly speaks to you, you'll be able to summon it for motivation when, inevitably, the urge to slow, cut short, or quit arises.

Recovery runs and easy- to moderate-intensity cross-training improve blood flow through the muscles; this process improves the repair of damaged muscle cells, removes waste products, and brings nutrients to your muscles. These benefits are lost, however, if you do recovery runs so fast that you tire yourself out for your subsequent hard training sessions. In addition, by doing your recovery runs slowly, you use less of your glycogen stores, so more glycogen is available for your hard training sessions. Optimizing your diet to enhance recovery is discussed in chapter 2. Cross-training is discussed briefly in chapter 3 as a recovery aid, and in depth in chapter 4. Other strategies to improve your recovery are discussed in depth in chapter 3.

HOW TO TRAIN TO IMPROVE THE KEY PHYSIOLOGICAL ATTRIBUTES

Now that we've discussed the physiological requirements for successful marathoning, let's look at the components of training that improve the key physiological variables and how to do each type of session most effectively in your marathon preparation. In this section, we'll look at how to train to improve your LT, ability to store glycogen and utilize fat, running economy at marathon pace, and $\dot{V}O_2max$. We'll also consider a specialized training session. In chapters 2 and 3, we'll look at strategies to enhance your recovery from this targeted training.

Improving Your Lactate Threshold

The most effective way to improve LT is to run at your current LT pace or a few seconds per mile faster, either as one continuous run (tempo run) or as a long interval session at your LT pace (cruise intervals or LT intervals). These workouts can be done on flat terrain, rolling hills, or uphill. It is useful to simulate the terrain you will encounter in your marathon during some of these sessions.

These workouts make you run hard enough so that lactate is just starting to accumulate in your muscles and blood. When you train at a lower intensity, a weaker stimulus is provided to improve your LT pace. When you train faster than current LT pace, you accumulate lactate rapidly and cannot maintain that intensity for long. Higher intensities may also be less effective in training your muscles to work hard without accumulating lactate. The more time you spend close to your LT pace, the greater the stimulus for improvement.

LT training should be run at close to the pace that you can currently race for 1 hour. This should be the intensity at which lactate is just starting to accumulate in your muscles and blood. You can do some of your tempo runs in low-key races of 4 miles (6 km) to 10K, but be careful not to get carried away and race all out. Remember that the optimal pace to improve LT is your current LT pace and not much faster.

A typical training session to improve LT consists of a 15- to 20-minute warm-up followed by a 20- to 40-minute tempo run and a 15-minute cool-down. The LT workouts in this book mainly fall within these parameters, although most of the schedules include one longer tempo run in the 7-mile (11 km) range. For marathon training, we recommend LT intervals of two or three repetitions of 8 to 18 minutes at LT pace with 2 to 4 minutes between repetitions.

For runners competing in shorter races, tempo runs and LT intervals are both excellent ways to prepare. For marathoners, however, tempo runs are preferable to LT intervals. After all, the marathon is one long continuous run, and tempo runs simulate marathon conditions more closely. There's both a physiological and a psychological component to the advantage of tempo runs. The extra mental toughness required to get through a tempo run when you may not be feeling great will come in handy during a marathon.

Improving Glycogen Storage and Fat Utilization

Your ability to store glycogen and use fat for fuel tends to improve with the same types of training. Pure endurance training stimulates these adaptations and increases the capillarization of your muscles. For marathoners, the primary type of training to stimulate these adaptations is runs of 90 minutes or longer. Your total training volume, however, also contributes. That's one reason to include two-a-day workouts and relatively high weekly mileage for runners who can handle the workload in their training programs.

WHAT'S YOUR LACTATE THRESHOLD?

The most accurate way to find out your LT is to be tested at the track or in a sport physiology lab. During an LT test in a lab, you run for several minutes at progressively faster speeds until your lactate concentration increases markedly. The tester measures the lactate concentration in your blood after several minutes at each speed by pricking your finger and analyzing a couple drops of blood. A typical LT test consists of six increasingly hard runs of 4 to 5 minutes each, with 1 minute between runs to sample your blood. By graphing blood lactate concentration at various running speeds, physiologists can tell the pace and heart rate that coincide with LT. You can then use this information to maximize the effectiveness of your training.

The lower-tech method to estimate LT is to use your race times. Remember that LT training should be run at close to the pace that you can currently race for 1 hour. For a sub-2:30 marathoner, this is slightly faster than half marathon race pace, whereas for a 3:00 marathoner, LT pace is about 15K race pace. Another way to estimate LT pace for experienced runners is about 10 to 15 seconds per mile slower than 10K race pace. Successful marathoners generally race the marathon 2 to 3 percent slower than LT pace.

In terms of heart rate, LT typically occurs at 82 to 91 percent of maximal heart rate or 76 to 88 percent of heart rate reserve in well-trained runners. (Heart rate reserve is your maximal heart rate minus your resting heart rate.) Instructions on determining your maximal heart rate can be found later in this chapter.

Long runs are the bread and butter of marathoners. For all marathoners, including the elite, the marathon distance is a formidable challenge. To prepare to race 26.2 miles (42.2 km) at a strong pace, train your body and mind to handle the distance by doing long runs at a steady pace. A long run also provides psychological benefits. By running long, you simulate what your legs and body will go through in the marathon. When your hamstrings tighten 23 miles (37 km) into the race, for example, it helps to have experienced a similar feeling in training—you'll know you can shorten your stride a few inches, concentrate on maintaining your leg turnover, and keep going. More generally, you'll have experienced overcoming the sometimes overwhelming desire to do anything but continue to run. During your long runs, you encounter many of the experiences—good and bad—that await you in the marathon.

No scientific evidence will tell you the best distance for your long runs as you train. However, a clear trade-off exists between running far enough to stimulate physiological adaptations and remaining uninjured. If you regularly do runs longer than 24 miles (39 km), you'll become strong but slow because you won't be able to run your other hard workouts at as high a level of quality. You'll also increase your risk of injury because when your muscles are very fatigued, they lose their ability to absorb impact forces, increasing your risk of injury.

Experience suggests that steadily building your long runs to 21 or 22 miles (34 or 35 km) will maximize your chances of reaching the marathon in top shape while remaining healthy. Experienced marathoners who are not highly injury prone should include one run of 24 miles (39 km) in their preparation.

Long runs shouldn't be slow jogs during which you just accumulate time on your feet. The appropriate pace for a specific long run depends on the purpose of that run within your training program. The most beneficial intensity range for most of your long runs is 10 to 20 percent slower than your goal marathon race pace. (A few of your long runs should be done at your goal marathon pace. The rationale for these sessions is explained later in this chapter.) If you use a heart monitor, your long-run pace should be in the range of 75 to 84 percent of maximal heart rate or 66 to 78 percent of your heart rate reserve. This will ensure that you're running with a similar posture and are using similar muscle patterns as when you run at marathon pace. To prepare optimally for your marathon, try to find courses for your long runs that simulate the terrain you will encounter on race day. Practicing the uphill or downhill that you will encounter late in your race can be invaluable to your marathon preparation.

If you do long runs much slower than this, you risk being unprepared for the marathon. Slow long runs reinforce poor running style and do a poor job of simulating the demands of the marathon. If you run long runs too fast, of course, you risk leaving your marathon performance out on your training loops because you'll be too tired for your other important training sessions. Using the suggested intensity range of 10 to 20 percent slower than marathon goal pace, table 1.1 lists suggested long-run paces for a wide range of marathoners.

TABLE 1.1
Sample Long-Run Paces

Marathon goal pace	Early part (20% slower than goal pace)	Latter part (10% slower than goal pace)
5:00 per mile	6:00 per mile	5:30 per mile
5:30 per mile	6:36 per mile	6:03 per mile
6:00 per mile	7:12 per mile	6:36 per mile
6:30 per mile	7:48 per mile	7:09 per mile
7:00 per mile	8:24 per mile	7:42 per mile
7:30 per mile	9:00 per mile	8:15 per mile
8:00 per mile	9:36 per mile	8:48 per mile
8:30 per mile	10:12 per mile	9:21 per mile

The first few miles of your long runs can be done slowly, but by 5 miles (8 km) into your long run, your pace should be no more than 20 percent slower than marathon race pace. Gradually increase your pace until you're running approximately 10 percent slower than marathon race pace during the last 5 miles (8 km) of your long runs. In terms of heart rate, run the first few miles at the low end of the recommended intensity range, and gradually increase your effort until you reach the high end of the range during the last 5 miles (8 km). This makes for an excellent workout and provides a strong stimulus for physiological adaptations. These workouts are difficult enough that you should schedule a recovery day the day before and 1 or 2 days after your long runs.

If you do long runs in this intensity range, a 22-mile (35 km) run will take approximately the same amount of time as your marathon. By running for the length of time you hope to run the marathon, you also provide psychological reinforcement that you can run at a steady pace for that amount of time.

Where the training schedules call for a long run the day after a tune-up race, you should run at a more casual pace. After a Saturday race, your Sunday long run should be at a relaxed pace because you will be tired and have stiff muscles, which increases your likelihood of injury. Start these long runs like a recovery run. If your muscles loosen up as the run progresses, increase the training stimulus by increasing your pace to about 15 to 20 percent slower than marathon race pace.

The total volume of your training also improves your ability to store glycogen and use fat, and it reinforces some of the other positive training adaptations, such as increased capillarization. There is some benefit, therefore, to doing relatively high mileage. The best marathoners in the world train from 110 to 170 miles (177 to 274 km) per week.

More is only better to a point, however. You have a unique individual current mileage limit that is dictated by your biomechanics, past training, injury history, shoes, running surface, diet, and various other life stressors. (For starters, most of those people running 150 miles [241 km] a week don't commute to a 50-hour-per-week job.) The challenge in pursuing marathoning excellence is to find the mileage range that you can handle without breaking down.

Also, although racing performance improves with increased mileage, the incremental improvement decreases. Increasing from 70 to 90 miles (113 to 145 km) per week, therefore, will not improve performance as much as increasing from 50 to 70 miles (80 to 113 km) per week, but it may produce a benefit nonetheless.

Although you have an individual current mileage limit, this limit changes over time. The mileage that contributed to your shin splints five years ago will not necessarily cause problems for you again. You need to be a good detective and figure out the causes of your past injuries. Many runners say, "I tried high mileage once years ago, and I just got tired and hurt," and they permanently return to what they consider to be their safe mileage range. They don't consider that in the ensuing years their bodies may well have gained the ability—and their minds the wisdom—to handle higher mileage and to reap the concomitant benefits.

Improving Your Running Economy

An important determinant of marathon performance is running economy at marathon race pace. Because running economy gets worse with fatigue, the ability to reduce this decrement as the race progresses will improve your ability to maintain pace for the full distance. Slowing less in the later stages of the race may not sound exciting, but helping you to hold your goal pace to the finish line is one of the primary goals of this book.

Although some evidence shows that economy improves with training, no one fully understands the secrets of improving running economy. Even less is known about how to train to maintain economy as you become more fatigued. Various studies have found running economy to improve with weightlifting, biofeedback, plyometric training, hill training, speed work, reducing vertical motion, and long intervals.

In your early days as a runner, the most important factor for improving economy may be the number of years (and accumulated miles) that you have been running rather than the specific types of workouts that you do. The mechanism for improvement may be that, with training, your fast-twitch muscle fibers gain characteristics of the more economical slow-twitch fibers. Renowned running physiologist and coach Jack Daniels recommends resistance training, hill running, and running fast intervals to improve running economy. These three types of training may reduce wasted motion and train the body to recruit the most effective combination of muscle fibers.

WHAT'S YOUR MAXIMAL HEART RATE AND HEART RATE RESERVE?

Throughout this book, we'll prescribe specific intensities for various types of workouts to help you prepare most effectively for the marathon. Heart rate monitors are a useful tool you can use to check the intensity of your training. Comparing your heart rate at the same speed (running on a track or measured stretch of road or using GPS) provides an indication of your fitness over time. Monitoring the intensity of your training in terms of heart rate is simple and, with a few caveats, reliable.

Maximal Heart Rate

The intensity of your runs can be stated relative to your maximal heart rate or as a percentage of your heart rate reserve. Your maximal heart rate is, quite simply, the fastest that your heart will beat during maximal-effort running. There are many formulas for estimating maximal heart rate, with the most accurate being 206 minus 0.7 times your age (Robergs and Landwehr 2002). Using this formula, a 43-year-old would have a predicted maximal heart rate of 176 [206 − (.7× 43)]. Because of the variability between individuals, however, your actual maximal heart rate may be more than 10 beats per minute higher or lower than your predicted maximal heart rate. Using an estimated maximal heart rate, therefore, can lead you to train too hard or not hard enough, so it's better to do a performance test to determine your actual maximal heart rate.

You can find your maximal heart rate quite accurately during a very hard interval session. An effective workout is to warm up thoroughly and then run three high-intensity 600-meter repeats up a moderate hill, jogging back down right away after each one. If you run these 600s all out, your heart rate should be within two or three beats of maximum by the end of the third repeat.

Heart Rate Reserve

Heart rate reserve is an even more accurate way of prescribing training intensities because it takes into account both your maximal heart rate and your resting heart rate. Your heart rate reserve is simply your maximal heart rate minus your resting heart rate, and it reflects how much your heart rate can increase to provide more oxygen to your muscles. By resting heart rate we mean your heart rate when you first wake up in the morning. As an example of calculating heart rate reserve, Scott's current maximal heart rate is 188 and his resting heart rate is 38. His heart rate reserve, therefore, is 188 minus 38, which equals 150 beats per minute.

To calculate the proper heart rates for a workout using heart rate reserve, multiply your heart rate reserve by the appropriate percentage and then add your resting heart rate. For example, as a highly experienced runner, if Scott wanted to do an LT workout at 82 to 88 percent of his heart rate reserve, he would stay in the range of 161 [(heart rate reserve of 150 × 0.82) + resting heart rate of 38] to 170 [(150 × 0.88) + 38] beats per minute. This compares closely to using 86 to 91 percent of his maximal heart rate, which would put him in the range of 162 to 171 beats per minute.

The prescribed training intensities used in this chapter and chapter 8 are summarized in table 1.2. These intensity ranges are appropriate for most experienced marathon runners. Less-experienced runners should generally train at the lower end of the recommended ranges, while elite runners will generally be at the high end of the ranges.

TABLE 1.2

Heart Rate Intensities for Standard Marathon Training Workouts

	Maximal heart rate (%)	Heart rate reserve (%)
$\dot{V}O_2max$ (5K pace)	93-95	91-94
Lactate threshold	82-91	76-88
Marathon pace	82-88	76-84
Long/medium-long	75-84	66-78
General aerobic	72-81	62-75
Recovery	<76	<68

Allowing for Heart Rate Drift

During an LT session or long run, your heart rate will tend to increase several beats per minute even if you hold an even pace. On a warm day, your heart rate increases even more as you become dehydrated and as your body sends more blood to your skin to aid in cooling. This phenomenon is discussed in greater detail in chapter 2. The implication for your LT sessions and long runs is that you should start these sessions at the low end of the specified intensity zone and allow your heart rate to increase to the high end of the zone during the workout.

On a low-humidity day with temperatures in the 70s (low 20s Celsius), increase your zones by up to six beats per minute to gain the same benefits as on a cooler day. On a high-humidity day in the 70s (low 20s Celsius) or a low-humidity day in the 80s (high 20s to low 30s Celsius), increase your zones by up to 12 beats per minute. On a high-humidity day in the 80s (high 20s to low 30s Celsius), adjust your training plan and just take it easy.

For marathoners, probably the four most worthwhile ways to try to improve running economy are remaining uninjured and accumulating mileage over time, resistance training, hill training, and running short repetitions (80-120 m) at a fast but relaxed pace.

Resistance training includes weightlifting and plyometrics (explosive training), both of which have been found to improve running economy in distance runners (Saunders et al. 2004; Larisova 2014; Rønnestad and Mujika 2014). Resistance training can improve your core strength, which enables you to maintain good running form longer during the marathon. The right types of resistance training may improve the stiffness of your muscles and tendons and their spring-like stretch-shortening cycle to return elastic energy. This simply means that your muscles get better at storing energy when you land and returning energy into your next stride. We'll look at resistance training in depth in chapter 4.

Running uphill is harder than training on flat terrain because of the need to overcome the resistance of gravity. It is, therefore, another type of resistance training but highly specific to the mechanics of running. A comprehensive study conducted on hill training found that short hill repetitions of 10 to 12 seconds led to the greatest improvement in running economy (Barnes et al. 2013). This seems consistent with the findings of studies on resistance training and improvements in muscle fiber recruitment and use of the stretch-shortening cycle to return elastic energy.

Running short repetitions quickly but with relaxed form—strides—may train your muscles to eliminate unnecessary movements and maintain well-coordinated control at fast speeds. Along with improved running form, you'll gain power in your legs and trunk that may also contribute to improved running economy. Because these intervals are short and performed with sufficient rest between them, lactate levels remain low to moderate throughout the workout. As a result, they won't interfere with your marathon-specific workouts.

A typical session of strides is 10 repetitions of 100 meters in which you accelerate up to full speed over the first 70 meters and then float for the last 30 meters. It's critical to remain relaxed during these accelerations. Avoid clenching your fists, lifting your shoulders, tightening your neck muscles, and so on. Concentrate on running with good form, and focus on one aspect of good form, such as relaxed arms or complete hip extension, during each acceleration.

These sessions aren't designed to improve your cardiovascular system, so there's no reason to use a short rest between accelerations. A typical rest is to jog and walk 100 to 200 meters between repetitions; this allows you to pretty much fully recover before you start the next stride. The most important considerations are to maintain good running form and to concentrate on accelerating powerfully during each repetition.

INCREASING MILEAGE WHILE MINIMIZING THE RISK OF BREAKDOWN

As with most aspects of running, there are no guarantees, but the following guidelines will help you increase your mileage without getting injured or overtrained.

- *Bite off small chunks.* Over a few years, you can double or triple your mileage, but increasing mileage too much at once is almost certain to lead to injury or overtiredness. Unfortunately, there's no scientific evidence indicating how great an increase over a given period is safe. A commonly used but unevaluated rule of thumb is to increase mileage by a maximum of 10 percent per week. Jack Daniels (2014) recommends increasing mileage by no more than 1 mile (1.6 km) for each training session that you run per week. For example, if you run six times per week, you would increase your mileage by up to 6 miles (10 km) per week.

- *Increase in steps.* When charting new territory, don't increase your mileage week after week. That approach is very likely to lead to injury. Instead, increase your mileage one week, then stay at that level for a couple weeks before increasing again.
- *Avoid speed work while upping your mileage.* Don't increase your mileage during a phase of training that includes hard speed work. Fast intervals put your body under a great deal of stress. Increasing your mileage adds more stress. Save the majority of your mileage increases for base training, when you can avoid intervals.
- *Reduce your training intensity.* When increasing your mileage, it helps to slightly reduce the overall intensity of your training. By backing off the intensity, you can increase your volume without increasing the strain of training. You can then return the intensity to its previous level before upping your mileage again.
- *Not all miles are created equal.* When building your mileage, it's particularly important to train on soft surfaces to reduce the accumulated jarring on your body and to wear running shoes that suit your needs and are in good repair.
- *Give yourself a break.* Don't let mileage become a goal in itself. Aimlessly running high mileage can lead to chronic overtiredness and burnout. Your training should be

focused on a target race such as a marathon. When you have run your target race, give your body a break before building your mileage for your next goal.

PETE'S PROGRESSION

My highest sustained mileage was before the 1984 Olympic trials marathon. With Alberto Salazar, Greg Meyer, Tony Sandoval, and Bill Rodgers in the race, making the Olympic team necessitated no compromises. My previous training had peaked at 125 miles (201 km) per week. At the time, I thought that was all my body could handle.

The trials were held in May. For 8 weeks during January and February, I averaged 143 miles (230 km) per week, with a high week of 152 (245 km) and a low week of 137 (220 km). Most of this was run at a fairly brisk pace (5:40 to 6:10 per mile), but I was in base training and didn't need to do much speed work.

After I cut my mileage to 100 to 120 miles (161 to 193 km) per week for the last 2 months before the trials, my legs felt fresh and strong all the time. Having adapted to the higher volume, I was able to do high-quality intervals and tempo runs while still running well over 100 miles (161 km) per week. While that mileage looks daunting to me now, there's little question that January's and February's high-mileage training contributed to the improvement that allowed me to win the 1984 trials.

Besides the physiological benefits, high-mileage training provided me with psychological benefits for the marathon. When I was coming up through the ranks, 2:10 marathoner Garry Bjorklund revealed to me that he was running 160 miles (257 km) per week. When I asked him if that much mileage was necessary, he said, "It's not necessary before every marathon, but you need to do it at least once to know you can."

—Pete Pfitzinger

Improving Your $\dot{V}O_2max$

The most effective running intensity to improve $\dot{V}O_2max$ is 95 to 100 percent of current $\dot{V}O_2max$ (Daniels 2014; Midgley et al. 2007). Well-trained runners can run at $\dot{V}O_2max$ pace for about 8 minutes. Ninety-five to 100 percent of $\dot{V}O_2max$ coincides with current 3,000-meter to 5,000-meter race pace. During marathon preparation, we use intervals at 5,000-meter race pace to provide a strong stimulus to improve your $\dot{V}O_2max$ but with less recovery required than for intervals at 3,000-meter pace. This coincides with an intensity of approximately 93 to 95 percent of maximal heart rate or 91 to 94 percent of heart rate reserve. (Be sure to use an accurate assessment of your current 5K pace, namely, a race run under optimal conditions, not a hilly course on a hot day.) Running intervals at this pace or intensity is part of the optimal strategy to improve $\dot{V}O_2max$.

The stimulus to improve $\dot{V}O_2max$ is provided by the amount of time you accumulate during a workout in the optimal intensity range. This fact has implications for how best to structure your $\dot{V}O_2max$ sessions. Consider two workouts that each include 6,000 meters of intervals—one of 15 × 400 meters and the other of 5 × 1,200 meters. When you run 400-meter repetitions, you're in the optimal zone for perhaps 45 seconds per interval. If you do 15 repetitions, you would accumulate about 11 minutes at the optimal intensity. When you run longer intervals, you are in the optimal intensity zone much longer. During each 1,200-meter interval, you would be in the optimal intensity zone for 3 to 4 minutes and would accumulate 15 to 20 minutes in that zone during the workout. This would provide a stronger stimulus to improve your $\dot{V}O_2max$.

The optimal duration for $\dot{V}O_2max$ intervals for marathoners is approximately 2 to 6 minutes. Intervals in this range are long enough that you accumulate a substantial amount of time at 95 to 100 percent of $\dot{V}O_2max$ during each interval but short enough that you can maintain the optimal intensity range throughout the workout. Intervals for marathoners should generally be between 800 and 1,600 meters. The training schedules in this book include some workouts of 600-meter repeats during weeks when your top priority lies elsewhere, such as when the week also calls for a tune-up race.

The training schedules don't include 2,000-meter repeats. Although repeats of this length can provide a powerful boost to $\dot{V}O_2$max, for all but the elite they take more than 6 minutes to complete. That's fine if you're focusing on a 5K or 10K, where $\dot{V}O_2$max is the primary determinant of success. As a marathoner, though, you want to be fresh for the week's more important endurance workouts, so you don't want your $\dot{V}O_2$max workouts to require several recovery days.

The total volume of the intervals in a marathoner's $\dot{V}O_2$max session should be 5,000 to 10,000 meters, with most workouts in the range of 6,000 to 8,000 meters. Any combination of repetitions of 800 to 1,600 meters will provide an excellent workout. Longer intervals (e.g., 1,200s or 1,600s) make for a tougher workout, physically and psychologically, and shouldn't be avoided. Your $\dot{V}O_2$max workouts can be run on a track or any even surface where you can run fast with confidence. These sessions can also be done as uphill intervals, which are particularly useful if you will be racing a hilly marathon. For uphill workouts, you will run much slower than 5,000-meter race pace, but your heart rate and perceived effort should be the same as if you were running on a flat surface.ald Tittel/picture alliance via Getty Images

The optimal amount of rest between intervals is debatable. One school of thought is to minimize rest so your metabolic rate stays high during the entire workout. This strategy makes for very difficult workouts, which can be good, but you risk shortening your workouts. Another school of thought is to allow your heart rate to decrease to 70 percent of your maximal heart rate or 60 percent of your heart rate reserve during your recovery between intervals.

A lower-tech approach is to allow 50 to 90 percent of the length of time it takes to do the interval for your recovery. For example, if you're running 1,000-meter repeats in 3:20, you would run slowly for 1:40 to 3 minutes between intervals. For uphill workouts, your recovery will be somewhat longer as you run back down the hill.

The $\dot{V}O_2$max sessions in the training schedules feature repeats that strike a balance between being long enough to provide a powerful training stimulus and short enough to leave you fresh for your other important workouts of the week.

DON'T MAX OUT YOUR $\dot{V}O_2$MAX WORKOUTS

Two related mistakes that marathoners sometimes make in training are running intervals too fast and too frequently. Let's consider why you should avoid these errors.

Running Intervals Too Fast

A common mistake among marathoners is to do speed work too hard. The idea that running your intervals harder will make you run better is appealing, and it seems logical. It's also incorrect. Running your intervals faster than the optimal zone will do two things—build up a high level of lactate and hydrogen ions in your muscles and shorten the duration of your workout. Both of these effects are counterproductive for marathoners.

The marathon is an aerobic event. More than 99 percent of the energy you use in the marathon is supplied by your aerobic system. During the marathon, you run slightly below your LT pace; therefore, you don't accumulate much lactate in your muscles and blood. In fact, when lactate levels are measured at the end of a marathon, they are only slightly above resting levels.

There's no reason, then, for marathoners to do training that builds up high levels of lactate, such as intervals run at 1,500-meter race pace or faster. Running intervals at this pace produces high levels of lactate and improves your ability to produce energy using the glycolytic system (what you probably think of as running anaerobically) and to buffer high levels of lactate. None of these adaptations is relevant to the marathon.

Running intervals much faster than 3,000- to 5,000-meter race pace also produces a smaller stimulus to improve your $\dot{V}O_2max$.

Running $\dot{V}O_2max$ Sessions Too Frequently

Another common mistake among marathoners is trying to include too many $\dot{V}O_2max$ sessions in their marathon training programs. The most important adaptations for marathon success are a high level of endurance, a fast pace at LT, and the ability to store a large quantity of glycogen in the muscles and liver.

$\dot{V}O_2max$ sessions are definitely a secondary consideration for a marathoner. Intervals require large amounts of physical and psychological energy, which can be better used doing more specific marathon training. $\dot{V}O_2max$ sessions have their place in marathon preparation, but they should be included sparingly.

Integrated Training: Training at Marathon Race Pace

Your goal for the marathon is to be able to maintain your goal race pace for 26.2 miles (42.2 km). The physiological demands of this task require a high LT, an excellent capacity to store glycogen, a well-developed ability to burn fat, and so on. Each of the various types of training that we have discussed so far focuses on improving a specific aspect of your physiology for the marathon. Now we'll discuss a type of training that integrates the various physiological attributes as specifically as possible for the marathon race.

Long runs at marathon race pace directly prepare you for the demands of the race. The principle of specificity of training states that the most effective way to prepare for an event is to simulate that event as closely as possible. The closest way to simulate a marathon, of course, is to run 26.2 miles (42.2 km) at marathon pace. Unfortunately (or perhaps fortunately), long runs at marathon pace are very hard on the body. If you run too far at marathon pace, the required recovery time will negate the benefits of the effort. Similarly, if you do long runs at marathon pace too often, you will greatly increase your likelihood of self-destructing through injury or overtraining.

The training programs in this book include up to four runs in which you'll run 8 to 14 miles (13 to 23 km) of a longer run at goal marathon race pace. These runs are the most specific marathon preparation you'll do. The intention is to stress your body in a similar way to the marathon but to limit the duration so that your required recovery time is held to a few days. On these runs, use the first few miles to warm up, then finish the run with the prescribed number of miles at marathon race pace. In addition to the physiological and psychological benefits these runs impart, they're an excellent opportunity to practice drinking and taking energy gels at race pace.

Where should you do your marathon-pace runs? Races of the appropriate distance are ideal—you'll have a measured course, plenty of aid stations, and other runners to work with. As with doing tempo runs in races, though, be sure to limit yourself to the day's goal and run them no faster than is called for.

Given the opportunity for regular splits and frequent fluids, a track would seem to be an ideal locale for marathon-pace workouts, but bear in mind the reason for these runs. The purpose is to simulate marathon conditions as closely as possible. This means running on a road, not doing endless repeats of a 400-meter oval. Learn your goal marathon's topography, and attempt to mimic it on your marathon-pace runs. Many runners do this when preparing for courses with obvious quirks, such as Boston, but the principle applies for all marathons. Pancake-flat courses such as Chicago also take their toll because your leg muscles are used exactly the same way from start to finish.

Wear your marathon shoes when doing at least one of these workouts, even if you'll be racing the marathon in flats. You want to have at least one run of 15 miles (24 km) or so in your race-day shoes to learn whether they provide enough support when you start to tire and whether they give you blisters.

STRUCTURING YOUR TRAINING PROGRAM: PERIODIZATION

Now that we've discussed the types of training that help improve marathon performance, the next step is to develop your overall training plan. You need to prepare so you're at your best on marathon day. Systematically structuring your training to bring you to your desired end point is called *periodization*. The challenge in developing a periodized training plan is to decide how many hard sessions to do, which types of sessions to do, and when to do them.

A useful framework is provided by organizing your training into progressively smaller chunks called *macrocycles* (several months), *mesocycles* (several weeks), and *microcycles* (one week). These concepts are used for preparing training programs in a wide variety of sports and have been used extensively in track and field. In this book, we will replace the scientific jargon of macrocycle with "complete marathon training plan," mesocycle with "training block," and microcycle with "training week."

As a marathoner, your complete marathon training plan is simply the entire training period leading up to the marathon, typically 3 to 5 months, and your postmarathon recovery.

Your complete marathon training plan is divided into several training blocks, each of which has one or two specific training objectives. For a marathoner, a training block may last from 4 to 8 weeks. For example, the first training block in marathon preparation will almost always have a primary emphasis on increasing the volume of training and the distance of your long runs for at least 4 weeks. As the race approaches, the priorities in your training shift. Each shift in priorities is reflected in a new training block. Each training week has a pattern of hard workouts and recovery.

Let's consider a runner whose annual training plan centers around two marathons per year. He or she would train for the marathon for 12 to 18 weeks culminating in the race, followed by several weeks to recover before starting focused training for the next target race.

Now let's consider the training objectives in preparation for the marathon. The complete marathon training plan will generally be divided into five training blocks (table 1.3). The first training block will focus on increasing mileage and long runs to improve pure endurance. This will likely be the longest training block in the program. The second training block will focus on improving LT, with further improvement of pure endurance as a secondary objective. The third training block will focus on race preparation and will include tune-up races. The fourth training block will include a 3-week taper and the marathon. The fifth and final training block will consist of several weeks of well-earned recovery.

TABLE 1.3

Typical Complete Marathon Training Plan

Training block	Primary objective
1	Increasing mileage and long runs to improve pure endurance
2	Improving LT
3	Race preparation
4	Taper and the marathon
5	Recovery

Each training week will typically consist of three hard training sessions. This is the maximum number of hard sessions that most distance runners can respond to positively. A few runners may be able to handle four hard sessions per week, and some runners can handle only two. Considering that there are at least five categories of hard training sessions that you can do, it takes a good deal of intelligent planning to come up with the optimal training program for you. The training schedules in this book are structured around four training blocks during your marathon preparation and generally include three hard training sessions per week.

TUNE-UP RACES

Training provides a variety of stimuli that lead to adaptations that improve your marathon performance. Training also gives you the confidence that comes with setting and achieving challenging training goals. However, training doesn't completely prepare you for the marathon. An additional component to successful marathoning can be gained only by racing.

Tune-up races are important benchmarks of your fitness and prepare you mentally for the rigors of racing the marathon. Because less is at stake, even the toughest workout isn't as mentally demanding as a race. After all, in a race, when you're competing against other runners, there's a fine margin between relative success and relative failure. Similarly, in a race, you're committed to finish (or you should be) whether you're having a good day or a lousy day; in a workout, if things aren't going well, you can always stop early with your pride relatively intact. The all-out aspect of racing requires a sustained mental focus that's necessary to run a good marathon. When runners do no premarathon tune-up races, they are more likely to be anxious leading up to the marathon.

TECHNOLOGY AND TRAINING

The ubiquity of affordable GPS watches is one of the major technological changes in running in recent years. These tools are useful—if you remember that they're tools, not your overlord.

It's great to have reasonably accurate data on how far and fast you're running. That's especially true on workouts like a long run ending with several miles at marathon race pace or a tempo run over an otherwise unmeasured loop that perfectly mimics your marathon course. Where we urge caution is making that data determinative most days. For example, on your recovery days, it's counterproductive to force yourself to hit a certain pace because you think anything slower isn't beneficial. We'll discuss this aspect of using data in greater detail in chapter 3.

Even when there are good reasons to care about hitting a certain pace for a certain distance, keep in mind that most runners' GPS watches aren't 100 percent accurate. Cloud cover, a winding course, and other factors can affect the devices' measurements. Try not to get hung up over discrepancies of a few seconds a mile, which easily fall within most watches' margin of error.

It's also important to maintain perspective on sharing your run data online. If it helps your motivation and if you'll get a boost from others' support, by all means post a great long run or track workout. But remember that the marathon is your goal, not winning the online workout wars. An ad for one GPS watch encourages runners to "beat yesterday." Taken to an extreme, that kind of thinking will have you racing your training. We'd rather you race the marathon to the best of your ability.

Tune-up races serve three purposes. First, they allow you to practice your prerace routine, including your diet and warm-up. Second, they provide feedback on your fitness, reducing an element of uncertainty about your marathon preparation. Third, they make you go through the nerves of racing, helping reduce anxiety in the last few days and hours before the marathon. When you're at your limit in the marathon, feeling tired, wondering whether you can hang on even though there are still 10 miles (16 km) to go, it helps to have been through the demands of racing at shorter distances. Even though the ultimate test (the marathon) is crueler, the preparation gained from shorter races is priceless.

By tune-up races, we mean all-out efforts, not races in which you give less than your best, such as races you use as the setting for a tempo run or marathon-pace run. Tune-up races can vary in length from 8K (5 miles) to 25K (16 miles), depending on their training purpose. Races of 5K (3 miles) or shorter are less specific to marathon success, and races of 30K (19 miles) or longer require too much recovery.

Tune-up races provide feedback on your fitness and build mental toughness.

Harald Tittel/picture alliance via Getty Images

Tune-up race distances can be divided into two categories. Races of 15K (9 miles) to 25K (16 miles) take at least 6 days to recover from, and you must place them strategically in your training program. These races provide the greatest physiological and psychological benefit. Therefore, prepare for these races with a mini-taper of 4 to 6 days. You can't afford to taper any longer than 6 days because the tune-up race isn't your primary goal, and you need to keep training for the marathon. A tune-up race of 15K to 25K really represents a training block of at least 11 days, consisting of 4 to 6 days of tapering, the race itself, and at least 6 days' recovery before the next hard training session.

The second category of tune-up race distances is 8K (5 miles) to 12K (7 miles). These races take less out of you and require less tapering and fewer recovery days than races of 15K (9 miles) or longer. You can approach tune-up races of 8K to 12K in two ways. First, you can train through them and treat them as an all-out effort done while fatigued. This will provide an excellent training stimulus as well as a mental challenge that will help steel you for the marathon. Racing when tired, however, brings the danger of believing that your finishing time and place represent your current fitness level. If you typically race 10K (6 miles) in 32:00 but run 33:10 in a tune-up race, you could interpret the result as meaning you're not in shape, and you might start to train harder or become discouraged. It's important to put the result in the context of the situation.

TABLE 1.4

Balancing Hard Workouts and Tune-Up Races

Type of workout	Minimum number of days before tune-up race
$\dot{V}O_2max$ interval	5
Tempo run	4
Long run	4

The other way to approach a tune-up race of 8K (5 miles) to 12K (7 miles) is to do a mini-taper and give yourself a couple of recovery days. This is the appropriate approach if you're using the race to assess your fitness level or as a confidence booster leading up to the marathon. Table 1.4 indicates how close to a tune-up race you can do a hard workout without going into the race fatigued. Although you won't see the benefits of the workout in this week's race, you should be recovered enough so the workout doesn't detract from your race performance.

Tempo runs are the easiest to recover from because they don't break down the body as much as other forms of hard training, but it is sensible to allow 4 days before a race. Long runs require at least 4 days of recovery to put in a good race effort, although replenishing glycogen stores generally requires only 48 hours. Interval workouts put the body under the most stress and require the longest time to recover from.

Now you know what physiological traits are needed to run a good marathon and how to train to improve those traits. More so than with any other popular distance, though, success in the marathon depends not only on what you do to your body but also on what you put in your body. Proper nutrition is critical when training for and running a marathon. We'll examine this in the next chapter.

Chapter 2
Nutrition and Hydration

Drew Angerer/Getty Images

This chapter looks at two critical but often misunderstood factors in marathon preparation and racing—nutrition and hydration. Why are these matters critical? Because two of the factors that typically conspire to make you slow in the last few miles of the marathon are glycogen depletion and dehydration. By understanding the role of nutrition for marathon preparation and racing, you can develop strategies to optimize your marathon performance.

This chapter discusses the impact of hydration on performance and how to prevent excessive dehydration, the roles of carbohydrate and fat as the primary fuels for endurance exercise and how to prevent glycogen depletion, the role of protein for endurance athletes, the need to maintain normal iron levels, and other nutrition considerations for racing the marathon. Understanding the information in this chapter is an essential component of your marathon preparation.

THE ROLE OF HYDRATION

Staying well hydrated is vital to successful marathoning during training and racing. Becoming excessively dehydrated negatively affects running performance and also slows your ability to recover for the next workout. Your blood and other fluids help remove waste products and bring nutrients to tissues for repair. Replacing lost fluids after running, therefore, will speed your recovery.

Let's take a look at the physiology of dehydration. When you sweat, the following chain of events occurs:

- Your blood volume decreases, so
- less blood returns to your heart; therefore,
- the amount of blood your heart pumps with each beat decreases; and eventually
- as you continue to sweat, less oxygen-rich blood reaches your working muscles; therefore, you produce less energy aerobically and must run at a slower pace.

These effects are magnified on a hot day because one of your body's major responses to hot weather is to increase cooling by sending more blood to the skin to remove heat from the body; this process means that even less blood returns to the heart to be pumped to the working muscles. The result is a higher heart rate for a given pace and an inability to maintain the same pace as on a cool day. Looked at in another way, dehydration also reduces your body's ability to maintain your core temperature because less blood is available to be sent to your skin, and your sweat rate decreases. Struggling to maintain a fast pace on a hot day becomes more dangerous as you become progressively more dehydrated and can lead to heat exhaustion.

The main benefit of drinking during the marathon is to reduce dehydration to a moderate level so running performance is not compromised. Staying well hydrated is also important during training. The amount of dehydration that starts to affect running performance varies between individuals and depends on a variety of factors. The American College of Sports Medicine recommends preventing dehydration of more than 2 percent of body weight (Thomas, Erdman, and Burke 2016). Your body's thirst mechanism will lead you to drink enough most of the time. During a heavy training load in hot conditions, however, it can be useful to have a plan to ensure your hydration level is normal before running, to take in fluids during running when you are likely to lose more than 2 percent of body weight, and to rehydrate appropriately after running.

Marathoners training in hot conditions sometimes become moderately dehydrated for a few days without realizing it, which can reduce training performance and increase perceived exertion (i.e., running at a given pace feels harder). For example, if your training schedule calls for a tempo run on Tuesday and a medium-long run on Wednesday, and you are training in hot or hot and humid conditions, it can be helpful to emphasize rehydration after your tempo run to ensure you are normally hydrated for the start of Wednesday's medium-long run. Similarly, anyone training twice per day, particularly in warm conditions, should put some thought into rehydrating prior to their second run of the day. Interestingly, paying attention to your hydration level is also useful in the winter, when the need to offset sweat loss isn't as obvious.

Sweat rates vary considerably between runners and depend on the environmental conditions, how intensely you are running, how acclimatized you are to the conditions, and your genetic predisposition to sweating. It's not unusual to lose 3 to 4 pounds (1.4-1.8 kg) of water per hour when running on a warm day. At this rate, during a 2-hour run you would lose about 6 to 8 pounds (2.7-3.6 kg). For a 140-pound (64 kg) runner, this represents a loss in body weight of over 4 to almost 6 percent and a likely decrement in performance of several percent. The effect increases as the run progresses, so this runner wouldn't be any slower the first few miles but would likely find that maintaining pace becomes harder and would slow progressively later in the run. Avoiding dehydration of more than about 2 percent of body weight, then, can be the difference between training hard enough to provide a strong stimulus for your body to improve and feeling like you are working harder but with less benefit.

A race-day hydration plan is key to running your best marathon.
Rebekah Downes/PA Images via Getty Images

MARATHONING AND CAFFEINE

Most runners have caffeine on a daily basis in coffee, tea, energy drinks, cola, or chocolate. Caffeine is part of daily life. It can also have a performance-enhancing effect, at least for some people.

A variety of studies have found performance-enhancing benefits from caffeine ingestion (Burke 2008; Gonçalves et al. 2017; Thomas, Erdman, and Burke 2016), and several have found no effect (Burke 2008). The different findings may depend on the study designs used but may also be related to recent findings (Guest et al. 2018) that an individual's genotype for a gene that influences caffeine metabolism determines the effect of caffeine on their performance. Individuals who have the genotype that allows them to metabolize caffeine quickly typically get a performance-enhancing effect, while those with the intermediate genotype (moderate metabolizers) do not seem to receive a boost in performance. Those with the genotype associated with slow metabolism of caffeine typically perform worse after caffeine ingestion.

A few studies have found no performance-enhancing effect of caffeine for individuals who consume caffeine regularly (Bell and McLellan 2002; Burke 2008). This led to some athletes abstaining from caffeine for a week or two before competition to try to increase the performance-enhancing effect. More recent studies, however, have found a performance-enhancing effect from caffeine even for habitual users, particularly if they consume more caffeine prior to competition than their typical daily intake (Gonçalves et al. 2017). In fact, if you’re used to having a cup of coffee each morning, abstaining from coffee could have a detrimental effect on your performance because of the withdrawal effects of caffeine deprivation.

Extrapolating from run-to-exhaustion studies in the lab, the likely benefit of taking caffeine for individuals with the genotype for fast caffeine metabolism is in the range of 1 to 2 percent (perhaps 20 to 45 seconds in a 10K or 90 seconds to 4 minutes in a marathon). The effect of caffeine that is most likely to boost performance for marathoners is stimulation of the central nervous system, which increases alertness and concentration. There is intriguing evidence that central nervous system stimulation reduces perception of effort so that a given pace feels easier.

An appropriately conservative view is that runners should use caffeine with the intention of improving performance only if they are already training hard and intelligently, have an excellent diet, and are working to optimize other lifestyle factors that influence running performance. If you are doing everything else right and have the right genotype, a moderate dose of caffeine may allow you to gain a small improvement in performance. The International Olympic Committee Consensus Statement on dietary supplements for high-performance athletes (Maughan et al. 2018) reviewed the scientific literature and suggests a benefit to performance from 3 to 6 mg of caffeine per kilogram body weight consumed about an hour before exercise, although they mention that some studies find a benefit from lower levels of caffeine intake. A variety of gels, sports drinks, and other products contain specific levels of caffeine that are more dependable than estimating how much is in your cup of coffee.

The potential side effects of caffeine include headaches, dizziness, anxiety, nervousness, gastrointestinal distress, and heart palpitations. Athletes vary widely in their sensitivity to and tolerance of caffeine, so you are an experiment of one. If you do not regularly consume caffeine, you will likely be more sensitive to the effects. You may also not have the genotype that has a positive performance response to caffeine intake. If you are considering using caffeine for your marathon, practice using it during a few of your longest training runs to see how your body responds.

How Much to Drink

For any marathoner training in warm conditions, preventing excessive dehydration that decreases performance is a priority. How much you need to drink to stay well hydrated during your marathon preparation depends on a number of factors, including the heat and humidity, your body size, how much you're training, how acclimatized you are to the conditions, and how much you sweat. Because sweat rates vary greatly between individuals, it is useful to figure out whether you are a moderate or heavy sweater so you can better plan your personal hydration needs.

On top of your baseline fluid needs, you need to add your fluid losses from training and other activities. Weigh yourself before and after running and calculate how much weight you lost, then drink with the objective of bringing your weight back up to normal. Becoming fully hydrated typically requires drinking about one and a half times the amount of weight you lost—the extra amount is required because some of what you drink will quickly wind up as urine. So, for example, if you lost 3 pounds (1.4 kg) during a training run, you would need to drink about 4.5 pounds (2 kg) of fluid (4.5 pints [2.1 L]) prior to your next run to be fully rehydrated. (Sodium in your food and drinks provides the benefit of enabling your body to retain more of the fluid you take in.)

Maintaining normal hydration levels from day to day requires some planning, particularly for those with normal jobs. Keeping a water bottle at your workstation is a must. You'll maintain your hydration status most effectively if you discipline yourself to drink regularly throughout the day. Try to avoid waiting until shortly before training to replace your fluids—if you rush the process, you'll go into your workout either bloated from too much fluid ingested too quickly or dehydrated from not having enough fluid. Once again, while not sweating profusely, your thirst mechanism is a good guide, but if you feel thirsty before the start of a run, your hydration level is likely somewhat low.

How much you should drink during your race is discussed in the "Marathon Race-Day Nutrition and Hydration" section later in this chapter.

What to Drink

During the many hours a day you're not running, water should be your primary beverage. Few people need to sip sport or energy drinks throughout the day. Water and carbohydrate-replacement drinks that contain sodium are excellent for maintaining hydration *during* running. The advantage of replacement drinks with 6 to 8 percent carbohydrate is that they're absorbed as quickly as water and also provide readily usable energy. The carbohydrate can help your performance during workouts lasting longer than 1 hour. The exact carbohydrate concentration that's best for you will depend on your stomach's tolerance and how warm it is during training and during your marathon. On a cool day, you may want to use a carbohydrate content of 8 percent, whereas on a warm day, when fluid is likely more critical than extra carbohydrate, you may want to use a drink with 6 percent carbs. Many sports drinks are now designed with more than one type of carbohydrate (typically glucose-fructose mixtures) to increase the rate that is absorbed in the intestines. Sports drinks should also contain at least 110 mg of sodium per 8 fluid ounces to enhance glucose and water absorption and improve fluid retention.

Some of the world's top marathoners, including 2016 Olympic champion Eliud Kipchoge, now use a higher-carb Swedish drink, despite reportedly not having endorsement deals with the company. The drink comes in two concentrations: one providing 40 grams of carbohydrate per half liter (16.9 ounces), the other providing 80 grams of carbs per half liter (16% carbohydrate). Drinks with this much carbohydrate have traditionally been problematic for runners because their high concentration slows gastric emptying, leading to bloating and other gastrointestinal issues. The Swedish drink attempts to get around that problem by turning into a more easily dispersed hydrogel once it reaches the stomach. Scientific evidence on this drink is currently limited, but several studies are underway. It may be a passing fad, but if more evidence emerges suggesting a benefit, then, as with anything new, curious runners should experiment with the drink in training before using it on race day.

Attempting to do high-mileage or high-intensity training in hot weather is a physiological challenge that requires you to be flexible with your training schedule. By planning your training, you can minimize the impact of hot weather. Start each workout fully hydrated by making rehydration a priority after the previous day's run. When possible, run at the time of day when the weather is the least taxing on your body. On a hot, humid day, slow your pace from the outset rather than waiting until your body forces you to slow.

MARATHONING AND ALCOHOL

Alcohol is part of many runners' diets. Is that good or bad for your running performance?

Alcohol (ethyl alcohol) primarily affects your brain. One or two drinks temporarily lead to reduced tension and relief from stress. In the short term, they will also increase dehydration and slow down rehydration. Where to strike the balance? The night before your marathon, reduced tension is a good thing, but as discussed earlier, it is wise to avoid any amount of dehydration as you toe the starting line. With this in mind, it's best to limit yourself to one or, at the most, two beers or one glass of wine the night before the marathon. Take in enough extra fluid to make up for the dehydrating effect of the alcohol. Drink an extra ounce (30 mL) of water for each ounce of beer and an extra 3 ounces (89 mL) of water for each ounce of wine that you drink. The same guideline holds for the night before a long run.

After training or racing, wait until you're reasonably well rehydrated to enjoy a postrun potable. Imbibing while you're still dehydrated from running will slow your recovery.

Alcohol has long been part of running lore. Former New York City Marathon winner Rod Dixon famously said, "All I want to do is drink beer and train like an animal." There is great variance in how much alcohol runners can tolerate. How much is too much? Be honest with yourself about whether drinking regularly detracts from your running such as by lowering your sleep quality or making you groggy and dehydrated when you wake. And right before training or racing, well, let's not go there.

CARBOHYDRATES AND THE MARATHONER

The main fuels for endurance exercise are carbohydrate and fat. Protein also provides a small amount of energy. Carbohydrate supplies the majority of your energy during the marathon, and fat supplies the bulk of the remainder. If you want to run 26.2 miles (42.2 km) at a good pace, you had better like carbohydrate foods, because they'll be a mainstay of your diet during most of your day-to-day training and especially in the final few days before the marathon.

Even if you're a gaunt marathoner, your body has a large stockpile of energy in the form of fat. A 140-pound (64 kg) runner with a body fat level of 6 percent still carries around 8.4 pounds (3.8 kg) of fat. Each pound of fat supplies 3,500 calories of energy, so this individual has more than 29,000 calories stored as fat.

For the purposes of fast marathoning, what matters are your reserves of carbohydrate, not fat, and your carbohydrate stores are much more limited.

If you do a good job of carbohydrate loading, you can store about 2,000 to 2,500 calories of glycogen (the body's storage form of carbohydrate).

When you run, your body burns a mixture of carbohydrate and fat. The harder you run, the higher the proportion of carbohydrate you use; the slower you run, the higher the proportion of fat you use. During walking, more than half of the calories you burn are provided by the breakdown of fat. As your pace increases, you use proportionately less fat and more carbohydrate. An easy recovery run may be fueled by 60 percent carbohydrate and 40 percent fat. When you race the marathon, over 75 percent of the fuel you use is supplied by the breakdown of carbohydrate. For those jogging the marathon, the proportion of carbohydrate used may be somewhat lower.

Carbohydrate is a more efficient energy source than fat. The breakdown of fat requires more oxygen per calorie released than does carbohydrate. Because fat metabolism doesn't produce energy aerobically as efficiently as carbohydrate metabolism does, you can't run as fast when burning just fat.

Your body uses several strategies to keep you from running out of carbohydrate stores. One of these strategies is to use relatively more fat as your carbohydrate stores become low. When your glycogen stores become critically low, you experience "hitting the wall" or "bonking." A problem with glycogen depletion is that there aren't warning signs that it's going to occur until it's too late. When you need to slow suddenly in a marathon, the culprit is probably glycogen depletion, not dehydration, which tends to affect you more gradually.

You can prevent carbohydrate depletion by glycogen loading. Glycogen loading (also known as carbohydrate loading) is the practice of manipulating your diet and training to increase your glycogen stores.

Marathoners can increase their glycogen stores for race day by tapering training and eating a high-carbohydrate diet for 2 to 3 days before the race as recommended in the training programs in chapters 9 through 13.

Rice, pasta, bread, sweet potatoes, pancakes, bagels, potatoes, corn, and raisins are excellent sources of carbohydrate. Expect to gain a couple of pounds and feel slightly bloated when you glycogen load, because your body stores 2.6 grams of water for every gram of glycogen. The added weight shows that you have done a good job of glycogen loading, and the stored water may help prevent dehydration as the marathon progresses.

If you eat a normal runner's diet, with about 60 percent of your calories from carbohydrate, you probably store about 1,500 to 2,000 calories of glycogen in your muscles. If you glycogen load, however, your muscles have the capacity to store about 2,000 to 2,500 calories of glycogen. Each mile (1.6 km) that you run burns about 90 to 140 calories, depending on your weight and metabolism, and over 75 percent of those calories are supplied by carbohydrate. If you do a great job of loading, you'll have just about enough glycogen for the marathon.

Glycogen loading is also useful before your long runs so you have plenty of fuel to go the distance. Carbohydrate loading before your long runs will help ensure that those runs are high quality, which will increase your confidence for the marathon. For some of your long runs, however, it may be beneficial to allow your glycogen tank to run low to stimulate increased glycogen storage. This strategy, called *train low/race high*, is explained in the following sidebar.

TRAIN LOW/RACE HIGH

In chapter 1, we discussed that one of the adaptations to endurance training is the ability to store more glycogen. This occurs because running low on glycogen provides a stimulus for increased activity of the glycogen synthase enzyme, which leads to increased glycogen storage. Recent evidence suggests that there may be other benefits of allowing your glycogen stores to run low during some of your training runs, including increased mitochondrial content, increased aerobic enzyme activity, and increased ability to oxidize fat (Burke 2010; Stellingwerff 2013).

Elite distance runners have used this "train low" approach for decades (without understanding the scientific rationale) by doing long runs in the morning with little or no carbohydrate intake and running twice per day with their glycogen stores partially depleted during the second workout of the day.

The most convenient way to train low is to do a long training run in the morning before breakfast (or after a very small breakfast) or at least 6 hours after a meal. It is not yet clear how much or how often depletion is needed to stimulate these adaptations, but as with any change to your training, try this approach cautiously so you have plenty of energy for most of your training. With glycogen depletion there is a risk of delayed recovery from training and of immune system suppression.

Allowing your glycogen stores to run low (but not become entirely depleted) once or twice per week may provide a useful balance between gaining the positive adaptations from training low without it becoming a drag on your enthusiasm for training. Start with a moderately long run without stocking up on carbs before or taking carbs during the run, and progressively increase the length or intensity of the run from week to week. If you feel a bit more fatigued than usual in the last couple miles of your run, you have probably gauged it about right. If you feel wiped out during the latter stages of your run and need a couple days' recovery, you have overdone it and should start with a shorter, easier run.

How Much Carbohydrate Do You Need in Your Daily Training Diet?

Your daily carbohydrate requirement depends on your weight and how much you're training. If you're averaging an hour to an hour and a half of training per day, you need approximately 2.3 to 3.2 grams of carbohydrate per pound (5-7 g/kg) of your body weight per day. If you're training for an hour and a half to two hours per day, you need approximately 3.2 to 3.9 grams of carbohydrate per pound (7-8.5 g/kg) of body weight per day. Training for 2 hours or more per day requires at least 3.6 grams of carbohydrate per pound (8 g/kg) of body weight per day.

As an example, say Gary is running 80 miles (129 km) per week and weighs 154 pounds (70 kg). His average daily training time is about 80 minutes. Gary's daily carbohydrate requirement is 350 to 490 grams (70 × 5 to 70 × 7). Each gram of carbohydrate supplies 4.1 calories, so Gary's calorie supply from carbohydrate should be about 1,400 to 2,000 per day.

SHOULD YOU GO GLUTEN-FREE?

For much of the modern marathon era, runners took a more-is-better approach to gluten, or at least to the foods it's most commonly found in—pasta, bread, bagels, muffins, and the like. More recently, the pendulum has swung in the other direction. One survey (Lis et al. 2015) of predominantly competitive endurance athletes found that 40 percent avoid gluten, far greater than the portion of the population thought to be diagnostically gluten sensitive. Anecdotally, you may have encountered many fellow runners who say they try to avoid gluten. As in most matters in running, the best approach for most people lies somewhere between the extremes.

Gluten is a protein found in wheat, barley, and rye. In North America and Europe, 1 percent of the population has celiac disease, an autoimmune disorder in which eating gluten causes damage to and inflammation in the small intestine. Untreated celiac disease can lead to poor nutrient absorption and a cascade of symptoms (diarrhea, bloating, fatigue, osteoporosis) that can harm normal health, not to mention marathoning. The best treatment for celiac disease is a strict gluten-free diet. High-level marathoning on such a diet is possible, as evidenced by the success of runners such as Stephanie Bruce, an American with a personal best below 2:30.

Things get a little trickier when the topic is gluten sensitivity or gluten intolerance. It's estimated that about 5 percent of the population have some degree of sensitivity or intolerance. Some of the symptoms are similar to those of celiac disease, such as fatigue, headaches, and gastrointestinal issues. But there's no reliable test for the condition. And it's quite possible that many people's symptoms aren't caused by gluten per se. For example, bloating could stem from eating too much fiber, which glutenous foods such as whole-wheat bread are usually high in. Similarly, a challenging workout like a long tempo run will mean blood is diverted from your stomach, potentially leading to short-term trouble digesting glutenous foods. Eating the same foods long after the run might not cause symptoms.

If you're not gluten sensitive, you might think there's no harm in going gluten-free. But there's unlikely to be gain, either. In general, dietitians don't recommend avoiding an entire class of food without good reason. If you think you might have gluten sensitivity or intolerance, start by keeping detailed records of your diet, symptoms, and running performance to see if you can identify trends. If you decide you might be in the small minority of the population with the condition, consult a sports nutritionist.

High-Fat/Low-Carb Diets

Much has been written over the past several years on high-fat/low-carb (HFLC) diets for endurance athletes. A typical HFLC diet calls for 50 to 75 percent of calories from fat, up to 20 percent of calories from protein, and less than 50 grams per day from carbohydrates. The more extreme versions are also called ketogenic, or keto, diets because these diets increase ketosis, which occurs when the body metabolizes fat at a high rate and converts fatty acids to ketones. A number of ultraendurance athletes have switched to a HFLC diet, and a growing number of studies are looking into the impact of these diets on the metabolism of fat, weight loss, blood lipid levels, and performance.

Studies have found that a HFLC diet increases fat oxidation even if the athlete is only on the diet for a short time (Havemann et al. 2006). Longer-term studies have found an increased proportion of fat oxidation at higher exercise intensities; in other words, subjects burned relatively more fat at higher exercise intensities while on a long-term HFLC diet (Volek et al. 2016). Theoretically, this adaptation could help when racing a marathon in that you wouldn't burn as much glycogen at a given pace and could therefore reduce your risk of hitting the wall.

Evidence of the impact of switching to a HFLC diet on cholesterol and triglyceride levels is mixed and may depend on what types of fats are emphasized in the diet. Subjects also tend to lose several pounds on a HFLC diet (McSwiney et al. 2018; Urbain et al. 2017; Zinn et al. 2017), likely due to less storage of water with lower glycogen stores and ketosis, and some maintain a lower body weight over time. For individuals with type 2 diabetes or high blood glucose levels, a HFLC diet may lead to reduced and stabilized blood sugar levels due to reduced production of insulin. On the other hand, there is evidence that exercise economy (the equivalent of running economy) is decreased on the HFLC diet, meaning more oxygen is required to maintain a given speed (Impey et al. 2018). There is currently no evidence that a HFLC diet will improve marathon performance compared to a high-carbohydrate diet.

Studies and anecdotal evidence have found that runners feel fatigued and endurance performance decreases in the first few weeks on a HFLC diet but that the fatigue decreases over time and endurance performance gradually returns to its normal level (Urbain et al. 2017; Zinn et al. 2017). As would be expected, studies have found that high-intensity exercise performance decreases on a HFLC diet, so the ability to do interval workouts such as 1200-meter repeats at 5K race pace would be impaired (Urbain et al. 2017; Havemann et al. 2006). It is not clear whether training at the intensity required for lactate threshold workouts (e.g., tempo runs) can be conducted as effectively on a HFLC diet, but with long-term adaptation that may be the case.

Currently, there is not enough evidence to recommend that marathon runners, particularly those who are trying to maximize their performance, switch to a HFLC diet. To date, the majority of evidence supports the view discussed in this chapter that carbohydrates are the primary fuel source for marathon training and racing. In coming years, more evidence will emerge on this interesting topic, but for now it is premature to change from the conventional approach of providing enough carbohydrates to fuel your training.

Tips to Replenish Your Glycogen Stores

If you follow a typical runner's high-carbohydrate diet, you probably have enough glycogen to get you through a 20- to 22-mile (32-35 km) run or a hard interval workout. After a long run or a long interval workout, therefore, your glycogen stores are depleted. It typically takes 24 to 48 hours to completely replenish your glycogen stores. When you do two long or hard workouts in a row, therefore, you risk going into the second workout with partially filled glycogen stores, becoming depleted, and having a bad workout. The frequency with which you can train hard is determined by your recovery rate between workouts, and this will be increased by replenishing your glycogen stores quickly.

Here are strategies you can use to increase your rate of glycogen replenishment.

- Don't wait. Your body stores glycogen at a faster rate during the first two hours after exercise and at the fastest rate during the first 30 minutes after exercise, so have a carbohydrate drink with you when you finish your long runs or other glycogen-depleting workouts. Bring along some easy-to-digest carbohydrate foods as well. To speed glycogen resynthesis, take in a little under half a gram per pound of body weight (1 g/kg) in the first 30 minutes after the workout and another gram per pound of body weight during the following 2 hours, and have a meal within 3 hours of finishing training.
- Increase your intake of carbohydrate. After a glycogen-depleting workout, increase your carbohydrate intake to at least 3.6 grams per pound of body weight (8 g/kg) during the next 24 hours.
- Eat moderate– or high–glycemic index foods during the first few hours. The glycemic index of a food is determined by the effect it has on your blood glucose level. High–glycemic index foods cause a large increase in blood glucose levels, whereas low–glycemic index foods have a lesser effect. During the first few hours after a workout, your glycogen stores will be replenished more quickly if you consume moderate– or high–glycemic index foods, such as sports drinks, recovery bars, fruit bars, potatoes, rice cakes, bread, bagels, raisins, and crackers.

- Consume some protein with your carbohydrates. A small amount of protein (e.g., 15-20 g) consumed with carbohydrates has been found to increase glycogen storage and also stimulates protein synthesis for muscle repair.

Nancy Clark's Sports Nutrition Guidebook and *Endurance Sports Nutrition* by Suzanne Girard Eberle are excellent and extensive resources for more information on nutrition for endurance athletes.

THE ROLE OF PROTEIN FOR MARATHONERS

Conventional wisdom indicates that strength-trained athletes such as weightlifters need lots of extra protein to build muscle but that the protein needs of endurance athletes are the same as for sedentary folks. Over the past several years, however, studies have clearly shown that endurance athletes have elevated protein needs. As a marathoner, your body needs protein to repair damaged muscles, make red blood cells to deliver oxygen to your muscles, make mitochondria in your muscles to produce energy aerobically, maintain a strong immune system, and make enzymes and hormones that keep your body functioning normally.

Sedentary individuals need about 0.35 to 0.45 gram of protein per pound of body weight per day (0.8-1.0 g/kg per day). Endurance athletes have elevated protein needs because of their greater wear and tear on muscle tissue and red blood cells, need for more mitochondria, and so on. Several formulas are used for calculating the protein needs of endurance athletes. The American College of Sports Medicine guideline for protein intake for endurance athletes had previously been 0.55 to 0.64 grams of protein per pound of body weight, but this range was recently broadened to take into account the specifics of the athlete's training and the timing of protein intake (Thomas, Erdman, and Burke 2016). In the aforementioned *Endurance Sports Nutrition*, sports dietitian Suzanne Girard Eberle provides a guideline of 0.55 to 0.75 grams of protein per pound of body weight (1.2-1.7 g/kg of body weight) per day for endurance athletes. Table 2.1 presents daily protein requirements for marathoners using this formula.

Although the protein intake of most Americans exceeds their requirements, this is not necessarily the case for marathoners, particularly those who restrict some aspect of their diets. For example, if you're a vegetarian, it's not difficult to meet your protein requirements, but it does require some knowledge and planning.

Eating too much protein can also have negative consequences for your running performance. If you eat too much protein, you may not be consuming enough carbohydrate, so such a diet would reduce your energy levels. Your body would use the excess protein as energy by removing the amino groups and oxidizing the resulting carbon skeleton. This process requires the removal of waste products, which can stress the kidneys.

TABLE 2.1

Daily Protein Requirements for Marathoners

Weight (lb)	Weight (kg)	Protein required (g/day)
100	45	55-75
120	55	66-90
140	64	77-105
160	73	88-120
180	82	99-135
200	91	110-150

THE IMPORTANCE OF IRON

Iron is vital to running performance. Despite this importance, many runners don't monitor their iron levels.

Iron is necessary for producing hemoglobin in your red blood cells. Oxygen attaches to hemoglobin for transport in your blood to your muscles. If your hemoglobin level is low, less oxygen reaches your muscles, which means your muscles can't produce as much energy aerobically. The result is that your $\dot{V}O_2$max and lactate threshold are reduced, and you can't maintain as fast a pace. In addition, iron is a component of many other substances in the body, such as enzymes in your muscle cells that affect aerobic energy production, so low iron levels may cause low energy levels by altering production of these other substances.

For many years, top athletes and coaches have recognized the benefits of a high red blood cell count; this awareness has led to the illegal practices of blood doping and using synthetic erythropoietin (EPO) to increase red blood cell count. EPO is a hormone the body produces naturally that determines the body's level of red blood cell production. When EPO levels rise through natural means or through injection of synthetic EPO, red blood cell production and hemoglobin levels increase. The result is that the runner can produce more energy aerobically and, therefore, maintain a faster pace.

The typical marathoner needs to ensure that he or she doesn't have a low red blood cell count or low iron stores. Low iron levels may be the most prevalent nutrition deficiency in Western marathoners, particularly for women. With iron-deficiency anemia, your iron stores are gone and your hemoglobin level is reduced. With iron depletion, on the other hand, your iron stores are low but not gone, and your hemoglobin is still in the normal range. Although anemia is more detrimental, both of these conditions can negatively affect your running performance.

Why Do Marathoners Tend to Have Lower Iron Levels?

Runners may have slightly lower hematocrit and hemoglobin levels than do sedentary folks due to increased blood volume. Runners may have relatively low iron stores due to low iron intake, foot-strike hemolysis, damage to red blood cells from muscle contraction, and iron loss through sweat and urine and through the gastrointestinal (GI) system. For marathoners, the iron losses tend to be higher than for those doing shorter races, primarily because of higher training volumes. Let's look at each of these factors.

- *Increased Blood Volume.* Endurance athletes have more blood than do normal people. This adaptation allows the stroke volume of the heart to increase, which allows $\dot{V}O_2$max to increase. This is a good thing. The iron in a runner's red blood cells, therefore, is diluted in a greater volume of blood. If the runner's red blood cell mass doesn't increase as much as the blood volume, hemoglobin concentration will decrease and may incorrectly indicate an iron deficiency.

THE NO-MEAT MARATHONER

People follow a vegetarian or vegan diet for many reasons—primarily health, ethical, or environmental—but few do so primarily to improve their running. Is it possible to run your best marathon while not eating animals or, in the case of veganism, not eating any animal products?

The short answer is yes, but you will probably have to pay more attention to your diet than would otherwise be the case.

That extra attention isn't necessarily a negative. Of course, you could live on candy bars and potato chips and call yourself a vegetarian, but that isn't the approach most take. Following a plant-based diet usually means greater awareness of the nutritional value of foods and striving to eat high-quality, nutrient-dense items. This might be one reason that in general health measures such as cholesterol and body mass index, vegetarians and vegans tend to have better profiles than the average person.

But what about marathoning? The few studies (Craig and Mangels 2009; Nieman 1999) that have compared vegetarian athletes to omnivorous athletes have found the groups to be roughly similar in measures such as thigh muscle size and lung function. There is also no evidence that a well-planned vegetarian or vegan diet will lead to being deficient in protein.

As noted on page 46, the biggest potential challenge for marathoning vegetarians and vegans has to do with iron. Only about 10 percent of iron from plant sources is absorbed, compared to almost twice as much from meat sources. And that assumes you're regularly eating large amounts of iron-rich plants, such as spinach and kale. The same problem of lesser bioavailability from plant sources occurs with some macronutrients that have a role in endurance performance, such as vitamin B_{12}, zinc, and omega-3 fatty acids. Vegans can also be short on calcium, which plays a role in bone health.

For these reasons, it is likely worth consulting a dietitian to ensure you are meeting your nutritional requirements if it's important to you to follow a vegetarian or vegan diet.

Shalane Flanagan

Fastest marathon: 2:21:14 (Berlin, 2014) Marathon highlights: 1st place, 2017 New York City Marathon; 1st place, 2012 U.S. Olympic Trials Marathon; 6th place, 2016 Olympic Marathon; 10th place, 2012 Olympic Marathon

Shalane Flanagan began 2017 with a stress fracture in her back. She ended 2017 as the first American woman in 40 years to win the New York City Marathon. That trajectory perfectly captures the patience, persistence, and self-belief underlying Flanagan's legendary career.

Flanagan has always risen to the level of her competition, whether while winning a high school national indoor championship, NCAA cross-country titles, and U.S. Olympic Trials races on the track, or medaling at 10,000 meters in the 2008 Olympics. So it was no surprise when she nailed her marathon debut, placing second against some of the world's best at New York City in 2010. Given her standards for herself, it was also no surprise that Flanagan then set the goal of winning a major marathon.

Elsa/Getty Images

One interesting aspect of her quest to meet that goal is that she didn't immediately switch to a traditional regimen of two marathons a year. Flanagan continued to compete in cross country (she won bronze at the 2011 World Championship) and on the track (she ran the outdoor world meet as late as 2015). There are two lessons to draw from this approach.

First, Flanagan focused on shorter distances because they were still a passion of hers. (She still holds the U.S. indoor records at 3,000 and 5,000 meters.) There is no rule saying that once you start running marathons, you're not allowed to step away from the distance and enjoy other aspects of running. You're more likely to run your best marathon when you view the distance with enthusiasm, not obligation.

Second, Flanagan is one of many runners who have gotten faster at shorter races after becoming marathoners. She set her U.S. road records for 10K and 15K in 2016 and 2014, respectively. Being a more complete runner helps, rather than hurts, your marathoning.

Flanagan, a Massachusetts native, set her sights on winning Boston after placing 10th in the 2012 Olympic Marathon. She first raced in Boston in 2013, when she placed fourth. The following year, she ran aggressively from the start to ensure a fast pace. Flanagan led through 19 miles before finishing sixth. A slight consolation was that her time that day, 2:22:02, remains the fastest on the course by an American woman in race history.

In the fall of 2014, Flanagan went to the Berlin Marathon to try to break Deena Kastor's American record of 2:19:36. She was on pace for that mark as well as the win until the final 10K, when she slipped to third. A personal best of 2:21:14 again provided some consolation, but Flanagan remained eager for an international marathon win. She returned to Boston in 2015, but was never a factor en route to placing ninth. The Olympic year of 2016 meant running the U.S. trials in February and the Rio Games in August, so Flanagan couldn't take another shot at Boston or New York City. She did finish sixth, however, at the Olympics, leading the way for a strong U.S. team performance resulting in all three women placing in the top 10.

Imagine Flanagan's frustration, then, when the lower-back discomfort she felt early in 2017 was diagnosed as a stress fracture. She had to take several weeks off from running and withdraw from that spring's Boston Marathon. With Flanagan's 36th birthday approaching, even some of her most stalwart fans wondered if her time for winning a major marathon had passed.

Flanagan continued to believe otherwise. That belief was so even though her return marathon, New York City in 2017, featured Mary Keitany, who had won the three previous editions and earlier that spring had become the second-fastest female marathoner in history. Flanagan ran confidently and patiently through the first 20 miles, covering Keitany's key moves but making none of her own.

Then, when she sensed Keitany was struggling, she seized the opportunity. She pushed hard, then harder, running some of her final miles in just over 5:00, or close to her 10K race pace. With a fist pump and a shouted expletive just before the finish, Flanagan captured the joy and satisfaction of any runner meeting a years-long goal. The New York City Marathon title was hers.

Before winning New York City, Flanagan had talked about retiring, especially if she won. But she found she still wanted to train for and race marathons. Any notion of her phoning it in was disproved by her fighting through horrific weather to finish seventh at Boston in 2018, then running with Keitany as long as possible and placing third in her New York City title defense. As she did throughout her career, Flanagan showed the best way forward is to follow your heart.

■ *Low Iron Intake.* Many endurance athletes have low iron intakes. Low iron intake can be a problem for vegetarians and runners who eat red meat less often than once a week. The typical high-carbohydrate, low-fat, low-cholesterol runner's diet often includes little or no red meat. Red meat contains heme iron, which is more easily absorbed than plant sources of iron. Runners who don't eat meat can obtain sufficient iron through dietary sources but only by carefully selecting their foods. Enette Larson-Meyer's book *Plant-Based Sports Nutrition* (2019) is a good resource for more information on proper nutrition for athletes who limit or avoid meat. *The No Meat Athlete Cookbook* by Matt Frazier and Stepfanie Romine is a good recipe source. For more on marathoning while following a vegetarian or vegan diet, see the sidebar "The No-Meat Marathoner."

■ *Foot-Strike Hemolysis and Damage from Muscle Contractions.* Foot-strike hemolysis is the breakdown of red blood cells when the foot hits the ground. Foot-strike hemolysis is potentially a problem for marathoners who run high mileage on asphalt or are heavier than most runners. In addition, recent evidence from athletes across a range of sports suggests that muscle contractions from heavy training loads can also damage red blood cells.

- *Iron Loss Through Sweat and Urine.* A relatively small amount of iron is lost through sweat and urine, but for high-mileage runners training in hot, humid conditions, this iron loss may add up. For marathoners living in the South or training through the summer in preparation for a fall marathon, sweat may be a significant source of iron loss.
- *Iron Loss Through the GI System.* Loss of iron through the GI tract (primarily the stomach or large intestine) is a problem for some marathoners. Low levels of GI bleeding occur in some runners, especially during prolonged or high-intensity training. The bleeding is fairly minor each time and generally not noticeable, but there may be a cumulative effect over years of running.

All the preceding factors in combination make it important for marathoners to monitor their iron intake and their iron levels. The highest risk occurs in premenopausal female runners, whose iron intake often doesn't meet their needs.

How Do You Know if You Have Low Iron?

If you have low iron, first, you'll be dragging. Your heart rate may be elevated, and your enthusiasm for running will have sunk. You may also feel cold much of the time and have generalized fatigue throughout the day. These symptoms tend to come on gradually, however, so you may not suspect that you have low iron levels until they've had a large impact on your training. You can confirm your suspicions only with a blood test. You should find out your hemoglobin level (the iron in your red blood cells) and your serum ferritin level (your body's iron stores).

Normal hemoglobin concentration ranges vary between countries and labs but are typically from 14 to 18 grams per deciliter (g/dL) of blood for men and 12 to 16 g/dL of blood for women; for an endurance athlete, the lower end of normal should be extended by about 0.5 g/dL because of his or her larger blood volume.

Normal reference serum ferritin levels also vary between countries and labs but are typically 12 to 200 nanograms per milliliter (ng/mL) for women and 12 to 300 ng/mL for men. Conflicting schools of thought exist on the relationship between ferritin levels and running performance. One opinion is that ferritin levels aren't directly related to performance, but if your ferritin level falls, eventually your hemoglobin and performances will decline too. Low ferritin, therefore, can be viewed as an early warning sign.

The other school of thought is that ferritin also reflects the iron stores the body can use to make enzymes for oxidative energy production; therefore, they have a direct impact on performance. The level of serum ferritin below which performance is affected seems to differ among individuals. Physiologists have found that training and racing performance is frequently impaired when serum ferritin levels fall below 20 ng/mL, whereas a serum ferritin between 20 and 40 ng/mL may be low or normal depending on the runner's individual physiology (Eichner 2012; Peeling et al. 2008; Schumacher, Schmid, and Grathwohl 2002). A sports doctor can provide expert guidance if your iron levels are borderline or low.

How Much Iron Do You Need?

The U.S. recommended daily intake (RDI) for premenopausal women is 18 milligrams of iron a day, compared to 8 milligrams of iron a day for men and postmenopausal women. According to the American College of Sports Medicine's 2016 Position Stand on Nutrition and Athletic Performance, iron requirements for women athletes may be up to 70 percent higher than for nonathletes, and distance runners and vegetarian athletes should be screened regularly and maintain iron intakes higher than the RDI (Thomas, Erdman, and Burke 2016). Iron requirements haven't been established for high-mileage runners, so all that can be said with confidence is that marathoners need at least the RDI. As with any mineral, too much iron can be a health hazard. In fact, the typical American man is more likely to get an iron overload than to be iron deficient.

How Can You Prevent Iron Depletion?

As with other running problems such as injuries, the best strategy is to avoid low iron in the first place. Good food sources of iron include liver, lean red meat, poultry dark meat, fish, oysters, egg yolk, dark green leafy vegetables, legumes, dried fruit, lentils, and whole-grain or enriched cereals and bread.

The following guidelines can help increase iron absorption to prevent iron deficiency.

- Eat 3 ounces (85 g) of lean red meat or dark poultry at least 3 times per week.
- Don't drink coffee or tea with meals because they reduce iron absorption.
- Eat or drink foods rich in vitamin C with meals to increase iron absorption.
- Have meals containing both heme iron (from animal sources) and nonheme iron to increase absorption of the nonheme iron.
- Eat iron-enriched breakfast cereals.
- Use cast-iron cookware (particularly for acidic foods such as spaghetti sauce).

Although these recommendations may seem like subtle changes in diet, they can have a powerful effect on your iron levels. For example, you'll absorb three times as much iron from your cereal and toast if you switch from coffee to orange juice with breakfast. Women distance runners may consider taking iron supplements after consultation with their physician, only if necessary after making the recommended dietary changes.

SUPPLEMENTS AND OTHER POTENTIAL ERGOGENIC AIDS

There are myriad types of nutritional supplements, with more coming on the market each year. Unfortunately, many are backed by false or exaggerated claims, and the supplement industry is not well regulated in most countries, including the United States. In addition to wasting your money, taking supplements poses a risk of negative side effects. Let's look briefly at several major categories of nutritional supplements.

Protein Supplements

As discussed earlier in this chapter, marathoners have higher protein requirements than sedentary people, but these moderately increased requirements are easily met by a well-balanced diet. Most runners don't need to take protein supplements to meet their needs.

Vitamin and Mineral Supplements

Meeting your baseline need for vitamins and minerals is important for good health and for positive adaptation to training. This is easily accomplished without supplements for runners who eat a healthy diet. Runners whose diets may be deficient in certain key vitamins and minerals, however, should consult with a doctor or appropriately qualified sports dietitian. Vegetarians, for instance, often have a difficult time getting enough iron (as previously discussed), zinc, and vitamin B_{12} from natural food sources, and they may also be low in omega-3 fatty acids. In that instance, appropriate nutritional supplements might prove beneficial to their running and overall health. More is not better, however, and excessive supplementation with minerals and fat-soluble vitamins can be toxic.

During the winter, the recommended 1,000 international units (IU) of vitamin D can be difficult to obtain through sunlight and diet alone. That's especially true if you work a normal schedule and do almost all of your running in the dark for a few or more months per year. Insufficient vitamin D levels can suppress your immune system, thereby potentially leading to catching more colds and generally not recovering from your training as well. A doctor or dietitian may recommend a vitamin D supplement for marathoners in this situation.

You also need to be mindful of the ways isolated vitamins and minerals in supplements may interact with one another, which is another reason we strongly recommend taking the advice of a doctor or dietitian before consuming supplements. Trying to time your supplements so they don't interfere with one another is a hassle you don't need. Better to just avoid nutritional deficiencies by eating a well-rounded diet.

Other Nutritional Supplements

This category includes the hundreds of nutritional supplements on the market claiming to improve various aspects of athletic performance. Among these, most focus on strength and power performance, but an increasing array is marketed toward endurance athletes. Decades of experience has shown that spending your hard-earned cash on miracle cure supplements is a monumental waste. To run your best, stick with a healthy diet and lifestyle combined with intelligent training, and steer clear of quick fixes claiming to enhance running performance.

According to the 2018 IOC Consensus Statement: Dietary Supplements and the High-Performance Athlete, which reviewed the evidence behind hundreds of types of supplements, two potential exceptions in this regard are caffeine and nitrate (Maughan et al. 2018). We've discussed caffeine elsewhere in this chapter. You may not have heard about nitrate, but you've probably heard about the performance-enhancing promise of beet juice. Well, beet juice is rich in nitrate, which is converted to nitrite by the saliva in your mouth, which then is converted to nitric oxide in your body. Nitric oxide is said to improve various running-related processes, such as muscle contraction and blood flow. Some research has found that, after drinking beet juice, athletes' oxygen consumption is a little lower at a given workload (in other words, maintaining that pace is a little easier) (Bailey et al. 2009; Jones 2014). There is some evidence that beet juice, with its not-great taste and potential for causing digestive issues, may be more effective than an isolated nitrate supplement (Flueck et al. 2016).

It's not yet clear exactly what produces the beet juice effect, what the right amount might be for most people, and whether the effect is universal. Some studies (Wilkerson et al. 2012) have found that the fitter the subjects, the smaller the effect. As with almost all nutritional matters, be cautious and don't look at beet juice as a magic bullet.

MARATHON RACE-DAY NUTRITION AND HYDRATION

So you've followed the advice in this chapter by eating properly and staying well hydrated throughout your months of preparation. Guess what—your work isn't done yet. Your strategies for taking calories and fluid on race day can have a strong influence on your marathon performance.

Let's assume you've done a good job of glycogen loading during the previous several days and you're well hydrated. Before the race, you want to take in between 200 and 500 calories of mostly carbohydrate to top off your glycogen stores. It's best to ingest these calories 3 to 4 hours before the race. This shouldn't be a big deal for races with late starts, such as New York City or Boston, which have wave starts beginning at 10 a.m. But for a race such as Chicago, which starts at 7:30 a.m., or Honolulu, which starts at 5:00 a.m. (!), you may have to get up a bit on the early side, eat something, and then try to doze a while longer. (Good luck with that on race morning!) You should also take in about a pint (0.5 L) of fluid to replace fluids lost overnight and ensure that you're fully hydrated.

Even if you carefully carbohydrate load for several days leading up to the marathon, you don't have much of a buffer against glycogen depletion. The solution is to take in additional calories during the race.

How much you need to drink during the marathon depends on your body size, the heat and humidity, and your sweat rate. The target is to replace the fluid you lose from sweating so you do not lose more than 2 percent of your body weight during the marathon. As we will see later, that is a challenging target to achieve, particularly on a warm day. The maximum amount you should drink during running is the amount that can empty from your stomach or the amount required to avoid excessive dehydration from sweat loss, whichever is less. Drinking more than you have lost brings the risk of hyponatremia, which is discussed later in the chapter.

Research has shown that runners' stomachs can typically empty only about 6 to 7 ounces (177-207 mL) of fluid every 15 minutes during running, representing about 24 to 28 ounces (710-828 mL) per hour. If you drink more than that, the extra fluid will just slosh around in your stomach and not provide any additional benefit. You may be able to handle more or less than the average, however, so experiment with how much liquid your stomach will tolerate.

During training, it's relatively easy to stop and drink as much as you want whenever you feel like it. All that's required is a bit of planning and perhaps a few containers strategically placed before your long run. During the marathon, however, it's very difficult to drink 6 to 7 ounces (177-207 mL) of fluid at an aid station without stopping. In fact, a study by Dr. Tim

Noakes and colleagues (2007) found that most runners drink less than 16 ounces (473 mL) per hour when racing.

For serious marathoners going for a personal best time, if you drink 3 ounces (89 mL) at 8 to 10 drink stops during your marathon, you will have done a typical job of hydrating. Let’s look at fluid balance and carbohydrate intake from a practical level of 24 to 30 ounces (710-887 mL) of fluid intake during the marathon. If you run the marathon in 3 hours and are losing 3 pounds (1.4 kg) per hour, you will lose 9 pounds (4 kg) and take in 1.5 to 2 pounds (0.7-0.9 kg), for a net loss of 7 to 7.5 pounds (3.2-3.4 kg). If you weigh 150 pounds (68 kg), you will have lost 4.7 to 5 percent of your body weight; this will likely contribute to slowing down moderately late in the race.

Drinking 24 to 30 ounces (710-887 mL) of an 8-percent solution will supply 56 to 72 grams of carbohydrate. Each gram of carbohydrate contains 4.1 calories, so you’ll be taking in 230 to 295 calories during the race.

A complementary method of taking in carbohydrate during the marathon or your long runs is to use energy gels. Depending on the brand you choose, each gel packet typically contains between 80 and 120 calories of carbohydrate. You should follow most gels with a couple of sips of fluid to wash them down, and you should take in approximately 4 to 6 ounces (118-177 mL) of water afterward to help absorb the gel. Some gels, however, are isotonic (check the label), so you do not need to take in fluid to help with absorption. The best time to take an energy gel that is not isotonic is shortly before an aid station.

As always, don’t wait until race day to try an energy gel because it takes practice to get the water intake right and to feel comfortable running after taking a gel. You should develop a plan for taking in sports drinks and gels during your marathon. The makeup of your personal plan will depend on how warm and humid your marathon is likely to be, how much carbohydrate you intend to take in during the race, and what types of carbohydrate you are most comfortable taking while running. A typical plan for a sub-3-hour marathoner would be to drink 24 to 30 ounces (710-887 mL) of a sports drink with 8 percent carbohydrates, divided between 8 to 10 aid stations, and to take gels providing 100 calories of carbohydrates each at about 1 and 2 hours into the marathon. This plan would supply 430 to 495 calories of carbohydrates. During the marathon, a typical 140-pound (63 kg) male burns about 100 calories per mile. Of those 100 calories, about 80 are supplied by carbohydrate. This plan, therefore, supplies enough carbohydrate fuel to last an extra 5 to 6 miles (8 to 10 km) and substantially boosts your likelihood of reaching the finish line without running critically low on glycogen. Slower marathoners can further boost their carbohydrate intake by taking another gel after about 3 hours (and after 4 if you're still going).

Recent evidence (Burke and Maughan 2015) has found that even just rinsing your mouth with a carbohydrate drink can enhance performance. The mechanism seems to be that receptors in the mouth sense the carbohydrate and signal reward centers in the brain. You can use this strategy as a boost in the last two miles of the marathon when it is too late for carbs to be absorbed in your intestines.

Avoiding Hyponatremia

If you run the marathon in more than 3 hours on a warm day and drink large amounts of plain water during the race, you are at risk of hyponatremia. This is a condition caused by unusually low sodium levels in your blood; a large proportion of your body fluid is replaced with water, thereby reducing your body's sodium content. There is evidence that women have a moderately higher risk of developing hyponatremia than do men. The symptoms of hyponatremia include weakness, nausea, disorientation, bloating, dizziness, seizures, and coma. Hyponatremia typically occurs only toward the end of ultramarathons or Ironman triathlons, but it can occur in the marathon on warm days, especially for 4-hour-plus marathoners who consume only water. The simple way to avoid hyponatremia during a hot-weather marathon is to consume fluids containing at least 250 milligrams of sodium per liter and to not drink more than you have lost as sweat.

How to Drink on the Run

The race nutrition plan described above assumes you're regularly taking in a good amount of fluid, as opposed to most of it spilling down your front. Practice drinking while running at close to marathon race pace until you get good at it. It makes sense to slow a bit at the aid stations, but if you're competitive, you won't want to lose time to the runners around you. By practicing drinking on the run, you can greatly improve your proficiency at this skill.

If you're an elite runner, you can usually arrange to have squeeze bottles at the aid stations along the course. This is optimal but obviously not readily available to everyone. Non-elites can help themselves by choosing marathons where friends or family members can meet them regularly along the way and give them bottles. Still, the majority of marathoners must master the paper cup.

A convenient way to practice drinking from cups is the round-and-round-the-track method—simply set up some cups at the local track and practice drinking every couple of laps. The advantage of the track is convenience. The disadvantage is that, if you're running intervals, you'll be breathing so hard that you'll get to experience the dubious thrill of getting water up your nose. This approach works really well during a tempo run. If you do a 20- to 30-minute tempo run on the track and take a drink every two to three laps, you will quickly improve your drinking-while-running technique.

Another convenient way to practice drinking on the run is the road-loop method. Back your car to the end of the driveway, put a few cups of the beverage you'll drink during the marathon on the back of your car, and head out for a repetitive loop run, grabbing a cup every time you pass your car.

Race-Day Technique

If volunteers are handing out fluids during the race, try to make eye contact with one and point at the cup so that you don't surprise him or her. (If the cups are on a table, eye contact with the cup generally won't help.) If volunteers are offering both water and a sports drink, begin yelling your preference as you approach the aid station so that the right volunteer hands you a cup.

Slow slightly and try to move your arm back while you grab the cup so that you don't hit the cup with your full running speed. Squeeze the top of the cup closed so that all of the liquid doesn't slosh out, and take a swig. This will help prevent fluid from going up your nose when you tip the cup up to drink. The trick is to breathe normally. Always take a couple of normal breaths between swigs. When you're done drinking, accelerate back to race pace.

Unless you're an elite marathoner, the best strategy on a warm and humid day may be to stop and drink at the aid stations. Marathons typically offer aid stations every two miles to 5 kilometers, although some larger races have stops every mile. Let's say that, from the start, you stop to drink every 2 miles. That's 12 stops between the start and finish. If you spend 10 seconds drinking at each stop, you'll add 2 minutes to your time. If you run through the stops while drinking, you'll slow a little anyway, so stopping isn't going to add much time, and stopping helps ensure that you take in enough fluid to fight off dehydration. On a warm day, an extra 2 minutes at the water stations can repay you with 10 to 20 minutes gained by the finish of the marathon.

What and when you eat and drink play an important role in how you adapt to training for a marathon. As we've seen, neglecting proper nutrition and hydration will mean not reaping the full benefits of your hard work. The same is true for not paying attention to easy days and other aspects of managing recovery from taxing training. Let's look at what to do to maximize your chance of marathon success during the many hours each week when you're not running long or hard.

Chapter 3
Balancing Training and Recovery

As we saw in chapter 1, every time you do a hard workout, you provide a stimulus for your body to improve in some way, such as your lactate threshold (LT), fat-burning ability, $\dot{V}O_2max$, and so on. Any one workout, though, provides only a mild stimulus for improvement; it's the sum of your workouts over time that determines the total stimulus to improve a specific component of your fitness. For example, if you do one tempo run in the few months before your marathon, you provide a mild stimulus for your LT to improve. If you do six tempo runs in 8 weeks, you provide a strong repetitive stimulus for your LT to improve.

The training stimulus, however, is only half of the formula for performance improvement. To improve, your body must recover from training and adapt to a higher level. By learning to manage your recovery, you'll optimize your training. If you manage your recovery so that you can do hard workouts more frequently or so that the quality of your hard workouts consistently improves, you'll provide a greater stimulus for your body to improve its capacities.

Recovery from training is important, both from day to day and over the course of your marathon-preparation program. Poor management of your recovery can lead to overtraining, which simply overwhelms your body's ability to respond positively to training. In this chapter, we'll review how to optimize your recovery for marathon success.

RECOVERY AND SUPERCOMPENSATION

One of the realities of running is that if you do a hard workout today, you won't be a better marathoner tomorrow. In fact, tomorrow you'll just be tired. Hard training causes immediate fatigue, tissue breakdown, dehydration, and glycogen depletion. Depending on the difficulty of the training session (and other factors discussed in this chapter), you'll require from 2 to 10 days to completely recover from a serious workout.

At some point, however, the fatigue of each workout dissipates and you adapt to a higher level. To optimize your training, you need to find the correct balance between training and recovery. Training provides the stimulus for your body to adapt, but recovery is when you allow your body to adapt and improve. Well-designed training sessions provide a stimulus for your body to adapt to a higher level, which is called *supercompensation*.

Effectively managing your recovery means answering two questions:

1. How many days after a workout do you reap the benefits of that workout?
2. How much time should you allow between hard workouts or between a hard workout and a race?

The training schedules in the second half of this book reflect the answers to those questions. The schedules aim to provide the ideal amount of stimulus and recovery so your fitness improves week by week as your marathon approaches. Let's look at the answers to the above questions to understand why the schedules are structured as they are.

Turning Genes On and Off

The intensity, duration, and frequency (number of sessions per week) of your training all influence the stress of your training and the rate at which your body adapts. The adaptations in hormone levels, fat-burning ability, capillary density, and so on that result from endurance training occur because of repeated training bouts rather than as a result of one workout in isolation. It's as though your body must be convinced that you're really serious about training before it makes the physiological adaptations that let you reach a new level.

The process of adaptation begins with your genes. Training provides stimuli (e.g., glycogen depletion) that turn specific genes on or off. By altering the expression of genes, training changes the rates at which your body makes and breaks down specific proteins. For example, endurance training turns on genes for the production of mitochondrial protein. More endurance training leads to more mitochondria in your muscles so you can produce more energy aerobically. Your muscles and cardiovascular system adapt over days, weeks, and months to the cumulative effects of your repeated training.

Factors Affecting Recovery Rate

Runners vary greatly in how long it takes them to recover from and adapt to a workout. Differences among runners in recovery time and rate of improvement are determined by genetics, age (you tend to recover more slowly with age), training history, gender (women tend to recover more slowly because of lower testosterone levels), and lifestyle factors. Your genetics determine your predisposition to adapt to training; some of us are programmed to adapt more quickly than others. Lifestyle factors such as diet, quantity and quality of sleep, general health, and various life stressors (such as work, finances, and relationships) all influence how quickly you recover from and adapt to training. Because so much variation exists among runners in how many workouts they can tolerate in a given period, you shouldn't copy your training partner's running program. Only through experience will you learn how much training you can handle.

Over time you will learn how much training your body can positively adapt to in a given time. Successful marathon preparation requires that you go through this self-discovery process intelligently and systematically. Determining this balance is tricky because it can be hard to isolate variables. For example, if your job is now much more stressful than the last time you trained for a marathon, your current rate of recovery might be slower. Or, as we'll see in detail in chapter 5, you'll probably find you don't recover as quickly as you used to if you're a middle-aged runner training for your first marathon in a decade. You must find the correct balance of training stimulus and recovery for your specific circumstances over the long weeks that constitute marathon training.

Time Required for Recovery and Supercompensation

Unfortunately, the scientific literature doesn't provide clear evidence of the amount of time required to realize the benefits of an individual training session. Personal experience and discussions with many runners and coaches indicate that 8 to 10 days is an adequate amount of time to recover from and reap the rewards of most hard training sessions. Given that any one workout provides only a small fitness benefit—on the order of magnitude of 1 percent—but that a workout can cause severe short-term fatigue, it's wise to err on the side of caution and allow enough time to fully recover from training before a race. For the marathon race itself, complete recovery from training is critical for success. Marathon tapering generally requires a full 3 weeks; tapering is the subject of chapter 6.

Table 3.1 shows typical times to reap the benefits of three major types of workouts. The third column indicates typical amounts of time to recover from a workout of each type. For example, the table indicates that you should allow at least 4 days between tempo runs or between a tempo run and a tune-up race. You don't, however, need to allow 4 days between a tempo run and a long run or interval workout. That's because each type of workout uses different combinations of energy systems, so complete recovery from one type of workout isn't necessary before you do another type of workout.

TABLE 3.1

Minimum Time Between Hard Workouts and Tune-Up Races

Type of workout	Sample workout	Days before tune-up race or next similar workout
Tempo run	4 miles at 15K to half marathon race pace	4
Long run	17-20 miles	4
$\dot{V}O_2max$ intervals	6 × 1,000 m at 5K race pace	5

Although you won't see the benefits of this week's workout in this weekend's race, if you do the workout early enough in the week you should recover sufficiently for it not to have a detrimental effect on your race performance. The timelines in table 3.1 take into account the fact that we often do a tune-up race when the fatigue of previous training is reduced rather than when supercompensation has occurred. You generally can't afford the time required to be optimally rested for tune-up races. During marathon preparation, you should allow only enough rest and recovery to obtain optimal results for the marathon itself and possibly for one tune-up race.

Of the major types of workouts, tempo runs are the easiest to recover from because they don't break down the body as much as the other forms of hard training. Tempo runs are neither fast nor long enough to cause substantial muscle damage or to totally deplete your muscles of glycogen.

Long runs seem to cause the most variability in recovery time among runners, although replenishing glycogen stores generally requires only 24 to 48 hours. Some runners are able to recover relatively quickly from long runs, whereas others are wiped out for a few days. The variability in recovery time depends on your training history, the genetic and lifestyle factors discussed earlier, the type of courses you train on (downhills cause more muscle damage and greater recovery time), and the weather (the same long run in 85-degree F [29-degree C] weather will take longer to recover from than one on a 50-degree F [10-degree C] day).

Interval workouts put your muscles and cardiovascular system under the most stress and generally require the longest recovery time. Later in this chapter, we'll discuss strategies that you can use to speed your recovery.

Regardless of the type of workout involved, the pattern of workout and recovery is basic to effective training. Generally known as the hard/easy principle, this dictates the structure of your training over the weeks and months leading up to the marathon. Let's investigate the rationale for following the hard/easy principle.

THE HARD/EASY PRINCIPLE

Conventional wisdom calls for following the hard/easy principle of training, which is typically interpreted to mean that a hard effort is always followed by 1 or more recovery days. During your marathon preparation, however, it's sometimes best to violate this training pattern and do back-to-back hard days. On page 61, we'll look at two situations in which you should do back-to-back hard training days.

The appropriate interpretation of the hard/easy principle is that 1 or more hard days should be followed by 1 or more recovery days. A recovery day may consist of an easy run, a light cross-training session, or total rest. Three reasons to follow the hard/easy principle are to allow replenishment of glycogen stores, to prevent illness, and to minimize the effects of delayed onset muscle soreness (DOMS). We'll look at each reason below.

Preventing Glycogen Depletion As discussed in chapter 2, your body can store only a limited amount of glycogen, and it takes about 24 to 48 hours to completely replenish your glycogen stores. When you do two hard workouts in a row, therefore, you risk going into the second workout with partially filled glycogen stores, becoming depleted, and having a bad workout. Although glycogen depletion is potentially a problem on the second hard day, with a bit of planning it needn't be an insurmountable problem. Three hard days in a row, however, would very likely lead to glycogen depletion and a more prolonged recovery period. By following the hard/easy principle, you give your body time to build up your glycogen stores so you are prepared for the next hard workout.

Preventing Illness Moderate training makes your immune system stronger. Various studies have found that people who get regular exercise have fewer colds than do sedentary folks. After high-intensity and prolonged exercise, however, the immune system is temporarily suppressed, creating an open window during which you're at increased risk of infection. Although immune function varies greatly among individuals, studies indicate that the immune systems of healthy, well-trained runners are typically suppressed only after particularly hard training sessions. This could include marathon pace runs, big $\dot{V}O_2$max workouts, tune-up races, and your longest endurance runs.

As with other aspects of training, the combination of running intensity and duration that leads to a dip in immune function is highly individualized and related to your overall health, and whether you have been stringing together too many hard training sessions in a row (discussed in the section "Defining Overtraining" later in this chapter). Large and sudden increases in training intensity or volume can lower resistance to infection, a fact that reinforces the message in chapter 1 and the training schedules to make changes in training load incrementally and gradually.

Immune system suppression after high-intensity running has been found to last from as little as 3 hours up to about 72 hours. Interestingly, there is evidence that some components of immune system suppression are linked to carbohydrate depletion. This evidence suggests that taking in carbohydrate during the workout and restocking carbohydrate quickly may reduce immune suppression and help restore your immune function to full strength in less time. The clear implication is to not do another hard training session until your immune function recovers from the previous hard session or race. Allowing at least one easy day before the next hard workout typically provides enough time for your immune system to return to full strength.

If you have a healthy, well-balanced diet, you are probably getting all of the vitamins and minerals you need for a well-functioning immune system. Runners with diets that do not provide enough protein, iron, zinc, or vitamins A, B_6, B_{12}, and E, however, may have weakened immune systems.

The best way to get the vitamins and minerals you need is to eat plenty of fruits and vegetables. Avoid supplements with megadoses of vitamins and minerals, which can have a negative effect on your immune system.

Minimizing the Effects of DOMS Contrary to many runners' beliefs, high levels of lactate (lactic acid) in your muscles aren't what make you sore for several days after a hard effort. Essentially, all the lactate you produce in a race or workout is eliminated from your body in less than an hour. DOMS is caused by microscopic muscle damage that occurs primarily from eccentric (lengthening) muscle contractions, such as when you run downhill. During downhill running, your quadriceps muscles contract eccentrically to resist the pull of gravity and keep your knees from buckling. The resulting muscle damage leads to inflammation, which causes soreness. It takes 1 to 2 days for this process of muscle damage, inflammation, and pain to reach a peak, and the effects can last for up to 5 days. While you're experiencing DOMS, your muscles need time to repair. The damaged muscles are also weaker, so any workout done before the soreness goes away not only will be painful but also will likely not be intense enough to improve your marathon fitness.

The physiology of DOMS favors an approach of 2 hard days followed by 2 easy days because it takes 1 to 2 days for DOMS to kick in, then it takes another couple days for the soreness to dissipate. By doing back-to-back hard days, you may sneak in your second workout before soreness and muscle weakness develop. You would then have 2 days to recover before the next hard effort.

When to Do Back-to-Back Hard Days

We've seen several reasons why you should follow the hard/easy principle in your training and that a hard day doesn't always have to be followed by an easy day. A pattern of 2 hard days in a row followed by 2 (or more) recovery days may actually allow you to handle and recover from more high-quality training. Let's look at two specific situations in which you should do back-to-back hard days.

During weeks that you race, you need to train but also rest for the race. Renowned exercise physiologist and coach Jack Daniels, PhD, recommends back-to-back hard days during race weeks rather than alternating hard and easy days.

For example, say you're following a strict hard/easy schedule and have a race on Saturday. If you did a long run on the previous Sunday, then you would run hard Tuesday and Thursday and easy on the other days. Doing a hard session on Thursday, however, doesn't make sense because you would still be tired from that effort for Saturday's race. If, however, you do back-to-back harder workouts on Tuesday and Wednesday, you would still get your hard sessions in but would have an extra day to recover for the race. Although this modification still doesn't provide the optimal amount of time to recover for Saturday's race, it's an intelligent compromise that allows you to get your high-quality training while also racing reasonably well.

Another time when you might do 2 hard days in a row is if your weekly schedule is dictated by the Monday-to-Friday workweek. If you're too busy or fatigued during the week to get in regular high-quality training, you'll want to take advantage of the weekend and squeeze in 2 hard days. Hard days on Saturday and Sunday followed by recovery days on Monday and Tuesday provide a strong training stimulus and 2 full days to recover before the next hard effort on Wednesday.

In the training schedules in this book, we often prescribe a long run on Sunday, a recovery day on Monday, a long interval session on Tuesday, and a medium-long run on Wednesday. That is a tough 4-day combination, and many runners find it the most challenging aspect of these training schedules. The back-to-back hard days on Tuesday and Wednesday require that two of the next 3 days are easy before you start the pattern over again. Not everyone successfully adapts to this schedule, but paying attention to your recovery will provide the greatest likelihood of adapting positively and taking your marathon performance to the next level.

This brings us to the time-honored tradition of racing on Saturday and doing your long run on Sunday. If you race 10K (6 miles) or less, you'll dip into your carbohydrate stores but (assuming that, like most runners, you generally eat a lot of carbohydrate) will most likely not come close to fully depleting your glycogen stores. By eating your normal high-carbohydrate diet, you'll be reasonably topped up with glycogen and ready to handle your long run on Sunday morning. You can also take a couple gels to provide carbohydrates during your run, which should be at a more relaxed pace.

DRIVING TO RUN

There are several common training scenarios—meeting others to run, going to the track, indulging in a trail run—that involve driving before and after your run. If your drive is 10 or more minutes, incorporate these practices to help with your recovery from the run.

- ***Stretch, then stretch again.*** Do your normal prerun stretching at home. When you get to your destination, do some dynamic movements, such as leg swings and knees to chest, to undo the stiffness that driving can induce. If you're meeting others, arrive a few minutes early so you have time for these exercises.
- ***And stretch some more.*** Before driving home, do some gentle static stretching for your hips, glutes, hamstrings, shoulders, and any other areas that tend to get tight when you drive. The cat-cow yoga pose is especially helpful at this time. If there's room and you have time, bring a mat or at least a towel to stretch on, to increase the odds you'll spend a few minutes stretching.
- ***Rehydrate and refuel.*** Bring a full water bottle, and commit to finishing it before you get home. If your drive is longer than 30 minutes or you've done a long run or another glycogen-draining session, have some solid or liquid carbohydrates available.
- ***Bring extra clothing.*** In colder weather, bring a dry shirt or more to change into before driving home. A fresh hat will also help you stay dry and warm while your immune system might be temporarily suppressed.
- ***And then stretch one more time.*** When you get home, spend at least a few minutes on more static stretching. The cat-cow yoga pose will help loosen your pelvic

region, which tends to feel locked up when you drive soon after running.

If Saturday's race is longer than 15K (9 miles), however, you'll likely be tired and sore, have severely depleted your glycogen stores, and find yourself at less than your best for Sunday's long run. In that situation, skip the long run on Sunday. You'll be better off by postponing your long run until you've recovered from the race.

So far, we've considered only the pattern of hard training and recovery within a week. Just as important is the pattern of hard efforts and recovery over the course of your marathon preparation. Week after week of hard training can eventually lead to staleness or overtraining. To adapt optimally, it's best to have several hard training weeks followed by a recovery week. The training schedules in this book regularly incorporate recovery weeks.

There are several patterns that you can follow. The correct pattern for you depends on how hard you're training, your body's ability to adapt to training, and the sum of other stressors in your life. The most commonly used pattern is 3 hard weeks followed by a recovery week. During the early buildup phase of marathon preparation, some runners can handle 4 high-mileage weeks followed by 1 recovery week. In other cases, 2 hard weeks followed by 1 recovery week is optimal. Again, through trial and error, you'll have to find the pattern that's best for you and adjust the training programs accordingly.

CONSECUTIVE HARD SESSIONS OF THE WRONG KIND

An old school of thought is to do several hard days in a row to get used to running on tired legs. Does this idea make sense?

As we've seen, the best way to prepare for marathon conditions is to do high-quality long runs and tempo runs. If you run a 22-miler (35 km) at 40 seconds per mile slower than goal marathon pace, starting relatively fresh, you'll provide a more specific stimulus to improve your marathon performance than if you start the run fatigued and struggle to run 2 minutes per mile slower than goal marathon pace. At least once every 3 weeks, give yourself the chance to do your long run fresh. You'll feel great on these runs, thereby leading not only to a better effort but also to positive psychological reinforcement.

Doing an interval session or tempo run on tired legs makes no sense whatsoever. The objective of interval training (e.g., 6 × 1,000 m at 5K race pace) is to improve your maximal oxygen consumption. The objective of tempo runs (e.g., 5 miles at LT pace) is to improve your LT. If you run these workouts while tired, you'll either do them more slowly than is optimal or you'll have to cut back the volume of the workout (e.g., do fewer intervals or a shorter tempo run). In either case, you'll provide less of a stimulus to improve than if you had started the workout relatively fresh.

The recovery weeks in these training schedules include about 70 percent as much training volume as the hard training weeks. For example, if your hard weeks consist of 60 miles (97 km) per week, you would run about 42 miles (68 km) during your recovery week. The schedules also reduce the quantity and the intensity of the hard sessions during recovery weeks. For example, the distance of long runs is reduced as well as the pace per mile, and there are no hard $\dot{V}O_2max$ sessions scheduled during a recovery week.

RECOVERY DAYS (OR EASY DAYS)

So far in this chapter, we've discussed the necessity of incorporating recovery into your training schedule. Following the hard/easy principle, 1 or 2 hard days are always followed by 1 or more easy days. Easy training days are more appropriately called recovery days because their purpose is to allow you to recover for your next hard effort.

So what constitutes a recovery day? As with most aspects of running, the answer depends on your physiology and training history. Recovery days should be less difficult than hard sessions in the volume (distance) and intensity of training. In some cases, a recovery day should be a day of rest or a day of cross-training.

The most common training mistake marathon runners make is training too hard on recovery days. If you train too hard on a scheduled recovery day, you'll be a bit tired for your next hard day, and that workout won't go as well as planned. If you're like most runners, you'll be ticked off, and you'll run your next scheduled recovery day a bit harder. So begins a vicious cycle in which your recovery days are done too hard and the quality of your hard days declines. The result is mediocre performances in training and racing. Just as it takes discipline to push through a tempo run when you feel bad, so does it take discipline to train easily when you feel good on a planned recovery day.

The other mistake that marathoners often make is trying to squeeze in too much distance on recovery days. Early in your training program, when the marathon is still more than 8 weeks away, it probably doesn't hurt to add a couple extra miles to recovery days because the overall intensity of training tends to be rather low. When you're into the last 8 weeks of training, however, you have hard sessions with specific purposes. If you go into your hard days tired from too many slow miles on your recovery days, your overall progress will be compromised.

Your recovery days shouldn't impose additional training stress on your muscles or your nervous system. You should try, therefore, to minimize the pounding on your legs on those days. Running on soft surfaces on your recovery days will reduce the cumulative impact your legs, hips, and back experience over the course of the week. When you consider that your recovery days occur when you're the most tired and when your muscles are the most fatigued and least resilient, it makes sense to take it easy on your muscles on those days. This also implies avoiding hill running on your recovery days, not only because running uphill is likely to require more effort than is optimal for an easy day but also because downhill running tends to induce muscle damage, and you certainly don't want to incur additional muscle damage on a recovery day.

Using a heart monitor is a good way to prevent yourself from training too hard on your recovery days. (See chapters 1 and 8 for information about training by heart rate.) If you keep your heart rate below about 76 percent of your maximal heart rate or 68 percent of your heart rate reserve plus your resting heart rate, you'll let your body recover to allow high-quality workouts on your hard training days.

For example, say your resting heart rate is 50 beats per minute and your maximal heart rate is 185 beats per minute. If you train by maximal heart rate, you would want to keep your heart rate below 141 [185 × 0.76] on your recovery days. Heart rate reserve is your maximal heart rate minus your resting pulse. In this example, then, your heart rate reserve is 135. If you train using this more complicated but more precise method, you would want to keep your heart rate below 142 [resting heart rate of 50 + (135 × 0.68)] on your recovery days.

The lower-tech way to determine your appropriate recovery training intensity is to run approximately 2 minutes per mile (75 sec/km) slower than your 10-mile (16 km) to half marathon race pace. For example, if you run the half marathon in 1:18, or just under 6 minutes per mile (3:45 per km), your recovery runs should be done at roughly an 8-minute-per-mile (5 min/km) pace.

That said, it's important not to obsess about hitting a certain pace on your recovery days. GPS watches are useful tools for much of marathon training, but they can be an impediment to running your recovery days at the right effort level. Many runners have an arbitrary pace that they think is too slow to count as real running for them. Rather than letting their body dictate the pace on their recovery days, they check their GPS watch throughout and make sure they're running faster than their self-prescribed too-slow pace. Worrying about how your run will look on Strava, Instagram, or elsewhere online compounds the problem.

Doing so is a mistake. That too-slow pace is often some figure that has no meaning to the human body, such as 9:00 per mile or 5:00 per kilometer. Also, having a rigid too-slow pace ignores that there's greater day-to-day variability in your recovery pace than there is in something like your 5K race pace or LT pace. Ensuring that you're faster than your too-slow pace works against the purpose of the day's training, which is to recover from your previous hard work so you're ready to put out a good effort on the workouts that really advance your fitness, such as long runs, tempo runs, and intervals.

The better approach on recovery days is to ignore your GPS watch and run at an effort level that feels comfortable for the entirety of your run. (Even better, if you have a set loop in mind, leave your watch at home.) American and European runners who have trained in Kenya marvel at the relaxed pace some of the world's best marathoners hit on their recovery days. Aim to feel like you're storing up energy rather than slowly leaking it. Running close to your normal cadence will make the run feel more normal. It's likely that over the course you'll get faster, but don't force that to happen. Ideally, you'll finish your recovery runs wishing you could tag on another few miles and feeling eager for the next day's training.

In some situations, cross-training is the best type of exercise on recovery days. For marathoners who come out of Sunday long runs feeling beat up, cross-training is the safest option for training on Monday. Your recovery is enhanced by the increased blood flow, but there's no additional pounding on your legs, hips, and back. Cross-training is discussed in chapter 4.

RECOVERY CONSIDERATIONS IN THE REAL WORLD

If you follow the day-to-day lives of elite marathoners, you'll soon notice how much importance they place on recovery in the hours between runs. Most of them don't have jobs outside of running and can therefore be meticulous in these matters. In the likely scenario that you fit in your running around an unrelated job, here's how to maximize your recovery while at work.

- ***Hydration.*** Always have a water bottle at your workstation, and commit to draining it a couple times a day.
- ***Calories.*** Keep healthful foods at work so that you can graze throughout the day as opposed to getting so famished that you hit the vending machines in desperation.

- ***Posture, part 1.*** Make sure your computer screen is at eye level and not too far away so that you don't sit with your head tilted and thrust forward all day.
- ***Posture, part 2.*** Even if your computer is set up ideally, it's still easy to sit with a slumped upper body when you're at a desk all day. Sit with your head, shoulders, and hips aligned, and with a slight curve in your lower back. Good posture at work translates into fewer biomechanical woes on the run.
- ***Move.*** Get up and walk around at least once an hour to lessen the strain on your lower back and hamstrings. If the smokers in your office are allowed to leave their desks throughout the day to tend to their habit, you should be able to stand and stretch your legs to tend to yours.

AVOIDING OVERTRAINING

Overtraining is a danger for any motivated marathoner. In striving to improve your performance, you progressively increase the volume and intensity of your training. At some point, you hit your individual training threshold. When you exceed that threshold, positive adaptation stops, negative adaptation occurs, and your performances in training and racing suffer.

Individual training thresholds vary greatly among runners. Four-time Olympian and New York City Marathon champion Shalane Flanagan handles repeated 120-mile (193 km) weeks, whereas some runners struggle to maintain 40-mile (64 km) weeks. Similarly, some runners can handle 2 hard days of training in succession, whereas others need 3 easy days after each hard workout. Your individual training threshold also changes with time. Flanagan couldn't always handle such big mileage, but she increased her mileage as her capacity to withstand the stress increased. A detailed training log will help you discern your limits and how they evolve throughout your running career. Software that tracks your training is especially helpful in illustrating your development over time.

Defining Overtraining

It's important to clarify what overtraining is and isn't. Fatigue for a day or 2 after a hard training session isn't overtraining. In fact, it's a necessary step in the process of recovery and development. When training stress is applied in the appropriate dosage, you improve at the optimal rate. If your training stress is above the optimal level, you may still improve, but you'll do so at a slower rate. Only above a higher threshold (your individual training threshold) does true overtraining occur.

What's much more common than overtraining is overreaching. Unfortunately, this zone is where many marathoners spend much of their time. Overreaching occurs when you string together too many days of hard training. Your muscle fatigue is most likely primarily from glycogen depletion, and you may simply need time for metabolic recovery. A few days of moderate training combined with a high-carbohydrate diet should quickly remedy the situation. Overreaching can also be caused by dehydration, lack of sleep, or other life stressors on top of your normal training. In all of these cases, your body should rebound in less than a week when the extra stress is removed.

Repeated overreaching eventually leads to overtraining syndrome. The simple explanation for overtraining syndrome is that the combination of training load and other life stressors is greater than the body's ability to recover and adapt positively for a prolonged period of time. The combination of contributing factors and threshold for overtraining syndrome varies greatly among runners.

The body's response to overtraining may be regulated by the hypothalamic-pituitary-adrenal (HPA) axis. This neuroendocrine system controls reactions to stress and regulates the immune system, body temperature, sugar and fat metabolism, mood, sexual function, and the release of a variety of hormones; it's essentially your master control center for dealing with stress. When your HPA axis can't handle the combination of training and other stressors in your life, typical symptoms include fatigue, reduced immune system function, disturbed sleep, decreased motivation, irritability, and poor athletic performance. Chronic inflammatory responses from repeated muscle damage without sufficient recovery may also contribute to overtraining syndrome.

Overtraining is caused by poor planning and not heeding your body's feedback. Rather than just training too hard, overtraining appears to be related to both the difficulty of training (the training load) and the monotony of training. Monotony of training is a lack of variation in the difficulty of training from day to day. Monotonous training typically consists of 1 moderately hard day after another, whereas varied training consists of a mix of hard days, easy days, and the occasional rest day.

The combined effect of your training load and training monotony can be thought of as your training strain. The most effective training schedules find the right balance of several types of hard training and easier recovery days or rest days for optimal improvement without breaking down. Again, a good training log can help you here. Use whatever type—handwritten or software-based—you're most likely to regularly update. If you can gain an awareness of the combination of training load and monotony that puts you over the edge, you can try to adjust these elements for optimal training and marathon performance.

Breaking Out of Overtraining

If you're truly overtrained, you need to take immediate action. The first step is to see a sports physician to check that you don't have an illness that mimics the symptoms of overtraining. The possibility always exists that excessive fatigue is caused by something worse than running. Among many other tests, your physician will likely check your red blood cell count, hemoglobin, and ferritin levels to see whether your iron levels are normal (see chapter 2).

Unless you have a particularly severe case of overtraining, 3 to 5 weeks of greatly reduced training should bring your energy level back to normal. It appears that reducing training intensity is more important than reducing training volume in breaking out of overtraining syndrome. Reducing your training intensity so that you're doing only easy aerobic running is the most important step in breaking out of overtraining.

You should, however, also reduce your training volume. The correct amount to reduce your training volume depends on your individual circumstances and how deeply entrenched in overtraining you've become. As a rule of thumb, reducing your mileage by 50 percent should be enough to allow your body to recover. In addition, if you’ve been training twice a day, it will be necessary to reduce to one training session a day. Your body needs time to recover, and a second workout will slow your progress. For the first several weeks, it’s also helpful to have at least 1 day a week off from training.

In some cases, a reduction in running performance is due to a prolonged imbalance between calories consumed and calories used. Termed *Relative Energy Deficiency in Sport* (RED-S), energy intake is less than energy expenditure and eventually leads to impaired health and performance. When you have a caloric deficit for a prolonged period in combination with hard training, your body responds to protect you. In this situation, body weight may stay the same or only slightly decrease because your metabolic rate drops as your body attempts to adjust to fewer calories. In women athletes, an imbalance in energy availability can lead to the female athlete triad, which includes low energy availability, an absence of or infrequent menstrual periods, and low bone mineral density. These conditions are interrelated, and highly committed athletes in sports such as distance running in which leanness may be associated with performance are at risk. The triad usually starts with restricting dietary intake while running high mileage, leading to less estrogen production and irregular menstrual periods. This leads to reduced bone mineral density, an increased risk of stress fractures, and other injuries. Running performance declines as the triad progresses, but the risks to long-term health are more important. Breaking out of RED-S and the female athlete triad requires increased caloric and nutrient intake, reduced training, and making other lifestyle changes, and often involves the support of a sports physician, a sports nutritionist, and a psychologist.

TECHNIQUES TO SPEED RECOVERY

In addition to finding the correct balance in your training and optimizing your diet, there are a variety of techniques you can use to enhance your body’s rate of recovery. Traditional aids to recovery from marathon training include cooling down after hard workouts, cold water immersion, and massage therapy; compression apparel may also be helpful. As discussed in chapter 2, appropriate postworkout nutrition has well-documented recovery benefits.

Cooling Down

The purpose of cooling down after a hard run is to help return your body to preexercise conditions. This is the critical first step in managing your recovery from high-intensity training or racing. A thorough cool-down improves your recovery by increasing blood flow, which removes lactate and metabolic waste products from your muscles and blood more quickly, reducing adrenaline and noradrenaline levels to help your metabolism return to resting levels more quickly, and reducing DOMS.

Your cool-down should start with easy running for 10 to 15 minutes. (If you're too tired to run, then walk for an equivalent amount of time or try some easy cross-training.) The optimal clearance of lactate, adrenaline, and so on occurs if you start your cool-down run at about 60 to 75 percent of your maximum heart rate (i.e., nice and easy) and slow to a jog or walk for the last 5 minutes. After running, your muscles are warm and have very good blood flow, which increases their ability to stretch without injury, so this is the perfect time to gently stretch your muscles.

Cold Water Immersion

Cold water immersion shortly after a hard training session can reduce delayed-onset muscle soreness and perceived fatigue. To have a positive effect, you need to be in the cold water long enough to lower the temperature in your muscles. The most effective temperature range is about 11-15 degrees Celsius (52-59 degrees Fahrenheit). This temperature range can be achieved in a bathtub filled with cold water with some ice added, or in a creek or the ocean (coauthor Scott is a reluctant participant near his home in South Portland, Maine) in the spring or fall. The water will feel very cold when you first get in, but try to stay in for 5 to 15 minutes.

MONITORING YOUR “RECOVER-ABILITY”

Monitoring your body provides valuable information on your adaptation to training, your risk of injury or illness, and your readiness for the next hard training session. There are several good ways to determine when you are overreaching so you can avoid overtraining and remain healthy. You can use this information to improve your recovery by modifying your training schedule to your individual limits. A variety of apps exist for runners and other endurance athletes to monitor the key factors that influence recovery from training, such as resting heart rate and amount of deep sleep. These apps take just a few minutes each day; they make it easy to track both your training and recovery factors and typically provide warning signs when several factors are heading in the wrong direction for several days.

There are many ways to monitor your recovery, but the simplest measures are useful and the easiest to adhere to. In combination, these measures provide insight into your adaptation to training. Typically, when results on these measures decrease, running performance and recovery deteriorate a few days later. In addition to the details of your training, try tracking the following factors and review the data periodically to find the patterns that predict overtraining, illness, and injury. It is important to be as consistent as possible when measuring these factors.

- ***Weight.*** Check your weight at the same time of day each day or several times per week. While weight may naturally fluctuate slightly from day to day, decreases in weight over a few days may indicate dehydration. Decreases in weight over a few weeks can indicate that you are not eating enough calories, have an illness, or are overtraining.

- ***Morning heart rate.*** Your heart rate when you first wake up in the morning provides an indication of your recovery. It is important to check your heart rate soon after you wake because it increases as soon as you start thinking about your plans for the day and by about 10 beats per minute when you get up. In addition, waking to an alarm can increase your heart rate and make the data less reliable. To find your resting heart rate, therefore, wear a heart monitor or take your pulse immediately upon waking for several days. Your true resting heart rate is the lowest rate you find. If your morning heart rate is more than 5 beats per minute higher than usual, this may be an indication of inadequate recovery or may be the first sign that you are not well. Early detection can be particularly useful in preventing illness.
- ***Environmental conditions.*** Record the temperature and humidity on hot days. Because of increased core body temperature and dehydration, your body undergoes substantially more stress when you run at 80 degrees Fahrenheit (27 degrees Celsius) and 80 percent humidity than at 60 degrees Fahrenheit (16 degrees Celsius) and low humidity. If you train hard or compete on a hot, humid day, the heat you generate can overwhelm your body's ability to eliminate heat, causing your core temperature to climb, which can increase recovery time. Similarly, as discussed in chapter 2, severe dehydration also increases recovery time. There's great variation in how runners are affected by heat. Monitoring these factors will reveal patterns that can help you make needed adjustments during a stretch of hot weather.
- ***Hours of sleep.*** The number of hours you sleep is not particularly important for any one night. Over several nights, however, your quantity of sleep can influence your

recovery and ability to adapt positively to training and can, in combination with other measures, explain a lack of recovery and indicate lifestyle changes required to enhance your running performance and help prevent illness or injury.

- ***Quality of sleep.*** The quality of your sleep is arguably more important than the number of hours. Evaluate the quality of your sleep each night—How soundly did you sleep? Were you awake a lot in the middle of the night? Did you get out of bed feeling refreshed?—and try to be consistent in your assessment. A reduction in quality of sleep is often associated with overtraining. Reduced sleep quality can also be caused by nonrunning stressors, but the result for your running performance is the same. See “Sleep Better, Run Faster” on page 75 for how to maximize the recovery benefits of sleep.
- ***Diet quality.*** Evaluate the overall quality of your diet each day. Did your meals cover your carbohydrate and protein needs? Did you get so hungry that you binged? Did the bulk of your calories come from healthy foods? Often, a lack of energy can be traced back to poor diet in the previous few days.
- ***Hydration level.*** Dehydration has a negative effect on running performance and slows recovery from training. Evaluate your hydration level each day. Was your urine clear? Did you drink small amounts regularly so you seldom felt thirsty? Did your mouth and throat often feel dry? Your daily weight also provides a good indication of your hydration level.
- ***Muscle soreness.*** It is not unusual for runners to have slightly sore muscles most of the time. An increase in muscle soreness can be due to a hard workout or running downhill. Evaluate your general muscle soreness each day. Did your soreness lessen after a few miles of running? Did your soreness seem explainable by your

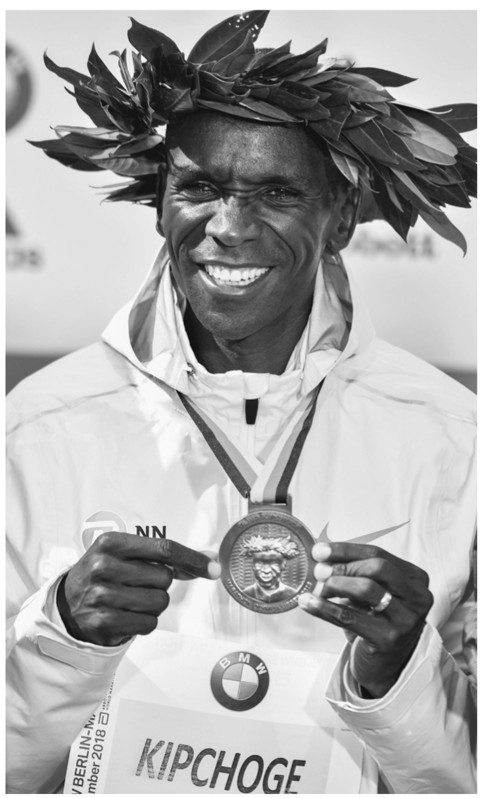
most recent workouts? If increased general muscle soreness lasts more than 4 or 5 days, it is likely that you are ill or overreaching. Soreness in a specific muscle indicates a potential injury, whereas more general muscle soreness provides an indication of your recovery and adaptation to training.

- ***Energy level.*** An assessment of energy level is one of the best indications of recovery from training. Evaluate your energy level each day. Did you have the energy to accomplish your running and daily life goals? Did you feel alert and focused when running or performing a task? If your energy level is reduced for more than 3 days, it is important to determine the cause of the reduction. Typical causes of reduced energy levels are lack of carbohydrate intake, training hard too many days in a row, illness, low iron levels, dehydration, and lack of sleep. By reviewing your training and considering your lifestyle factors, you should be able to identify the likely cause of a low energy level.
- ***Heart rate at a standard pace.*** If your heart rate at a set pace is more than about 7 beats per minute higher than usual, you may not be recovered from your previous training sessions. For example, if your heart rate at an 8-minute-per-mile pace is typically 145 beats per minute, and one day you find it is 155 beats per minute at that pace, you likely need additional recovery before doing your next hard training session. Heart rate during running at a given pace varies by a few beats per minute from day to day, and it is also influenced by factors such as dehydration and hot or humid conditions, so take this into consideration in evaluating the implications of a higher-than-usual heart rate.

Eliud Kipchoge

Fastest marathon: 2:01:39 (Berlin, 2018) Marathon highlights: Gold medal, 2016 Olympic Marathon; 1st place, 2018, 2017, and 2015 Berlin Marathon; 1st place, 2019, 2018, 2016, and 2015 London Marathon; world record, 2018 Berlin Marathon; fastest marathon run under any conditions, 2017 Nike Breaking2 Marathon

In 2003, at age 18, Eliud Kipchoge was the surprise winner of the 5,000-meter world title. In 2018 nobody was surprised when Kipchoge broke the world record at the Berlin Marathon. His time of 2:01:39—an astounding 78 seconds faster than the previous record—cemented this Kenyan's already strong claim to being the greatest male marathoner in history.



JOHN MACDOUGALL/AFP/Getty Images

Consider Kipchoge's record: In his first 11 traditional marathons, he won 10 times. His only loss in that stretch, second in a then-personal best at the 2013 Berlin Marathon, was in a race won in a world record time. Victories at Berlin, London, and Chicago against deep fields sandwiched his seemingly effortless gold-medal run in the 2016 Olympic Marathon. Kipchoge also famously ran the fastest marathon in history under any conditions, 2:00:25, at the Nike Breaking2 event in the spring of 2017. (The time doesn't count as a world record because of pacing and fueling arrangements during the run.)

Kipchoge obviously has supreme physical gifts—you don't dominate as a marathoner and win Olympic and world championship medals on the track otherwise. One of his key talents is the ability to hold up to world-class training. Kipchoge hasn't suffered a major injury for several years, allowing his fitness from each previous training cycle to underlie his current work.

Still, we suspect some of his competitors would match or exceed some of Kipchoge's physiological measurements in lab tests. What has really separated Kipchoge from the pack since he became a marathoner is his mind-set. And that's an area all marathoners can look to for time gains.

"If you don't rule your mind, it can rule you," Kipchoge says. "I tell my mind that I'm really able to do this thing. And I will do it."

Kipchoge isn't delusional—as far as we know, he's not targeting a 1:30 marathon. What he's talking about is being open to the possibility that, with the right physical preparation, great things can happen on race day if his mind is in the right place. It could have been Kipchoge, not a previous marathon world record-holder, Paul Tergat, who said, "Ask yourself, 'Can I give more?' The answer is almost always yes."

Such a mind-set is more sophisticated than thrashing yourself and otherwise ignoring your body's signals. It's about learning how to work through the inevitable tough patches—in training and racing—so that you stay positive, relaxed, and efficient. There's a growing body of research showing that concentrating on staying relaxed not only diverts your mind from thinking about less pleasant matters but also slightly boosts your running economy at a given pace.

Kipchoge practices prerace visualization; he forms concrete images of winning and running great times as well as scenarios in which he overcomes setbacks. He has an arsenal of personally meaningful mantras he repeats to himself in racing and training that motivate him to stay focused on his goals. It was these techniques, more than some vague notion of mental toughness, that allowed him to win the 2015 Berlin Marathon despite his racing flats' insoles protruding sideways out of the shoes for the bulk of the race.

Another key to Kipchoge's psychological approach is that he loves the process of preparing for a marathon. This isn't to say every run is an endorphin rush for him or that you should be giddy every time you get up early on a Wednesday to do a medium-long run before work. Kipchoge's take is similar to U.S. marathon record-holder Deena Kastor's opinion that we make choices, not sacrifices. That is, view what you do to further your running as contributions to your big-picture goal of running the best marathon you're capable of. For Kipchoge, that includes spending time in training camp away from his family. For you, that could be putting a positive spin on things like what you eat, when you go to bed, and how often you do strength training. That's a champion's mind-set, regardless of your marathon times.

Massage

Massage therapy is widely used by competitive marathoners to improve recovery, relax, and prevent injury. There is increasing scientific evidence and much anecdotal evidence for the benefits of massage therapy for athletes in general and distance runners in particular. Muscles feel fatigued after massage, so runners typically have a massage after training and avoid a deep massage the day before a hard workout or race.

The established benefits of massage are improved blood flow to the massaged area, enhanced muscle relaxation, improved mobility and flexibility of the muscle and surrounding connective tissue, general relaxation of the athlete, breakdown of scar tissue, and identification of tight areas before they lead to injury. There is increasing evidence that massage can reduce DOMS. Interestingly, research with horses has shown that massage therapy can increase both range of motion and stride length.

If you can afford massage, it may help you recover more quickly from hard marathon training. To be effective, sports massage should be pleasantly uncomfortable (i.e., it shouldn’t be gentle). It is beneficial to supplement massage sessions with self-massage on tight muscles that can be easily reached, such as the quadriceps, calves, and feet. A variety of tools are available to assist with self-massage, including foam body rollers, massage balls, and roll recovery devices.

There are many different types of massage therapy, and as with any discipline there are wide ranges in expertise among massage therapists. It is best to use a massage therapist who is a member of the American Massage Therapy Association (or a similar national organization in other countries) and has been recommended by other runners so you can be confident that the sessions will be effective.

Foam rolling can be a good form of self-massage.

SLEEP BETTER, RUN FASTER

Getting a good night's sleep is important for recovery and positive adaptation to training. Running generally improves both the quantity and quality of sleep, but overtraining can interfere with sleep patterns. No one knows for sure how exercise leads to improved sleep, but the mechanism may be a change in the balance of sympathetic to parasympathetic nervous system activity. Stimulation of the sympathetic nervous system increases heart rate, blood pressure, metabolic rate, and mental activity, all of which are counterproductive to falling asleep. Parasympathetic activity has the opposite effect. During running, sympathetic activity increases, but endurance training leads to a decrease in sympathetic activity relative to parasympathetic activity when you are not exercising. This alteration in the balance of sympathetic to parasympathetic activity may allow you to fall asleep more quickly and to sleep more deeply.

The benefits of sleep include increased secretion of human growth hormone and improved brain function and memory, immune function, reaction time, and mental health. Sleep improves hypothalamic functioning, which improves recovery and the body's ability to adapt to stress. The benefits of sleep are complex and interrelated; a chronic lack of sleep interferes with your ability to positively adapt to training and compromises marathon performance.

A change in sleeping habits is an early warning sign of overtraining. The physical and psychological stress of training beyond your individual threshold may stimulate the sympathetic nervous system, leading to irritability and reducing the quality and quantity of sleep. A reduction in sleep is a double-edged sword for a runner because much of the body's recovery and rebuilding occurs during sleep. During preparation for your marathon, you should ensure that you get adequate sleep, or you may experience a decline in performance, have immune system suppression, and be more prone to injury.

When you have uncharacteristic difficulty sleeping, you could be training hard too frequently. You may be able to improve your sleep fairly easily by backing off your training and not running too late in the day. The harder you run, the greater the stimulus to your nervous system, so cutting back your training intensity will likely benefit your ability to sleep more than cutting back your mileage.

To improve your sleep pattern, stick with a routine that works for you. Eating dinner and going to bed at approximately the same time each day will help set your body clock so that your body and mind automatically shut down at the same time each night. In addition, avoid the blue light from electronic device screens at night, which affects the sleep-inducing hormone melatonin, and avoid caffeinated or alcoholic beverages for several hours before bedtime. Finally, avoid lying down until you are ready to go to sleep so that when you do lie down your mind receives another signal to ease toward sleep.

A wide variety of personal sleep tracking devices are now available, which provide data such as heart rate, breathing rate, restlessness in bed, REM sleep, temperature, humidity, and heart rate variability. Some are also designed to help you fall asleep and wake up gradually. A number of these measures are not backed up by solid research, but if you love technology and have a few dollars to spare, these devices may help you better understand whether you are getting enough sleep and if not, what to do about it.

Compression Apparel

Do compression tights speed recovery? Probably. Compression tights and compression socks are widely available to wear during training and recovery. Compression apparel applies external pressure to the muscle groups; the most effective products apply graduated pressure, which reduces from the foot or ankle up the leg to the hip. Manufacturers make many claims for the benefits of compression apparel, including improved venous return of blood to the heart, increased lactate flushing, faster muscle repair, and reduced fatigue.

Research on compression clothing is evolving rapidly, but recent evidence suggests that compression tights and knee-high socks are useful for runners in reducing DOMS and perceived fatigue during recovery. Compression socks can also help a traveling marathoner during plane rides because they are particularly useful for reducing stiffness and swollen ankles when flying.

In this chapter, we looked at how ensuring adequate recovery allows you to get the most from your long runs and hard workouts. Successful marathoning, however, often involves more than just running. Just as true recovery days can mean the difference between adequate and optimal progress in your training, supplemental training such as flexibility work and core strength training can help you get the biggest bang for your marathon-training buck.

Chapter 4
Supplementary Training


TONY KARUMBA/AFP/Getty Images

This chapter focuses on several important aspects of training that can make the difference between mediocrity and marathoning excellence. The chapter discusses five types of supplementary training that often get lumped into the category of cross-training but deserve to be treated separately.

First we look at the importance of flexibility for marathon performance and how to improve it. Next we examine core stability training, which is a vitally important aspect of training, particularly for marathoners. Third, we look at why strength training is beneficial for marathoners and how to incorporate it into your overall training program. Then we describe a few technique drills that can improve your running form. Finally, we discuss various forms of aerobic cross-training that will enhance your cardiovascular fitness and reduce your likelihood of incurring injuries.

For the flexibility, core, resistance, and form exercises, we've given a brief explanation of how the exercise in question benefits marathoners. If you have an especially hard time with any of the exercises, you're most likely weak or tight—or both!—in that area. Addressing your most troublesome areas will lead to faster, more enjoyable training and racing. Figure 4.1 provides a diagram of the muscles of the body to use as a reference when performing the stretches and exercises in this chapter.

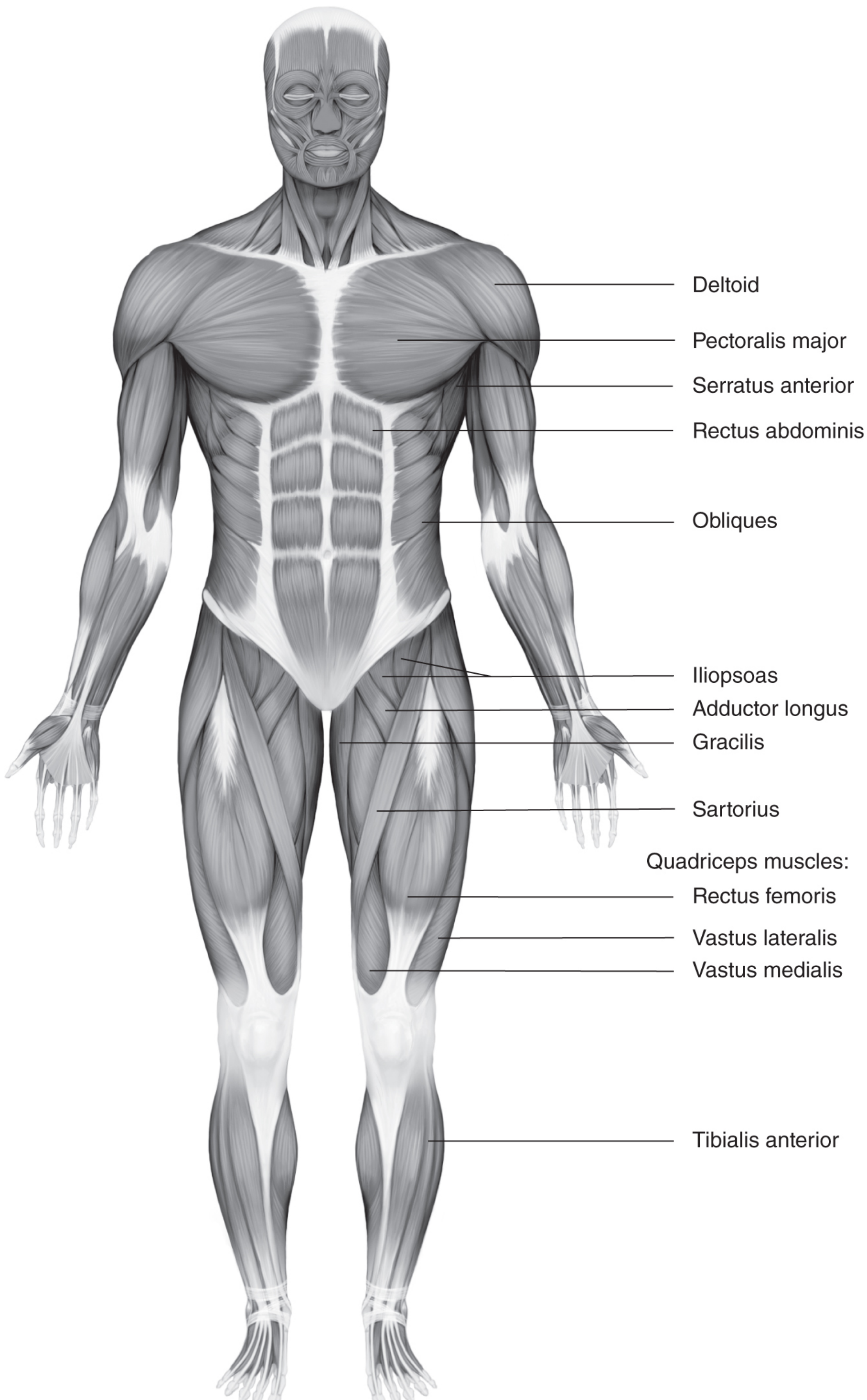


Figure 4.1 Use these diagrams as a reference for locating the muscles worked in the stretches and exercises provided in this chapter.

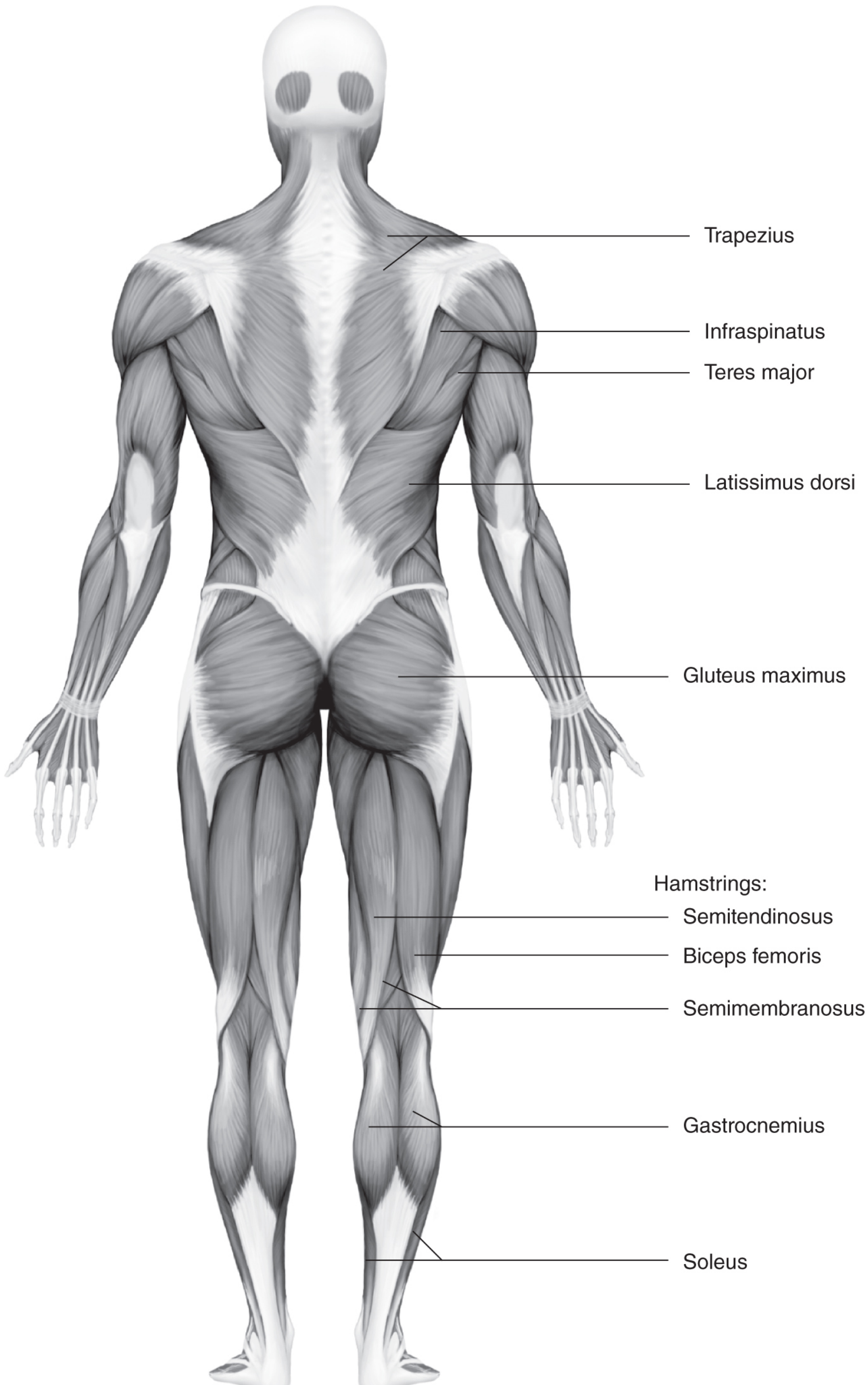


Figure 4.1 *(continued)*

Supplementary work, especially core stability training, form drills, and flexibility exercises, is easy to skip when you're tired and your main training goal is getting in your long runs and tempo runs. These extra sessions, however, will provide refreshing variety to your training. Even more important, correcting imbalances and weaknesses in your body can contribute to better running form. With that improved form, you can train harder and longer at a lower risk of injury, and you will be able to maintain a more effective running technique throughout the marathon. When scheduling your training, count time for these sessions as an integral part of your marathon preparation.

FLEXIBILITY TRAINING

Marathon training takes a toll on the body. One of the greatest costs of all that mileage is a loss of flexibility. Improving your natural range of motion can improve your running technique and increase your stride length while reducing your risk of injury.

Tight muscles provide resistance that limits your ability to stride out. Stretching not only increases your muscle length but also improves the length of the connective tissue surrounding the muscle fibers.

There are two primary types of stretching. In static stretching, you isolate a muscle group and maintain a muscle in a stretched position, typically for 20 seconds or more. In dynamic stretching, you repeatedly move a joint (e.g., your hip) through its range of motion.

Both types of stretching have a place in your marathon training. Dynamic stretching is a good way to stretch muscle groups before the muscles are warmed up, such as before a normal training run. Prerun dynamic stretching increases blood circulation, improves joint mobility, and increases muscle power compared to static stretching or not stretching at all. You can also incorporate dynamic stretching into your warm-up before a workout or a race. Dynamic stretches may be particularly useful for runners who need to get out the door early in the morning because the movements are time efficient and a good way to increase your range of motion after a night in bed.

Static stretching is best performed after running or as part of a supplementary training session. A few static stretches can also be worked in with your dynamic stretching as part of your warm-up. Static stretching lengthens your muscle fibers as well as the connective tissue around and at the ends of your muscle fibers. After running, try to allow a minimum of 10 minutes for stretching your major muscle groups. It would be ideal to do the 24-minute flexibility program in table 4.2 on page 87 after each run, but with busy lives, few runners will devote that much time. For day-to-day postrun maintenance, select the stretches from the program that work on the tightest parts of your body. To achieve gains in flexibility, include the full 24-minute flexibility program two to three times per week.

Prerun and postrun flexibility work can improve your form and reduce your injury risk.

Jeff Zelevansky/Getty Images for Peace and Sport

If you have the time and interest, yoga can be a delightful addition to marathon training, counteracting the impact of high mileage by improving flexibility, core strength, and posture, and helping correct muscle imbalances. There is an array of yoga styles (e.g., hatha, Ashtanga, vinyasa, and power yoga), all suitable for runners. One yoga session per week is probably all you can fit in during marathon training, but it may be the activity that you most look forward to. In our training schedules, yoga can easily fit in a recovery day or general aerobic training day. There are several good runner-oriented apps and videos that will guide you through an at-home program in the likely scenario that you don't regularly have time for an hour-long studio class while marathon training.

PRERUN DYNAMIC FLEXIBILITY ROUTINE

In the dynamic flexibility program in table 4.1, do two sets of each exercise. Perform the first set with a gentle intensity and the second set with a moderate intensity. Don’t stretch forcefully.

TABLE 4.1

Dynamic Flexibility Warm-Up

Exercise	Repetitions
1. Arm cross	10
2. Cat-cow	8
3. Leg swing	15 per leg
4. Side swing	15 per leg
5. Hip circle	10 in each direction
6. Knee hugs	10 each leg (alternating legs), then 5 both legs
7. Side skip	15 in each direction

EXERCISE 1: ARM CROSS

How many: 10
How it helps: Improves flexibility of shoulders and upper back
How to do it:
Start by holding your arms out to the side, then gently swing your arms across your body, keeping them relaxed and even with your shoulders.
Alternate which arm crosses on top with each swing.

EXERCISE 2: CAT-COW

How many: 8
How it helps: Improves flexibility of neck, shoulders, spine, and hips
How to do it:

Get on your hands and knees with your knees under your hips and wrists under your shoulders. Inhale and gently arch your back, lengthening your spine *(a)*.

Pause, then exhale, lowering your head, pulling in your abdominals, and allowing your back to round *(b)*.

Repeat.

EXERCISE 3: LEG SWING

How many: 15 per leg
How it helps: Improves flexibility of hip flexors, gluteals, and hamstrings
How to do it:
Stand next to a wall or other solid object, bracing yourself with one arm.
Swing the leg that is farthest from the wall forward and back through its full range of motion (*a* and *b*).
Face the other way and repeat with the other leg.

EXERCISE 4: SIDE SWING

How many: 15 per leg
How it helps: Improves flexibility of adductors, abductors, and gluteals
How to do it:
Stand facing a wall or other solid object and place your hands against it, about shoulder-width apart.
Start with your feet together about 2 feet from the wall.
Swing one leg side to side through its full range of motion (*a* and *b*).
Repeat with the other leg.

EXERCISE 5: HIP CIRCLE

How many: 10 in each direction
How it helps: Improves flexibility of trunk and hips
How to do it:
Place your hands on your hips with your feet shoulder-width apart and knees slightly bent.
Without moving your feet, slowly rotate your hips and pelvis in a circle.
Repeat by rotating in the other direction.

EXERCISE 6: KNEE HUGS

How many: 10 each leg (alternating legs), then 5 with both legs together
How it helps: Improves flexibility of gluteals, hamstrings, and lower back
How to do it:
Lie on your back. Bring one knee to your chest and wrap your hands around it to pull it closer to your chest. Hold for 3 seconds before lowering leg to the ground.
Repeat with the other leg.
After doing 10 repetitions on each side, bring both knees to your chest and hold for 3 seconds before lowering both legs to the ground.
Repeat.

EXERCISE 7: SIDE SKIP

How many: 15 in each direction

How it helps: Improves flexibility of shoulders, upper back, gluteals, adductors, abductors, and calves

How to do it:

Start with your arms at your side and feet shoulder-width apart.

Skip sideways, clicking the sides of your shoes together *(a)* with each step while swinging your arms up through their full range of vertical motion (like a jumping jack) *(b)*.

Repeat in the opposite direction.

POSTRUN OR SUPPLEMENTARY STATIC STRETCHING ROUTINE

Doing static stretching after a run and as a stand-alone session will help you maintain your flexibility during marathon training. Static stretching should be firm enough to create adequate tension in the muscle but gentle enough that your muscles can relax. If you stretch aggressively, your muscles will tighten in a protective reflex to prevent straining or tearing of muscle fibers. You need to stretch gently and consistently to obtain improved length in the muscle and surrounding connective tissue.

For static stretching, the traditional recommendation is to hold a stretch for at least 30 seconds and to do each stretch once or twice. To strike an optimal balance between effectiveness and efficiency, we recommend holding stretches for 20 to 30 seconds and performing each stretch twice. Start with mild pressure and gradually increase the stretch, staying within your body's limits. If a stretch becomes painful, back off and check that you are using the right technique. Be sure to breathe while you stretch. Some runners inadvertently hold their breath while stretching, thereby reducing the stretch's effectiveness.

Two important areas for marathoners to focus on are the hip flexors and hamstrings. Your hip flexors (primarily iliopsoas and rectus femoris) are the muscles that lift your thigh relative to your hip. These are some of the strongest muscles in the body, and they tend to become short and inflexible in runners. Improving the flexibility of your hip flexors increases your thigh's ability to move back relative to your pelvis, thereby allowing your stride length to increase.

Tight hamstrings restrict your stride length by preventing your thigh from swinging forward completely. The combination of tight hip flexors and tight hamstrings causes the familiar marathoners' shuffle. Stretching your hamstrings consistently (a slow but steady process) will allow your stride to increase to its natural optimal length. The static stretches in table 4.2 will help you improve your flexibility over time.

Program Notes

- Perform two repetitions of each stretch before moving to the next stretch.
- Breathe normally while stretching; don't hold your breath.
- Don't stretch an area that's painful.

TABLE 4.2

24-Minute Static Stretching Flexibility Program

Exercise	Repetitions	Duration
1. Bent-leg calf stretch	2 per side	20-30 seconds
2. Straight-leg calf stretch	2 per side	20-30 seconds
3. Straight-leg hamstring stretch	2 per side	20-30 seconds
4. Lying hamstring stretch	2 per side	20-30 seconds

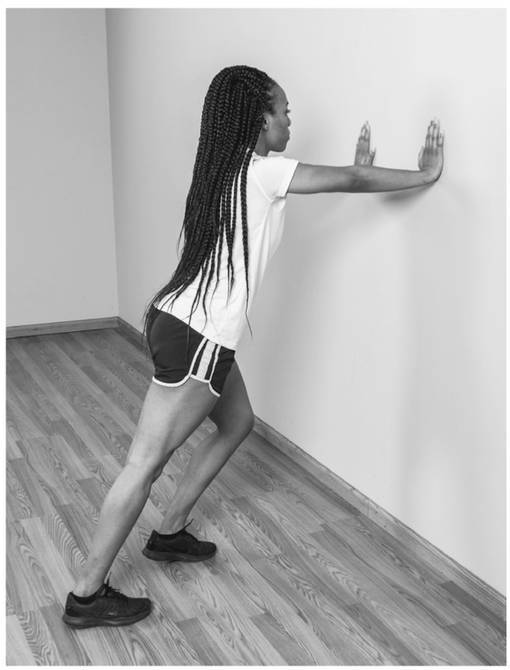
5. Quadriceps stretch	2 per side	20-30 seconds
6. Hip flexor stretch	2 per side	20-30 seconds
7. Gluteal stretch	2 per side	20-30 seconds
8. Hip rotation stretch	2 per side	20-30 seconds
9. Shoulder and lat stretch	2	20-30 seconds
10. Chest stretch	2 per side	20-30 seconds
11. Swiss ball lower back stretch	2	20-30 seconds
12. Downward dog	2	20-30 seconds

EXERCISE 1: BENT-LEG CALF STRETCH

How many: 2 repetitions of 20 to 30 seconds per side
How it helps: Improves flexibility of soleus (deep, lower calf) muscles
How to do it:
Stand an arm's length away from the wall with your feet shoulder-width apart and toes pointing directly forward.
Slide your left foot back so your weight is over your right foot.
Slowly bend your right knee until you feel a stretch in the lower calf muscle.
Repeat on the other side.

EXERCISE 2: STRAIGHT-LEG CALF STRETCH

How many: 2 repetitions of 20 to 30 seconds per side
How it helps: Improves flexibility of gastrocnemius (upper calf) muscles
How to do it:
Stand an arm's length away from a wall with your feet shoulder-width apart and toes pointing directly forward.
Take one step and lean forward so that your hands are flat on the wall.
Keep your back foot flat on the floor and your back knee straight.
Slowly move your hips forward until you feel a stretch in the calf muscle of the back leg.
Repeat on the other side.



EXERCISE 3: STRAIGHT-LEG HAMSTRING STRETCH

How many: 2 repetitions of 20 to 30 seconds per side
How it helps: Improves flexibility of hamstring muscles
How to do it:
Stand just under a leg length away from a bench or other stable object between knee and hip height.
Lift one leg and rest the heel on the bench.
While keeping a slight arch in your lower back and the rest of your back as straight as possible, lean forward until you feel a stretch in your hamstrings.
Repeat on the other side.

EXERCISE 4: LYING HAMSTRING STRETCH

How many: 2 repetitions of 20 to 30 seconds per side
How it helps: Improves flexibility of hamstring muscles
How to do it:
Lie on your back on the floor. Lift one leg up, keeping it relatively straight, and join your hands behind your thigh.
Pull your leg toward you until you feel a stretch in your hamstring muscle.
Repeat on the other side.

EXERCISE 5: QUADRICEPS STRETCH

How many: 2 repetitions of 20 to 30 seconds per side

How it helps: Improves flexibility of quadriceps muscles (major muscles that straighten the knee)

How to do it:

Stand near a wall for balance. Lift your right foot off the floor, bend your right knee, and pull your right heel toward your buttocks until you feel a stretch in the quadriceps.

Don’t lean forward or allow your lower back to arch.

Repeat on the other side.

EXERCISE 6: HIP FLEXOR STRETCH

How many: 2 repetitions of 20 to 30 seconds per side
How it helps: Improves flexibility of hip flexors (muscles connecting front of hip to trunk)
How to do it:
Start in a kneeling position with your knee on a mat or thin pillow, and move one leg forward so that your foot is flat on the floor and your front shin is approximately vertical.
While keeping your upper body vertical and your head up, move your hips forward until you feel a stretch across the front of your hip.
Activating your lower abdominals will adjust where you feel this stretch. You can make this stretch more advanced and effective by using your hand to bring your back leg's heel up toward your buttocks as in the quadriceps stretch.
Repeat on the other side.

EXERCISE 7: GLUTEAL STRETCH

How many: 2 repetitions of 20 to 30 seconds per side
How it helps: Improves flexibility of gluteal and external rotator muscles
How to do it:
Lie on your back on the floor with your knees and hips bent to 90 degrees and feet flat against a wall.
Cross your left ankle over your right knee, and push the inside of your left knee toward the wall until you feel a stretch on the outside of your left hip.
Repeat on the other side.

EXERCISE 8: HIP ROTATION STRETCH

How many: 2 repetitions of 20 to 30 seconds per side
How it helps: Improves hip rotation by stretching gluteals and muscles of the lower back
How to do it:
Lie on your back on the floor, with arms out to the side and legs outstretched.
Lift one leg off the floor, bending it at the knee and hip to 90 degrees.
Rotate the bent leg across your body until you feel a stretch in your hip, torso, and lower back.
Use your hand to push the bent leg across your body and toward the floor.
Keep your head and shoulders in contact with the floor.
Repeat on the other side.

EXERCISE 9: SHOULDER AND LAT STRETCH

How many: 2 repetitions of 20 to 30 seconds
How it helps: Improves flexibility of shoulders, upper chest, and back
How to do it:
Kneel in front of a chair or Swiss ball, or stand in front of a table or countertop, stretch your arms out in front of you, and rest both hands on the surface.
With your upper body horizontal and head looking straight down at the floor, slowly push your chest downward toward the floor until you feel a stretch through your chest, upper back, and shoulders.

EXERCISE 10: CHEST STRETCH

How many: 2 repetitions of 20 to 30 seconds per side
How it helps: Improves flexibility of chest and shoulders
How to do it:
Kneel on the ground with a chair, Swiss ball, or object of similar height positioned beside you. Place one arm on the object, and bend your elbow to 90 degrees.
Keep the other arm on the floor to provide balance and support.
Gently push your upper body toward the floor until you feel a stretch through your chest and shoulder.
Repeat on the other side.
This exercise can also be performed with your arm straight.

EXERCISE 11: SWISS BALL LOWER BACK STRETCH

How many: 2 repetitions of 20 to 30 seconds
How it helps: Improves flexibility of lower back and abdominal muscles
How to do it:
Sit on the Swiss ball, with your feet flat on the floor.
Slowly roll your hips forward over the ball and lean back so you're lying over the ball. You should feel a gentle stretch in your lower back and abdominal muscles.
Reach above your head only as far as is comfortable.

EXERCISE 12: DOWNWARD DOG

How many: 2 repetitions of 20 to 30 seconds

How it helps: Lengthens spine and improves flexibility of shoulders, hamstrings, and calf muscles

How to do it:

Kneel down and lean forward with your arms outstretched and your hands pressed firmly against the floor *(a)*.

Slowly lift your hips in the air by straightening your knees until you feel a stretch in your hamstrings *(b)*. Depending on your level of flexibility, you might not be able to get your legs completely straight.

Keep your back straight and your head down throughout the stretch, as shown.

Rising up and down onto the toes while in the downward dog position alters the stretch in the hamstring and calf muscles.

CORE STABILITY TRAINING

Long-distance running develops muscular endurance in specific leg and hip muscles and is wonderful for your cardiovascular system, but it tends to make some muscles strong and tight while others remain weak. Modern lifestyles exacerbate these problems. Sitting for much of the day tightens the hip flexors, weakens the hip muscles and abdominals, and deactivates the gluteal muscles, all of which lead to poor posture and, frequently, lower back pain. Sitting with poor posture puts pressure on the lumbar discs, shifts the head forward, and rotates the shoulders. Sitting in a car has the same effect, so individuals with a desk job and a long car commute have a double challenge. Hunching over your phone also tends to round your shoulders and move your head forward. None of this is helpful for marathon runners, who depend on a stable core to maintain good running form for 26.2 miles (42.2 km).

Core stability training can eliminate these imbalances, thereby preventing injuries and reducing the degree to which your form deteriorates as you fatigue during the marathon. Core stability training consists of strengthening your abdominal, hip, lower back, and gluteal muscles using a series of exercises. Core stability exercises can be done in the comfort of your own home—you don't need a gym or machines, just the dedication to stick with the exercises.

When you run, your trunk acts as a fixed base while your legs work as levers relative to that base to propel you forward. If the torso and pelvic muscles that form your fixed base are weak or fatigue quickly, you can't maintain an efficient body position while running. By improving the strength and muscular endurance of your pelvis and torso, you provide a more stable base of support from which your legs work. This improvement will allow you to maintain your stride length throughout the marathon; part of the reason that many marathoners slow as the race progresses is that their stride shortens as they tire.

In addition, runners who lead an otherwise normal modern life often have weak abdominal muscles. This weakness allows the pelvis to rotate forward and put more stretch on the hamstrings. This is a less efficient position for your running and also increases your risk of lower back problems. Core stability exercises strengthen the abdominal muscles and work on other stabilizer muscles of the pelvis and trunk. By improving the position of your pelvis, you create a more stable base.

Core stability work is part of elite marathoners' training the world over. Those who don't do core training have become the exception. Some elites do short sessions of core training most days of the week. Others do longer sessions a few days per week. The results can be seen both in their low incidence of injury and in their late-race form, which varies little from the form they exhibit in the early miles.

For marathoners with busy nonrunning lives, aim to do core stability training three times per week. It can fit in anywhere within the week other than immediately before a hard running workout, so schedule your core sessions whenever you are most likely to do them.

Following are two core strength training programs. The first program (table 4.3) contains basic exercises for runners who don't have much experience with core conditioning. The second program (table 4.4, beginning on page 98) is more advanced and includes more difficult exercises. For optimal results, do one of these programs three times per week. If you don't want to do the whole program, select at least a few from this list that target your weakest areas.

In some of the exercises, a key step is to activate your transverse abdominal muscles (TVAs). The TVAs are located deep within the abdominals and wrap around the front of your trunk like a corset, providing stability to the spine. It is important to be able to isolate and activate the TVAs; for most people, doing so requires conscious practice. To activate your TVAs, gently draw your belly button in toward your spine while exhaling slowly as if trying to hollow out your belly.

TABLE 4.3

Basic Core Strength Session

Exercise	Repetitions
1. Abdominal squirm	20, alternating sides
2. Leg pushaway	20
3. Hip bridge	6 of 5 seconds each
4. Bird dog	10 per side

5. Prone plank	4 of 5-15 seconds each
6. Alphabets	1 per leg

Perform this sequence of exercises twice.

Program Notes

- Perform these six exercises as a circuit. That is, do one set of the first exercise, then move immediately to the second exercise, then the third, and so on. When you have completed the sixth exercise, return to the first exercise and complete a second circuit.
- Rest briefly (15 to 20 seconds) between exercises and 1 to 2 minutes between sets.

EXERCISE 1: ABDOMINAL SQUIRM

How many: 20 repetitions, alternating sides

How it helps: Strengthens abdominal muscles (i.e., six-pack abs), which contribute to force production and running speed; strengthens obliques, which reduces excess side-to-side motion; increases ability to maintain a level pelvis

How to do it:

Lie on your back with your knees bent and feet flat on the floor. Place your arms on the floor by your sides *(a)*.

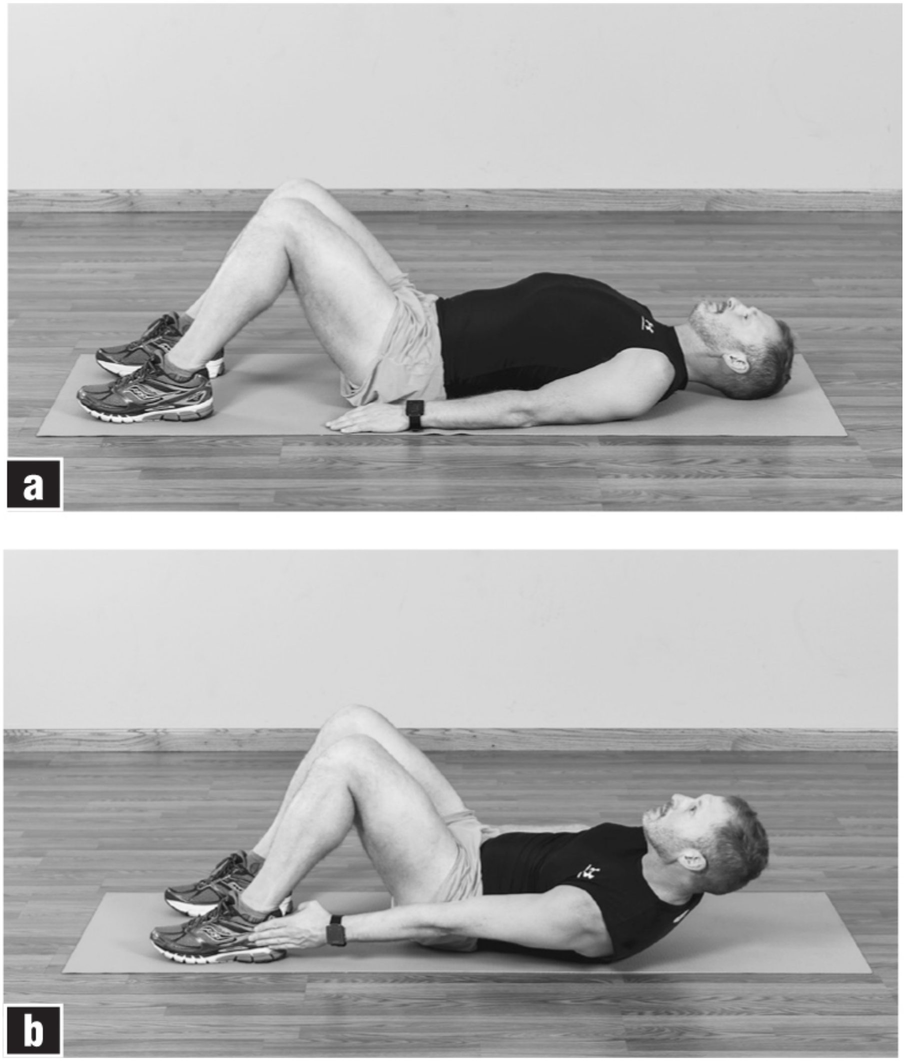
Draw your belly button in to activate your TVAs.

Lift your head, shoulders, and upper back until they are just off the floor.

Slide your left arm and body along the floor toward your left foot as though you are trying to touch your left ankle *(b)*.

Return to the start position.

Repeat on the right side.


a
b

EXERCISE 2: LEG PUSHAWAY

How many: 20 repetitions

How it helps: Improves ability to activate the deep core muscles for better control of the hips and trunk; improves stability and ability to maintain effective running technique

How to do it:

Lie on your back with your knees bent and feet flat on the floor.

Position your arms next to your body as shown *(a)*.

Draw your belly button in to activate your TVAs and engage other lower abdominal muscles.

While holding this lower abdominal contraction, don't hold your breath; make sure you can inhale and exhale normally.

Slowly lift one foot off the floor, and raise it until your thigh is vertical *(b)*.

Return to the start position, and repeat with the opposite leg.

Your goal during the exercise is to maintain the lower abdominal contraction as you move your legs up and down so your back does not arch and your hips do not move.


a


b

EXERCISE 3: HIP BRIDGE

How many: 6 repetitions of 5 seconds each
How it helps: Strengthens hips, lower back, gluteals, and hamstrings to allow full hip extension and a longer stride
How to do it:
Lie on the floor with your knees bent and your feet together *(a).*
Place your arms flat on the floor by your sides to provide balance.
Raise your hips off the ground as shown so that your body is in a straight line from your shoulders to your knees *(b)*.
Hold for 5 seconds, lower your body to the ground, rest briefly, and repeat.

EXERCISE 4: BIRD DOG

How many: 10 repetitions per side

How it helps: Strengthens lower back and gluteals; improves balance and coordination, thereby increasing the ability to maintain good running posture when fatigued

How to do it:

Kneel on your hands and feet. Draw your belly button in to activate your TVAs *(a).*

Lift one arm and the opposite leg off the floor as shown *(b)*, hold for 2 or 3 seconds, then return to the floor and repeat with the opposite side.

Aim to bring the arm and leg to a horizontal position when you lift them and keep your hips aligned.

EXERCISE 5: PRONE PLANK

How many: 4 repetitions of 5 to 15 seconds each

How it helps: Engages most core muscles; decreases undesirable lateral midsection movement when running to maintain optimal running technique

How to do it:

Lie facedown with your weight supported on your toes and forearms. Your elbows should be shoulder-width apart and directly under your shoulders, your feet slightly apart, and your TVAs activated.

Maintain your head in alignment with your spine. (Don't look ahead or to the side.)

Hold this position for 5 to 15 seconds, drop your knees to the floor, rest briefly, and repeat.

EXERCISE 6: ALPHABETS

How many: 1 repetition per leg

How it helps: Improves balance and proprioception; strengthens foot and gluteal stabilizing muscles; improves ankle mobility

How to do it:

Stand barefoot on one leg. Lift the other leg a few inches off the ground.

Trace the letters of the alphabet in the air while balancing on one leg (*a* and *b*). (You can lightly hold on to a chair or gently touch a wall if you are struggling to maintain your balance.)

Repeat on the other side.

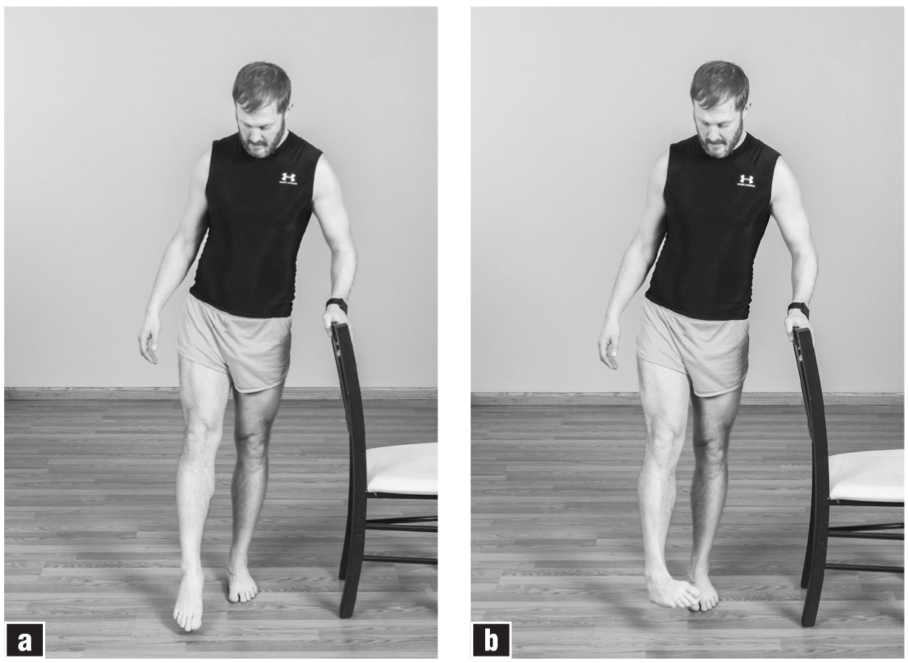


TABLE 4.4

Advanced Core Strength Session

Exercise	Repetitions
1. Leg pushaway (advanced)	20
2. Staff	6 of 5 seconds each
3. Standing knee hold	12
4. Back extension	12
5. Side plank	5 of 10 seconds each per side
6. Single-leg squat	12 per leg

Perform this sequence of exercises twice.

Program Notes

- Perform these six exercises in a circuit. That is, do one set of the first exercise, then move immediately to the second exercise, then the third, and so on. When you have completed the sixth exercise, return to the first exercise and complete a second circuit.
- Rest briefly (15 to 20 seconds) between exercises and 1 to 2 minutes between sets.

EXERCISE 1: LEG PUSHAWAY (ADVANCED)

How many: 20 repetitions

How it helps: Improves ability to activate the deep core muscles for better control of the hips and trunk; improves stability and ability to maintain effective running technique

How to do it:

Lie on the floor with your knees and hips bent at 90 degrees so your thighs are vertical and your feet are off the ground. Place your hands on your hips. Draw your belly button in to activate your TVAs, contract your lower abdominal muscles, and push your lower back toward the floor *(a)*.

While holding this lower abdominal contraction, make sure you can breathe normally.

Slowly lower and extend one leg until your heel almost touches the floor *(b)*.

Return to the start position and repeat with the opposite leg.

EXERCISE 2: STAFF

How many: 6 repetitions of 5 seconds each

How it helps: Engages most core muscles; improves coordination between upper body and core muscles to keep shoulders and hips in optimal position to maintain running speed

How to do it:

Start in the push-up position with your hands shoulder-width apart. Draw your belly button in to activate your TVAs.

Lower your body until your elbows are next to your rib cage.

Hold this position for 5 seconds, then push your body back up to the start position.

Rest briefly and repeat.

Try to maintain a flat body position, and don't allow your hips to sag.

EXERCISE 3: STANDING KNEE HOLD

How many: 12 repetitions

How it helps: Strengthens knee and ankle-stabilizing muscles and improves single-leg balance; helps reduce wasted motion in running form; increases stride length

How to do it:

Stand with feet shoulder-width apart and arms by your sides.

Lift one foot off the floor and pull your knee up toward your chest.

Hold this position for 5 seconds, then repeat with the other leg.

EXERCISE 4: BACK EXTENSION

How many: 12 repetitions

How it helps: Strengthens lower back; increases ability to maintain good running posture when fatigued

How to do it:

Lie facedown on the floor with your arms straight out in front of you. Your eyes should be looking at the floor. (This keeps your neck in alignment with your spine.)

Lift your chest and shoulders off the floor, hold for 1 or 2 seconds, then return to the floor and repeat.

EXERCISE 5: SIDE PLANK

How many: 5 repetitions of 10 seconds per side

How it helps: Strengthens stabilizing muscles on your side from gluteals through shoulders; helps reduce wasted side-to-side motion

How to do it:

Lie on the floor on your side. Place your elbow on the floor directly under your shoulder and place your top hand on your hip *(a)*.

Hold your feet together, and align your body in a straight line (from front to back) from your heels to your shoulders. Draw your belly button in to activate your TVAs.

Lift your hip off the floor and hold for 10 seconds *(b)*.

Lower to the floor, rest briefly, and repeat on the other side.

EXERCISE 6: SINGLE-LEG SQUAT

How many: 12 repetitions per leg

How it helps: Strengthens the gluteal muscles and quadriceps; strengthens the stabilizing muscles of the foot and ankle

How to do it:

Stand sideways on a stair with one leg near the edge of the stair and the other leg hanging just over the edge *(a)*. Draw your belly button in to activate your TVAs.

Slowly squat down so the knee of the supporting leg reaches an angle close to 90 degrees while the hanging leg moves down toward the stair below *(b)*.

The hanging leg may need to bend slightly so as not to touch the stair below.

Make sure the knee of your supporting leg does not move over the front of your toes.

Slowly come back up to your starting position and repeat.

STRENGTH TRAINING

Resistance training using weights, bands, or your own body weight can correct muscle imbalances and prevent injuries. We've already discussed core stability training, a type of resistance training with a specific purpose. Other types of resistance training will strengthen your leg muscles and get your arms and shoulders, which help drive you forward, working more effectively. Done correctly, resistance training can reduce your risk of injury by strengthening both muscles and connective tissue, including tendons and ligaments, and may improve your running economy so you use less oxygen at a given pace. Done incorrectly, it can make you muscle-bound, tighten up your muscles, leave you injured, and give you extra bulk that you might not want to be carrying around come the 23-mile mark. The program outlined on the following pages is designed to increase your strength without adding unwanted pounds.

The greatest gains for marathoners are obtained by including exercises that strengthen your propulsive and stabilizing muscles. The closer those exercises simulate how you would use those muscles during running, the greater the benefits for your running performance.

Schedule your resistance training sessions so they're not right before or after a hard running workout. If you run before or after work, lunchtime is an excellent opportunity to get in lifting sessions that won't detract from your running.

Lifting for the Long Run

Most runners naturally use the most economical stride length for a given speed, which implies that runners shouldn't alter their stride length. That advice is correct for the short term, but that doesn't mean you can't or shouldn't attempt to improve your body to make it a more effective running machine. Over months and years, you can increase your stride length by improving your strength and flexibility. The gains per stride will be small, but when multiplied over thousands of strides, the benefits can be substantial.

Resistance training can improve running performance by increasing the force that your slow-twitch muscle fibers develop. Lifting to increase muscle size is counterproductive to endurance (and particularly marathon) performance. During endurance training, you work to increase the capillary density and mitochondrial content of your muscles. When muscle size is increased, the capillary and mitochondrial density of the muscle is reduced. It's important, therefore, that you design your resistance training to avoid gains in muscle size. The program that follows is designed to improve strength specifically for your running without adding unneeded muscle.

Resistance training generally should be included in your training program two times a week. (See table 4.5 for a sample session.) With this frequency you will see steady improvements in strength but will not compromise the rest of your training program because of excess fatigue. Core stability training can be done as a warm-up before your strength training session. The best place to fit resistance training into your weekly schedule is whenever your muscles are not too fatigued and you do not have a hard running workout later that day or the next day. General aerobic training days and medium-long run days often work well for your resistance training sessions.

Program Notes

- A gentle aerobic warm-up or completing your core strength program will enhance the safety and effectiveness of this program.
- Activating your TVAs by gently drawing your belly button in will provide stability to the spine and decrease the likelihood of injury while performing these exercises.

RUNNING UPHILL: NATURE'S RESISTANCE TRAINING

If lifting weights isn't for you, try another form of resistance training—hill running. During hill running, your body weight is the resistance. There is some evidence that running hills can produce improvements in running economy similar to those that occur through normal resistance training. Of course, traditional strength training and hill running don't produce identical results. You'll still want to include upper-body resistance exercises as part of your supplementary training program.

Running uphill requires that your legs propel your body weight upward against gravity. Moreover, they do so under conditions that more closely replicate racing conditions than does even the most well-designed weight machine. Anecdotal evidence for the benefits of hill running comes from the Kenyan and Ethiopian runners of today and goes back to coaching legend Arthur Lydiard and the great New Zealand runners of the 1960s and 1970s. The best runners in the world run hills day after day. Of course, genetic factors separate elite runners from recreational runners, but it certainly appears that hill training is an important element that, unlike your genes, you can influence.

An advantage of hill running over lifting weights is that you simultaneously build your cardiovascular system. As discussed in chapter 1, doing short hill reps of 10 to 12 seconds on a moderately steep hill will build muscle strength and power, and should improve your running economy. Short hill reps are discussed further in chapter 8 and included in the training schedules.

TABLE 4.5

Strength Training Session

Exercise	Repetitions
1. Push-up	10
2. Step-up	15 per leg
3. Dumbbell lateral row	15 per side
4. Calf raise	10
5. Bench dip	15
6. Lunge	15 per leg
7. Triceps press	15
8. Squat	15

Perform this sequence of exercises twice.

EXERCISE 1: PUSH-UP

How many: 10 repetitions

How it helps: Strengthens the chest, shoulders, and triceps; helps improve arm drive when running powerfully (e.g., hills, finishing kick) and ability to maintain good upper-body form when tired

How to do it:

Start in the push-up position with your toes on the floor and your hands slightly wider than shoulder-width apart *(a)*.

Bend your elbows and lower your body down until your chest is just above the floor *(b)*.

Push your body back to the start position.

Don’t dip your head toward the floor or allow your hips to sag during this exercise.

Your elbows should remain close to your sides to ensure your triceps are working.

EXERCISE 2: STEP-UP

How many: 15 repetitions per leg

How it helps: Strengthens the calves, quadriceps, hamstrings, and gluteals; opens up the chest and encourages an upright running posture; improves balance and increases the forward power of each stride, increasing stride length

How to do it:

Stand approximately one step back from a bench (or chair or flight of stairs).

Place one foot up on the bench, with the whole of the foot flat on the surface of the bench.

Rise up onto the ball of the foot on your back leg, and keep your head up; this is the start position for every repetition *(a)*.

Using your front leg as much and your back leg as little as possible, step up onto the bench, and finish in a standing position with feet together *(b)*.

Try to keep your upper body erect, and don't lean forward more than necessary.

Carefully step back off the bench, and repeat with the other leg.

EXERCISE 3: DUMBBELL LATERAL ROW

How many: 15 repetitions per side

How it helps: Strengthens large muscles along the side of the upper back; improves running posture by balancing strength of the chest and shoulder muscles

How to do it:

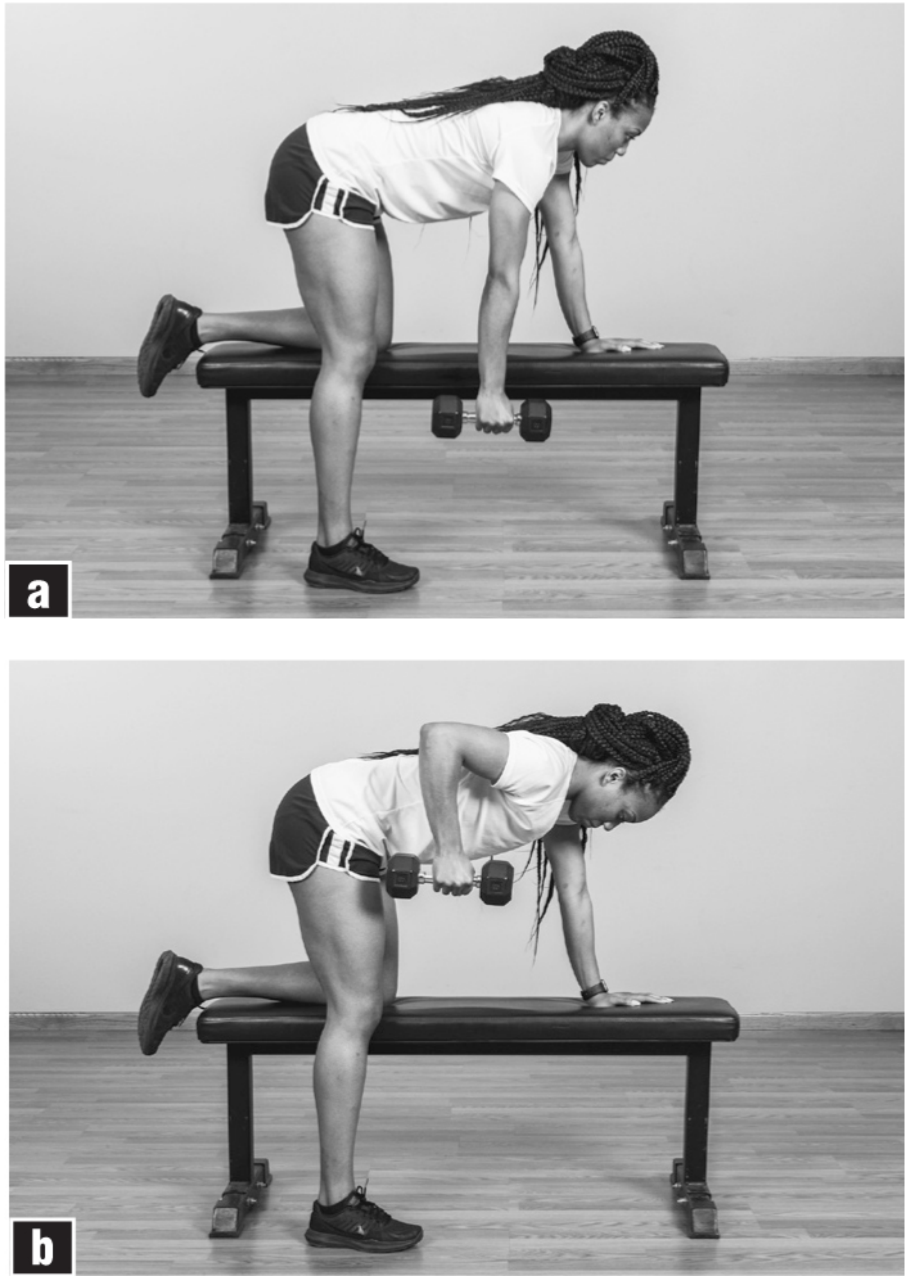
Place your left knee on a bench, with your left hand also on the bench to provide balance and support.

Bend forward so your upper body is approximately horizontal.

Hold a light dumbbell in your right hand, with your arm hanging straight *(a).*

Pull the dumbbell upward, with your elbow passing beside your ribs *(b)*.

Lower the dumbbell back to the start position, and repeat.


a
b

EXERCISE 4: CALF RAISE

How many: 10 repetitions

How it helps: Strengthens calf muscles and Achilles tendon; improves the toe-off phase of the stride; reduces injury risk

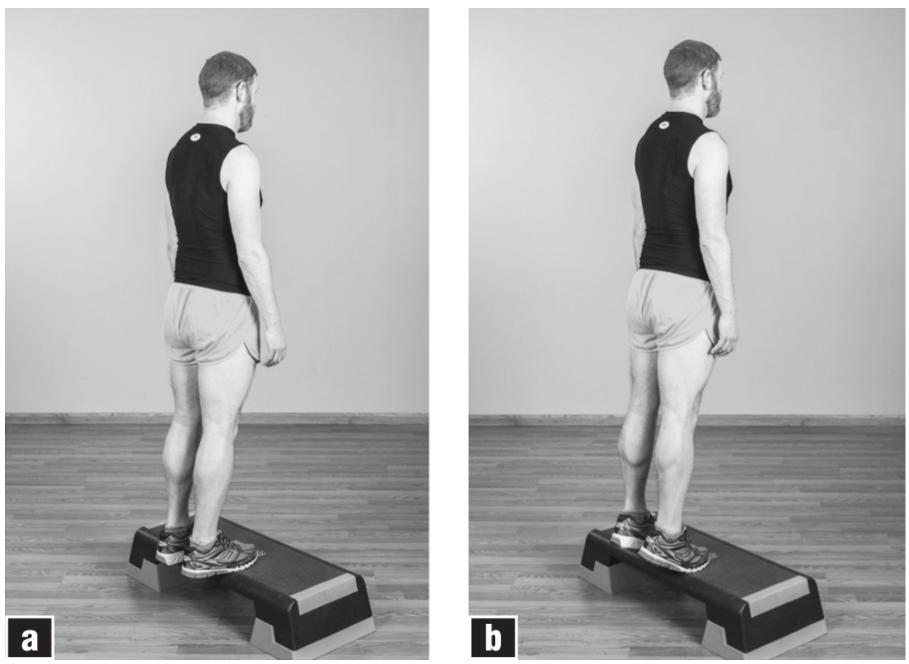
How to do it:

Stand on the edge of a stair or stable box with your heels hanging over the edge *(a)*.

Lower your heels slowly toward the floor until you reach the end of your comfortable range of motion.

Rise up onto your toes, bringing your heels upward *(b)*. Repeat.

Note: To make this exercise harder and work your calf eccentrically, lower yourself slowly down on one leg and then rise up using both legs.



EXERCISE 5: BENCH DIP

How many: 15 repetitions

How it helps: Strengthens shoulders and arms; increases ability to maintain upright running posture when tired

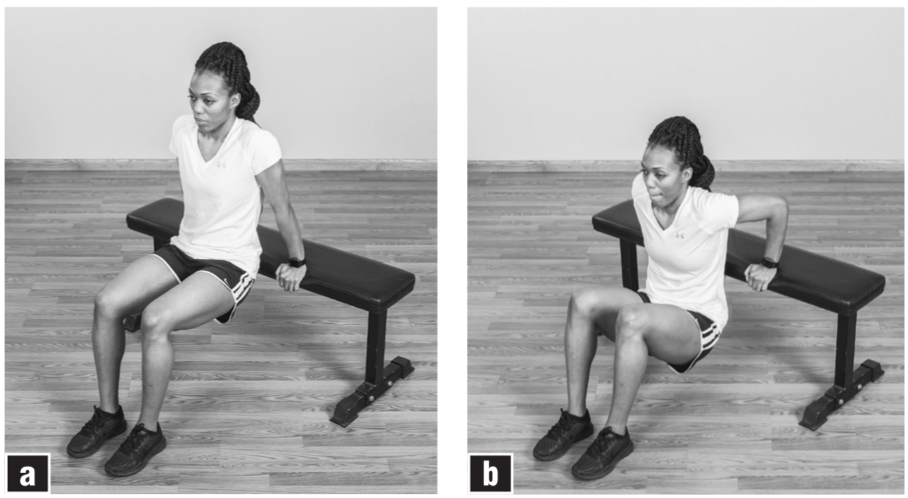
How to do it:

Place your hands on a bench or chair, with your feet flat on the floor and your hips just off the edge *(a)*.

Lower your hips straight down toward the floor by bending the elbows *(b)*.

Push back up to the start position, and repeat.

To make the exercise more difficult, move your feet farther away from the bench.



EXERCISE 6: LUNGE

How many: 15 repetitions per leg

How it helps: Strengthens quadriceps, hamstrings, and gluteals; improves balance between left and right legs; helps develop ability to control the large forces through the legs and maintain form while running downhill

How to do it:

Stand with your feet shoulder-width apart and toes pointing straight ahead.

Hold two light dumbbells (no more than 10 pounds [5 kg]) by your sides, and keep your upper body vertical, with your head up *(a)*.

In one movement, take a big step forward, and lower your back knee toward the floor *(b)*.

Push powerfully back off the front leg so you return to a standing position.

Perform the next repetition with your other leg.

EXERCISE 7: TRICEPS PRESS

How many: 15 repetitions

How it helps: Strengthens muscles along back of upper arms; helps maintain relaxed arm action when fatigued

How to do it:

Stand or sit holding one light dumbbell above your head with both hands *(a)*.

While keeping your upper arms vertical, bend at the elbows and lower the dumbbell behind your head as shown *(b)*.

Return to the start position, and repeat.

EXERCISE 8: SQUAT

How many: 15 repetitions

How it helps: Strengthens lower back, calves, quadriceps, hamstrings, and gluteals; improves ability to keep the knee in good alignment with the hip and ankle, which reduces injury risk and improves running efficiency; also helps develop triple extension (ankle, knee, and hip), which is an important feature of good running technique

How to do it:

Stand with your feet shoulder-width apart and toes pointing straight ahead.

Hold a light dumbbell with both hands under your chin *(a)*.

Initiate the squat by moving your hips backward as if you were sitting down on a seat.

As you push the hips backward, you'll be forced to lean forward slightly to keep from falling over.

Lower your body without losing your balance until the tops of your thighs are horizontal *(b)*, then return to a standing position.

During the movement, keep your head up and eyes looking ahead. Make sure that your knees are aligned with your feet and stay the same distance apart throughout the exercise.

RUNNING FORM DRILLS

Your running style is determined by your biomechanics, including the length of your bones, your muscle and tendon flexibility, the strength and endurance of various muscles, and the coordinated contraction pattern of your muscles and the resulting movement of your limbs. Because everyone has a unique physical makeup, there is no ideal or perfect form.

By performing the flexibility and strength training exercises outlined earlier in this chapter, you balance your body to improve your running form and the ability to maintain form during the marathon. Stride length, for example, is almost always determined naturally by your physiological makeup and is best improved by increasing strength and flexibility. Other examples include excessive forward lean at the waist, which can be overcome by strengthening the gluteal and abdominal muscles, and trunk instability, which can be improved through the core exercises provided in this chapter.

But there's something else you can do to improve your form. You've probably seen sprinters doing various combinations of high-knee running, butt kicks, skipping, and so on. Several of these drills are great for distance runners too. First, these exercises can improve your coordination and running form. Second, they lead to gains in strength endurance that allow you to maintain your stride length throughout a race. Drills up a moderate slope provide even greater resistance. By concentrating on a high-knee lift; a complete toe-off; good arm drive; a relaxed neck with the head positioned over the body; relaxed shoulders, arms, and hands; minimal vertical movement (not bouncing with each stride); and an upright posture (not leaning too far forward), you will improve your ability to hold good running form and maximize your running efficiency. When you consider how even a slight flaw in your form will be magnified over the course of a marathon, and when you add the likely scenario of your form, no matter how good, faltering in the last few miles of a marathon, it should be clear that working on your running technique can help you be a faster marathoner.

When doing drills, the key is to exaggerate various aspects of the running stride and to concentrate on maintaining your form as you begin to fatigue. This attention to different parts of the running gait will over time become ingrained and pay dividends late in your marathon.

There are endless drills you could do; we've selected four that will significantly help your marathoning. They'll help you maintain your stride length and lessen your ground-contact time, two aspects of running form that can deteriorate with lots of relatively slow marathon training.

Do drills when you are warmed up but still fresh—there is no use trying to improve your coordination and technique when you are already tired. You'll notice benefits if you do them regularly—at least once, and preferably twice, per week. A good way to incorporate drills easily into your routine is to do them before a session of strides and before harder workouts such as tempo runs and $\dot{V}O_2max$ sessions.

Perform the drills as a circuit; that is, do one repetition of each, and then repeat the sequence. Do one repetition of each drill for 15 to 20 meters, and rest before the next one by walking back to the starting point. Visualize yourself completing the drill perfectly.

SKIP MARCH WALK

How to do it:
Begin by walking slowly forward on the balls of your feet using small steps.
Raise one knee to hip level so your thigh is parallel to the ground.
Rise on the toes of the other foot, straightening your back leg.
Your trunk should be held upright, with your chest out and shoulders back.
Keep your head still and neck relaxed.
Swing your arms forward and back in an exaggerated running motion.
Keep your shoulders, arms, and hands relaxed.

SKIP MARCH RUN

How to do it:

Adopt the same start posture as for skip march walk.

Follow the same movements as for skip march walk, but increase your leg and arm drive to a more exaggerated skipping motion.

KICKOUT

How to do it:

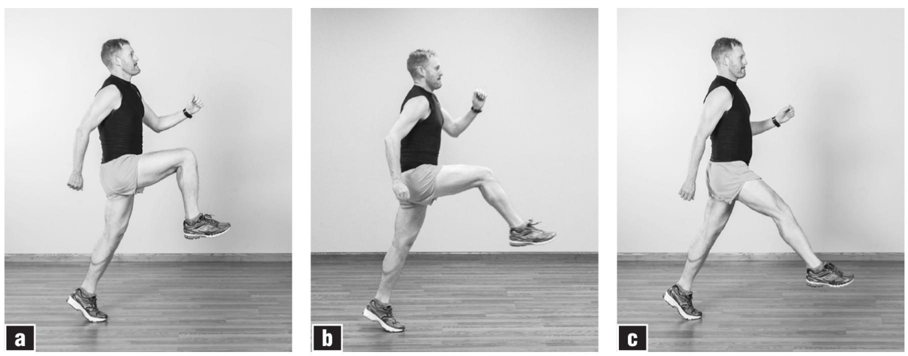
Walk forward slowly on the balls of your feet.

Raise one knee *(a)*, and as the knee approaches hip level, straighten the knee to nearly full extension. (Your leg will end up nearly horizontal.)

Allow your momentum to carry your body forward *(b)*, and hop on your back leg before stepping forward *(c)* to repeat with the other leg.

Hold your trunk upright with your head still and your arms swinging forward in a normal running motion.

As you become more adept at the movement over time, progress from walking to jogging while performing the kickouts.



FAST FEET

How to do it:
In this drill, you run by taking short steps as quickly as possible.
Stay on the balls of your feet at all times, and use a rapid arm movement.
Don’t lean too far forward.
Try to keep your trunk upright and your head still.

AEROBIC CROSS-TRAINING

Predictable training errors such as increasing mileage or adding speed work too quickly lead to the majority of running injuries. Just as the risk of coronary artery disease can be reduced through regular exercise, so can the risk of running injuries be reduced through modifying risk factors. One way to do this is to reduce pounding on your legs and back by substituting cross-training for a portion of your running.

The primary reason to cross-train is to provide additional cardiovascular fitness without increasing the repetitive wear and tear associated with running. Cross-training indoors can also be useful when the weather or pollution levels prevent you from running outside. Unfortunately, many runners cross-train only when injured and then return exclusively to running as soon as the injury recovers. Sure, cross-training is highly effective for maintaining fitness during times of injury, but that shouldn't be the only time most runners do it. If you're careful about increases in mileage and intensity, the surfaces you run on, and so on, and you still can't consistently reach the level of weekly mileage you'd like, you should incorporate cross-training into your training program year-round.

No form of cross-training is a perfect substitute for running because your body adapts very specifically to training. Though you will gain cardiovascular benefits from cross-training, your neuromuscular system will not make equivalent gains because the movement patterns are different. That's OK, however, because cross-training should be viewed as a supplement to, not a replacement for, your running. Use cross-training in place of recovery runs and, if necessary, in place of a portion of your general aerobic conditioning. The advantage of using it for recovery training is that the increased blood flow improves your recovery without increasing the cumulative impact forces on your body.

Apples and Oranges?

But won't your racing performances suffer if you replace some of your running with cross-training? The specificity-of-training principle states that your body adapts very specifically to the type of training you do. That's why you won't have much success as a runner by doing all your training on the bike or in the pool. But if the majority of your training is running, you can enhance your running performance by doing other types of aerobic workouts.

Scientific evidence suggests that reasonably well-trained runners can improve their running performance through cross-training, but the improvement is likely to be less than through increased running.

Cross-training activities that work the large muscle groups of the legs (e.g., cycling, elliptical training, deep-water running, and cross-country skiing) are most similar to running and should lead to the greatest improvements in performance. Activities less similar to running (e.g., rowing) will likely lead to smaller improvements in running performance.

Although the evidence suggests that cross-training can lead to improved performance in moderately trained or even well-trained runners, no scientific evidence exists concerning cross-training for elite runners, and the specificity-of-training principle likely becomes more critical the higher the level of performance. Over the past decade, however, increasing numbers of elite runners, particularly those with a history of previous injury, have made aerobic cross-training part of their regular training routine.

For the majority of runners, it appears that if you increase your training volume by cross-training, you can improve your running performance. The improvement, however, won't be as large as if you had increased your mileage. This point goes right to the heart of the mileage versus injury trade-off. Sure, you would improve more by increasing your running, but you would also increase your risk of injury. The challenge for marathoners is to manage that trade-off by running as much as you can handle before the risk of injury shoots up. After all, being able to train consistently without time off due to injury will enhance your performance far more than another recovery run.

Four ways to cross-train that have reasonably similar movement patterns to running and should transfer to improvements in performance are cycling, deep-water running, cross-country skiing, and using an elliptical trainer or elliptical bike. Let's look at the benefits of these types of cross-training for marathon runners. We'll also discuss swimming; although it doesn't closely simulate running, it works the cardiovascular system and is an excellent whole-body exercise.

Cycling

Cycling offers many options in that you can ride a bike outdoors, use your bike on a wind trainer indoors, or use an exercise bike at home or at a gym. An advantage of cycling is that it works the cardiovascular system while eliminating the impact forces that cause most running injuries. You can therefore add cycling to your training program with little risk of bringing on typical running injuries. An advantage of cycling compared with other cross-training options is that you get to cover ground and feel the wind in your hair, just as in running.

The downsides of cycling are the risk of getting squashed by a car, the large amount of time required compared with running, and the risk of decreasing your stride length. The first downside is all too possible, particularly for runners with good cardiovascular fitness but poor bike-handling skills. In a low-traffic area, cycling outdoors is a great option, but if you're limited to cycling in an urban area without bike paths, you may want to stay with the more boring indoor options.

Riding indoors can be a surprisingly satisfying experience because you can concentrate on your workout without distractions or dangers such as traffic lights and cars. During times of injury, an indoor bike can also be used for higher intensity training, such as lactate-threshold (LT) or $\dot{V}O_2max$ training. If a long-term injury puts you on the bike for multiple weeks, there are many workout apps and simulators to help pass the time productively.

Meb Keflezighi

Fastest marathon: 2:08:37 (Boston, 2014)

Marathon highlights: 1st place, 2014 Boston Marathon, 2012 Olympic Marathon Trials, and 2009 New York City Marathon; silver medal, 2004 Olympic Marathon

Meb Keflezighi is the only runner in history to win the New York City and Boston marathons and an Olympic marathon medal. What makes this accomplishment even more striking is its timespan: Keflezighi won Olympic silver in 2004, New York City in 2009, and Boston in 2014, the last title coming just two weeks before his 39th birthday. Keflezighi's marathon career is a testament to aiming high and believing in yourself while making necessary adjustments along the way.

Jerod Harris/Getty Images for Rock 'n' Roll Marathon Series

Keflezighi usually ran championship-style marathons, where place mattered more than time. (We're including the quirky-course New York City and Boston races in that category.) So his relatively modest personal best can be misleading when you consider how often he beat men who had run a marathon minutes faster. He believed that on a good day he could run with anyone in the world. His record shows that was a sound belief—Keflezighi regularly placed near the top of races in which several entrants had significantly faster personal bests than him.

Consistency was a Keflezighi specialty. He ran nine sub-2:10 marathons, the most by an American, and in the 25 marathons he finished, he averaged 2:12:52. Keflezighi was also consistent in that he toed the line year after year, from his debut in New York City in 2002 until retirement at the 2017 edition of the race. Only in one year during that time, 2008, did injury keep him from running at least one marathon.

One key to Keflezighi's longevity was his approach that it's better to be a little undertrained than overtrained. Keflezighi definitely trained hard, but any one day, or even week or month, would have been doable by slower runners. Keflezighi steadily built fitness with cornerstones of moderate-pace long runs, long tempos at marathon effort, and intervals at 5K to 10K race pace. He saved racing for race day, not workouts. He had the maturity to hold back in intensity and mileage so that he could regularly meet the marathoner's top training goal—getting to the start line healthy.

Another key: Keflezighi was adept at getting the most out of himself psychologically. He entered races with a series of tiered goals. His top goal was usually to win or set a personal best. He fought for that top goal as long as it remained in reach. If it became apparent the goal was unreachable that day, he shifted his focus to his next goal, such as placing in the top three, and worked to attain it with as much commitment as he had given his top goal. He went so on through other goals, the last of which was usually to get to the finish line no matter what. This type of goal-setting helped him keep pushing the whole way. "Coach Joe Vigil always talked about the nine inches above the shoulders being the most important part of racing," Keflezighi says. "I always tried to find something positive to focus on, no matter how badly things were going."

At the 2012 Olympics, he was able to use this process in reverse for one of his strongest showings. Soon before the halfway point, Keflezighi was in 21st place and considered dropping out. He resolved to finish. He figured running with others would make the rest of the race easier, so he latched onto a pack. The bad patch that had prompted thoughts of quitting passed, so he raised his goal to beating at least one person in the pack. Then two, then three. Keflezighi kept setting his sights higher as the second half of the race progressed, and wound up finishing fourth, eight years after winning Olympic silver.

That 2012 Olympic race was part of a spectacular second act of Keflezighi's career that started in his late 30s. Between November 2011 and April 2014, he ran his three fastest marathons, won the U.S. Olympic Trials, finished fourth at the Olympics, and, most famously, in 2014 became the first American man to win Boston in more than three decades.

Always a student of the sport and close reader of his body, Keflezighi realized in his mid-30s that his age demanded some adjustments if he were to remain competitive in the marathon. (We'll discuss many of these changes in the following chapter for older marathoners.) He stretched before and after every run. He did some form of core stability or other strengthening work most days. He retooled his diet to focus on high-quality protein with every meal and reduce empty calories, and he became fastidious about having a recovery drink immediately after finishing his main run of the day. He replaced some of his shorter recovery runs with ElliptiGO rides so that he was fresher and less sore for his key workouts. He did postrun form drills every day except after long runs to maintain range of motion and neuromuscular fitness.

Borrowing from Paula Radcliffe and other successful older runners, Keflezighi switched from a traditional seven-day training cycle to nine-day training blocks. He kept doing his staples of long runs, tempo runs, and interval workouts at the same level of quality but now took two days of easy or moderate running between each. These changes allowed him to stay healthy and fit enough to achieve his lifelong dream of winning Boston, and after that of running the 2016 Olympics, his fourth Games, at age 41, the oldest Olympic marathoner in U.S. history.

Keflezighi's attention to the little things other than running often occupied him for an hour or two per day. While few of us have that much time to devote to our nonrunning training, we can implement on our terms Keflezighi's guiding principle that there's always something you can do to improve. During your next marathon training block, carve out a few small chunks of time most days for the nonrunning training detailed in this chapter that will help you get the most from your running workouts.

To get a similar workout to running requires about three times as long on a bike. But because the main rationale for recovery runs is simply to increase blood flow through the muscles, you can replace a 30-minute recovery run with about 45 minutes on the bike.

Because cycling is highly repetitive and uses a limited range of motion, it presents a danger of shortening your stride. You can minimize this concern by walking briskly for several minutes after cycling—and then stretching your hamstrings, quadriceps, and hip flexors. Also, be sure to keep the bike in an easy-enough gear, with a pedaling rate of at least 90 RPM so that cycling doesn't detract from your running turnover.

Water Running

Unfortunately, a number of running injuries are aggravated by some types of cross-training. Fortunately, with most running injuries, you can safely run in the water. Deep-water running with a flotation vest or belt provides an excellent training stimulus and simulates land running more closely than most other cross-training options. Running in the water is a total-body exercise that works your legs, trunk, and arms and positively stresses your cardiovascular system.

Various studies have verified that runners can use deep-water running to maintain aerobic fitness, LT, running economy, and time-trial performance for at least 6 weeks. This research complements more than 30 years of practical evidence that runners can maintain fitness and return to racing form quickly by water running during injury.

Water-running technique is an area of some debate. Some coaches insist that you should try to simulate land-running form as closely as possible. Though that's a nice ideal, the most important consideration is to maintain your training intensity to the highest degree possible. Doing so will likely lead to moderate adjustment to your running technique so you run more like a sprinter, driving your legs and arms powerfully through the water.

Regardless of your running form, your stride rate will be slower during water running because of the increased resistance of moving your legs through water. If you try to simulate land running too closely, your stride rate will be even slower. For that reason, don’t worry if you don’t bring your leg behind your body to the same degree as in land running; just find a happy compromise with decent form and a reasonable rate of leg turnover.

Some athletes move forward while running in the water and (very slowly) do laps during their workouts. Whether you move forward or remain relatively still depends on subtle changes in body position. Try to maintain a relatively upright posture during water running; this posture will work your trunk muscles and result in only a slight tendency to move forward through the water.

You won’t be able to achieve as high a heart rate running in the water as when running on land. A study from the Karolinska Institute in Stockholm found that heart rate is 8 to 11 beats per minute lower for the same oxygen uptake when running in the water compared with normal running (Svedenhag and Seger 1992). This study also found that, on average, maximal heart rate is 16 beats per minute lower during all-out water running compared with land running. Lower heart rates during water running are primarily because of the pressure of water on the body; the water pressure makes more blood return to the heart so that more blood is pumped with each heartbeat.

A useful rule of thumb is that heart rates during water running are about 10 percent lower than during land running. For example, if you get your heart rate up to 140 beats per minute in the water, that’s roughly equal to 156 beats per minute during normal running. In addition, the temperature of the water affects your heart rate during deep-water running—your heart rate will be somewhat lower in cool water and higher in warm water. Interestingly, studies have found that women have slightly lower heart rates and oxygen consumption than do men during deep-water running. This is thought to be because of women’s generally higher body fat content and resultant greater buoyancy as compared with men.

The Karolinska Institute study found that perceived exertion is higher during water running for a given heart rate or level of oxygen consumption.

In other words, to get a beneficial workout in the water, you'll feel that you're working harder than during land running. (We can speak from experience that perceived effort at a heart rate of 140 in the water is much higher than for a heart rate of 156 running on land.)

For this reason, if you're injured and replacing land running with water running, you'll need to emphasize interval workouts in the water. If you do only steady water-running sessions, your effort won't be high enough to maintain your fitness. Interval sessions in the water, however, give you brief breaks, both physical and mental, that allow you to work harder and obtain a superior workout. Another plus is that time passes relatively quickly when you're doing intervals, whereas steady water running is terribly boring. A typical 40-minute water-running workout consists of a 5-minute warm-up followed by 10 repetitions of 45 seconds moderately hard with a 15-second recovery, a 1-minute rest break, and then 10 repetitions of 1 minute 40 seconds moderately hard with 20 seconds' recovery, and a 4-minute cool-down. A challenging 50-minute workout consists of a 5-minute warm-up, followed by 10 repetitions of 1 minute 40 seconds moderately hard with 20 seconds' recovery, a 1-minute rest break, and then 6 repetitions of 2 minutes 30 seconds hard with 30 seconds' recovery, and a 6-minute cool-down. Even if you're using water running on your recovery days while marathon training, to get in a halfway decent workout you'll probably need to concentrate on maintaining intensity more than if you were going for an easy run around the block.

Cross-Country Skiing

Cross-country skiing is the only form of exercise that provides cardiovascular benefits equal to, or even slightly better than, those associated with running. The whole-body nature of cross-country skiing really works the cardiovascular system, and some of the highest $\dot{V}O_2max$ values have been recorded in cross-country skiers. Running friends in New England, upstate New York, Colorado, and Minnesota use cross-country skiing during the winter months for enjoyable variety and to reduce the stress of fitting in runs when the roads are treacherous.

If you know how to do it, cross-country skiing is pretty much the perfect form of cross-training. Unfortunately, cross-country skiing also requires skill. Highly trained runners with no experience or little coordination may not be able to go fast enough for long enough while skiing to get in a good workout. After a few weeks, however, cross-country technique feels more natural and efficient, and an hour or two of skiing passes quickly. Cross-country ski machines are a good option too but are not as much fun as gliding along the snow.

Elliptical Training (Indoors or Elliptical Bikes)

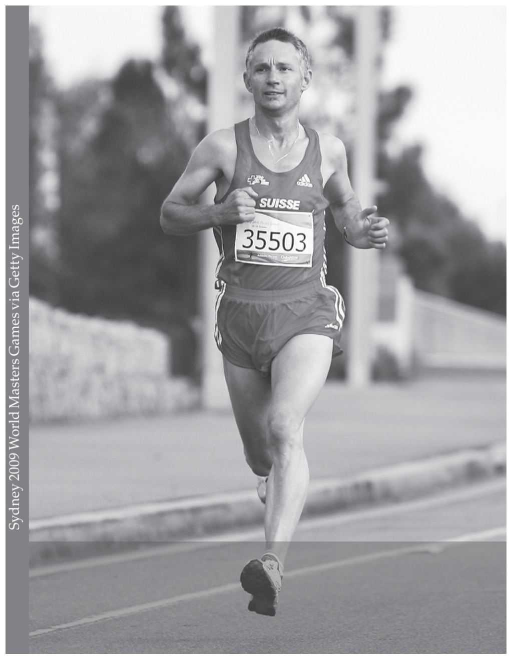
Elliptical training provides an excellent cardiovascular workout and can be done on an indoor trainer or outdoors using an elliptical bike such as an ElliptiGO. This type of training works your legs and hips in a pattern that is similar to running and also develops your upper body. Elliptical training has relatively low impact forces so can be used while recovering from a variety of running injuries. If you're healthy, elliptical training can substitute for recovery runs or some general aerobic runs. Toward the end of his career, Meb Keflezighi used an ElliptiGO for this purpose. He credited doing so for helping him win the Boston Marathon and make his fourth Olympic team in his late 30s and early 40s. An elliptical bike can also be used for LT training or uphill intervals, which is one reason they are becoming increasingly popular with elite runners to supplement their running training.

Swimming

Swimming can be an enjoyable form of cross-training that works the cardiovascular system with absolutely none of the jarring stress of running. To get in a decent workout requires some skill, but with a little bit of instruction or watching technique videos online, even a dyed-in-the-wool marathoner can quickly build up to a workout of up to an hour. Repeats of 50 to 200 yards (46-183 m) will work your cardiovascular system and break up the workout into chunks that help you accumulate more aerobic training. Using more than one stroke—such as swimming freestyle most of the time but periodically including breaststroke and backstroke—provides variety and reduces specific muscle fatigue. Using kickboards and pull buoys also add variety and can help you put in more aerobic work. Swimming isn't as similar to running as some of the other cross-training options, but if most of your training still consists of running, that doesn't really matter. Swimming is a great way to increase your recovery and your general aerobic fitness without increasing your risk of a running-related injury.

In this chapter, we looked at several types of training that build on the solid foundations of marathon preparation we discussed in chapters 1 to 3. The principles laid out in these chapters apply to all marathoners. How best to apply those principles, however, can change as you age. In the next chapter, we'll look at how marathoners over the age of 40 can balance accommodating age with ambitious training and racing goals.

Chapter 5
The Older (and Wiser) Marathoner



Sydney 2009 World Masters Games via Getty Images

This chapter looks at aging and running performance, and offers practical recommendations on how to stay healthy while continuing to chase ambitious marathon goals. As in the rest of this book, our advice is based on a combination of sport science, elite best practices, and personal experience as runners and advisors to runners.

Older runners have greatly varying levels of running experience, backstories, and injury histories. The right training for a 55-year-old marathoner with 30 marathons under his or her belt and a history of lower back pain will differ substantially from that for a 40-year-old newcomer to the marathon. The common thread is that any advice must be tailored to the context of the individual.

As an older marathoner, how close can you get to your earlier times? The answer depends on the degree to which you're already training hard and intelligently, whether you have a lifestyle that optimizes your recovery, and your genetics. If you're doing everything really well now, your running performances will likely gradually slow with the passing years. The rate of slowing tends to be about 1 percent per year across all runners but may vary considerably for you. Having said that, we have yet to meet a masters runner who can't improve some aspect of his or her training or lifestyle to help his or her running. The good news is that if you alter your training to provide the right stimulus to achieve your racing goals and improve aspects of your lifestyle such as your sleep pattern and diet, you'll likely improve your running performance from its current level, regardless of your age.

SLOWING THE RATE OF SLOWING

Looking at data on running records by age, Professors Ray Fair (a marathoner in his 70s) and Edward Kaplan of Yale University have calculated how much endurance running performance (5K through marathon) tends to decline with increasing age. The rate of slowing is very close to 1 percent per year between ages 40 and 45, increasing moderately to 1.3 percent per year between ages 65 and 70, and then increasing progressively more with advancing age. Unfortunately, their data use only men's results, but reviewing the women's marathon records shows a similar slowing with age (about 1.3 percent per year between ages 40 and 60). The slightly greater slowing for older age groups of both genders is likely due, at least in part, to the relatively small number of athletes competing in those age groups. In the coming decades, we can expect the 70-plus records to keep falling.

Savvy older runners can maintain their running performance for a long time. Let's look at four issues for older runners and how to modify your training and lifestyle to stem the impacts on your marathon goal.

Issue 1: $\dot{V}O_2$max Decreases

In chapter 1, we discussed the three key physiological measures for marathoners: $\dot{V}O_2$max, lactate threshold (LT), and running economy. Of these, $\dot{V}O_2max$ is most likely to decrease with age. If you maintain your level of training over the years, running economy remains relatively steady and LT pace tends to slow very gradually. In contrast, even experienced distance runners tend to have a decrease of about 0.5 to 1 percent in $\dot{V}O_2max$ per year after the age of 40 (Brisswalter and Nosaka 2013; Reaburn and Dascombe 2008; Suominen 2011).

What causes this decrease in $\dot{V}O_2max$? Remember that $\dot{V}O_2max$ is determined by how much oxygenated blood can be pumped to and then extracted by your working muscles. As you age, your maximal heart rate slowly declines (on average, about 0.7 beats per minute per year), you tend to lose muscle mass, and the amount of blood your heart can pump with each beat (stroke volume) tends to decrease. Each of these changes means less blood delivered to and used by your working muscles.

What to Do About It

A decreased maximal heart rate is a contributing factor, but the decline in $\dot{V}O_2max$ is largely due to the tendency to do less high-intensity running as we get older. Even moderate changes in training patterns over time lead to a reduction in $\dot{V}O_2max$, so fight back by including specific $\dot{V}O_2max$ training in your marathon preparation. The schedules in this book include workouts with hard efforts of about 2 to 6 minutes' duration at 5K race pace to stimulate increases in $\dot{V}O_2max$.

If you haven't recently been doing this type of training, you can enhance your marathon preparation by including $\dot{V}O_2max$ workouts before beginning the 12-week or 18-week schedules in chapters 9 through 12. If you haven't done such workouts in a while, be sure to do a thorough warm-up, and start with fewer repeats (e.g., 4 1,200-meter repeats instead of 6) in your first few sessions.

Issue 2: Body Composition Changes

Your body composition includes both how muscular you are and how much fat you have stored. If it seems harder to maintain a muscular and lean body composition as the years go by, that's because it is. Starting in one's 30s, the tendency is to gradually lose muscle mass and store more fat.

Some of this transformation stems from hormonal changes in both women and men that make it harder to retain muscle and easier to put on fat. Decreases in growth hormone, testosterone, and estrogen are the main bodily culprits behind reduced muscle mass. Lower testosterone levels in men allow the enzyme lipoprotein lipase to store more body fat. Women also tend to store more fat as their estrogen levels decrease postmenopause. The consequences of these hormonal changes aren't dramatic in any one year but can accrue over time such that you might feel (and look) dramatically different at age 60 compared to age 40.

Training tendencies also contribute to reduced muscularity. Older runners often shift away from high-intensity exercise. Endurance training keeps you fit but unfortunately isn't very good for maintaining muscle mass. Fast-twitch muscle fibers in particular tend to atrophy as you age. Even though you're running regularly, this phenomenon occurs in your leg muscles, just at a slower rate than for your sedentary friends. The decrease in muscle mass is associated with decreases in muscle strength and power and reduced $\dot{V}O_2$max with age.

Your resting metabolic rate also tends to decrease with age due to both the natural aging process and the tendency toward decreased muscle mass, so you burn fewer calories just hanging around.

What to Do About It

The best approach here is twofold: strategies to help retain and build muscle and strategies to slow the increase in body fat. (Some of these strategies overlap.)

To retain muscle as you age, you need to do purposeful resistance training. This resistance training can take the form of strength training or running against resistance (i.e., fast running and uphill running). Strength training builds muscle and has the added benefit of stimulating the release of growth hormone and testosterone. As discussed further below, adequate protein intake will help ensure your muscle-building efforts pay dividends.

The other side of the body composition equation is reducing (or simply maintaining) body fat levels. Factors include the calories you burn through exercise and the calories you take in through your diet. If you reduce your running mileage over time, you'll put on fat unless you increase other forms of exercise or modify your diet. With high-intensity exercise, you continue to burn calories after the workout due to excess postexercise oxygen consumption. (That is, your metabolic rate tends to remain elevated after high-intensity workouts such as $\dot{V}O_2max$ sessions.)

Another factor concerning energy balance is how active you are outside of running. Some experts use the phrase "active couch potatoes" to describe people who, other than their planned workouts, are just as sedentary as the bulk of the population. This phenomenon tends to increase with age as everyday responsibilities eat up more time and increased fatigue makes sitting usually seem like the best choice. If you struggle with maintaining a good running weight, try being more active throughout the day, such as by taking frequent short walks and breaking up work with brief bouts of body-weight exercises. Staying more active provides another good reason to do the strengthening exercises recommended in chapter 4 because they both build muscle and increase your calorie burn.

As discussed in chapter 2, a high-quality diet sets the stage for adapting well to training. A high-quality diet also leaves you feeling more satisfied and reduces the urge to overindulge. We're not saying to count every calorie and obsess over the nutritional content of everything you eat. (We love our ice cream!) But why not eat such that you get the most benefit from the hard work you do in training? By eating a well-balanced diet and avoiding highly processed foods, you give yourself the best chance of absorbing your training and maintaining your fat levels as you age, even though other factors, such as reduced resting metabolic rate and hormonal changes, are working against you.

Issue 3: Reduced Stride Length

Your running speed is determined by your stride length and stride rate (i.e., strides per minute). One way to understand why running performance decreases with age is to look at how these two parameters change. Older runners tend mostly to maintain their stride rate with age. Stride length, however, tends to shorten, sometimes dramatically.

Why does stride length decrease with age? Research points primarily to reduced power at the ankle, leading to lower forward propulsive force. The reduction in ankle power is likely due to decreased strength, reduced mitochondrial function, and a decrease in the number of motor neurons in the gastrocnemius and soleus muscles in the calf. Both of these muscles attach to your calcaneus (heel bone) via the Achilles tendon, so reduced elasticity of this important tendon may also contribute to a reduction in stride length.

What to Do About It

Developing more ankle power may help maintain stride length for older runners, thereby reducing the decline in running performance. You can increase ankle power by increasing the strength endurance of your gastrocnemius and soleus muscles and by increasing the effectiveness of the stretch-shortening cycle of these muscles. These goals can be met through specific types of running training as well as by exercises that strengthen your calves (see step-ups and calf raises in the strength training program in chapter 4) and exercises that work on the stretch-shortening ability of your calves and Achilles tendon (see running form drills in chapter 4). The bent-leg and straight-leg calf stretches in the flexibility program in chapter 4 can also improve your ankle flexibility.

With a few tweaks, older runners can continue to train and race ambitiously.

Donat Sorokin\TASS via Getty Images

There are two types of running training that improve ankle power. The first type is running short hill reps (as discussed in chapters 1 and 4 and included in the training schedules), in which you use your calf muscles to sprint up a moderate hill. The second is running strides (as discussed in chapter 1 and included in the training schedules), in which you accelerate powerfully on the flat. As with any modifications to training, be cautious in increasing these elements to avoid injury; start gently and increase gradually.

Issue 4: Increased Recovery Time

The muscular damage and fatigue you experience after a hard workout or race as a masters runner is likely similar to what you experienced as a younger runner. Not surprisingly, however, the vast majority of older runners find that recovery from hard efforts now takes longer.

Although the slower muscle recovery in older runners isn't well understood, hormone levels play a significant role. A variety of hormones, including human growth hormone, testosterone, and estrogen, regulate the repair of muscle fibers and tendons. As hormone levels decline with age, muscle repair and regeneration slows. After many years of running, accumulated scar tissue in your muscles and connective tissue may also slow your ability to bounce back for another hard effort.

What to Do About It

There are two categories of changes you can make to speed your recovery. The first is to do all of the little things right to improve your body's ability to recover quickly. The second is to modify your training to allow more recovery time between key workouts. Let's look at each of these strategies in turn.

Older marathoners should pay special attention to the discussion in chapter 3 on optimizing recovery. We can well attest that less-than-ideal choices about training, stretching, diet, sleep, and so on take far more of a toll now than they did when we were in our late 20s. If you want to continue to aim high as a marathoner in middle age and beyond, we salute you. Maximize your chances of success by consistently doing the nonrunning practices that younger runners often ignore.

Among the changes in lifestyle that can improve your recovery, the two that stand out are getting adequate high-quality sleep and improving your diet. As discussed in chapter 3, both the quality and quantity of your sleep affect your ability to recover. A lack of high-quality sleep is associated with overtraining and an inability to positively adapt to training. While it's important for all runners to get enough sleep, that's particularly true for older marathoners. Getting enough good-quality sleep increases the release of growth hormone and testosterone, which have multiple positive effects on your ability to recover, build muscle, maintain a lean body composition, and generally reap the benefit of your training. See the sidebar "Sleep Better, Run Faster" in chapter 3 for how to ensure you get enough high-quality sleep.

Older runners can't get away with dietary mistakes as they could when younger. Key aspects of diet for older runners to focus on include refueling after workouts, eating enough protein, rehydrating after running, and avoiding excess alcohol. As discussed in chapters 2 and 3, refueling quickly after hard workouts and races will allow you to recover more quickly. This is particularly useful for the older marathoner. While most Americans eat much more protein than their bodies require, older people have moderately increased protein needs. Older runners should check that they're eating enough protein not only for muscle repair, but also to allow muscle building as you focus more on higher intensity training.

As discussed in chapters 1 and 2, recovery is enhanced by replenishing the dehydration that occurs during running. The thirst mechanism in older people tends to be less sensitive, so older runners should pay a bit more attention to replenishing hydration levels after training. Alcohol isn't a friend for older runners because it leads to dehydration, interferes with sleep, and provides empty calories. It also slows recovery due to its effect on the liver. The serious older marathoner should keep alcohol intake to a minimum.

The other way to account for the need for increased recovery time after hard workouts or races is to modify your training. All runners need easy days after their key training sessions before they're ready to benefit from more hard work. Older marathoners, however, may require more or different types of recovery days than younger runners.

If the training schedules in chapters 9 to 13 are too challenging, you can adjust them either by skipping some of the harder workouts (which risks meaning you're not prepared for your marathon) or by extending the schedules across more weeks. For example, the hard workouts in the 18-week schedules could be accomplished across 20 or 21 weeks; the 12-week schedules could be extended across 14 or 15 weeks. In this way, you get in the same amount of specific marathon preparation but with more recovery to stay within your personal limits to adapt. Simply insert more recovery days (running, cross-training, or days off) between the harder workouts. Masters runners tend to choose cross-training (such as cycling or elliptical training as discussed in chapter 4) or to simply have more days completely off from training than younger runners.

Some runners also extend the concept of a week to 8 or 9 days to allow enough recovery. Unfortunately, this strategy is difficult to implement for many runners. First, it could mean often training alone—your running buddies are unlikely to change their traditional Sunday long runs or Tuesday track sessions. Second, it can easily conflict with a normal work schedule, such as if you find your 9-day "week" means running 22 miles before going to work on Wednesday morning. For these practical reasons, we've received the most positive feedback from our older readers on extending the number of weeks for their marathon preparation.

Rebecca Trachsel

Fastest marathon: 2:59:12
Marathon highlight: First sub-3:00 in her 22nd marathon at age 43

How fast can you run a marathon when you're supposedly past your physical prime? As Rebecca Trachsel shows, you'll never know until you try to find out.

In her 22nd marathon, at age 43, Trachsel met a years-long goal of breaking 3:00 when she ran 2:59:12 at the 2018 Bay State Marathon in Lowell, Massachusetts. She attributes her success to several practices from which masters marathoners of whatever speed can benefit.

Trachsel competed in high school and college, and graduated from Colgate University with a 5,000-meter personal best of 18:21. Chronic injuries and mental burnout led her to take a few years off from running. When she resumed, she did so primarily for general fitness and health. By the time she moved back to her native Massachusetts in 2001, she was running most days of the week. A half marathon in “around 1:40” (she’s unsure of the precise time) at age 26 gave her the idea of someday running the Boston Marathon. That goal simmered on the back burner while she started a family, giving birth to daughters in 2004 and 2007.

Courtesy of Mohawk Hudson River Marathon

Trachsel ran her first marathon at Bay State in 2007 at age 32. “I had no idea what I was doing,” she says about training. “All this stuff was new to me—I didn’t know what GU was.” Once a week she ran longer than usual, but did no faster workouts, despite being familiar with them from high school and college. She hit the wall at mile 18 but held on well enough to finish in 3:39, a minute under her Boston qualifying time. Injury caused her to defer her 2008 Boston entry to the 2009 edition, where she ran 3:31. After not significantly lowering her time in the next two Boston Marathons, she decided to try other marathons to remove the challenges of Boston’s course and occasional bad weather.

Pretty soon, thanks to consistency and more sophisticated training, her personal best was down to 3:16. “I wavered a lot between giving up on the marathon and thinking I could still improve a lot,” Trachsel says. She started working remotely with a Philadelphia-based coach, Lowell Ladd, who still guides Trachsel’s training. “That was when I really drank the Kool-Aid,” she says. “I put all my eggs in the marathon basket. I would still race other distances but toward the goal of seeing how close I could get to breaking 3:00.”

Before finally breaking 3:00, Trachsel started eight other marathons with that goal. On one occasion, she ran 3:00:16. In the fall of 2017, she ran 3:00:07 in a race that included a pit stop. The near-misses sent mixed messages—she was close, but how many more hard marathons and how many more personal bests could she run in her 40s? “I felt like if I took too long of a break from the marathon, the climb back at my age would be that much harder,” Trachsel says. “My coach said, ‘Your body is still letting you do this, so if you’re up for it, let’s keep going.’”

Over the summer of 2018, Trachsel hit repeated 70-mile weeks that included high-quality tempo runs and interval sessions. In contrast, in her late 30s, she often found herself exhausted, sometimes even struggling with normal activities of daily life, while following a less ambitious program. Trachsel says a few adjustments for age explain the difference.

First, in her early 40s she consulted a sport nutritionist. “We rebuilt the way I was putting my meals together,” Trachsel says. “Every meal is a balance of carbohydrates, protein, fiber, and complementary foods. I wasn’t getting enough protein with each meal.” Trachsel also committed to refueling within the first 30 minutes after long or hard runs. “Those two changes have been huge,” she says. “I recover so much better now.”

Trachsel also made adequate sleep more of a priority. “As my daughters have gotten older, they like to stay up later,” she says. “Now I’m better at kissing them good night and going to bed. I’m not going to stay up until 11:00 with them and then run 24 miles the next day.” She further enhances her ability to withstand hard training with stretching and foam rolling after most runs, core stability exercises three days a week, and a short session of running form drills postrun several days a week.

“I always wonder if I’ve reached my peak,” Trachsel says. “I know at my age the window is closing, and the opportunities will start being more challenging. But then I’ll have a little breakthrough in training or racing, and get remotivated. There are still lots of things I can work on to keep improving.”

MORE KEYS TO SUCCESSFUL MASTERS MARATHONING

Your likelihood of successful masters running can be increased by good planning, a healthy dose of common sense, and discipline. Good planning involves knowing how to adjust your training to accommodate your body’s capacity to handle stress. It also includes aspects like wearing the right shoes and wearing orthotics if you need them. A specialist running store with experienced runners and a treadmill can help ensure you have shoes that meet your needs. If necessary, a podiatrist experienced with runners can fit you for custom orthotics. Be open to trying different makes and models of running shoes as your body changes (i.e., you might benefit from more cushioning than 20 years ago, your feet may have widened, and so on).

SCOTT'S APPROACH TO BEING A HEALTHY MASTERS RUNNER

Every December I write down my main running goals for the coming year. A quarter-century ago, the goals usually had to do with setting personal bests. Now that I'm in my mid-50s, I still have time-related goals, and I often have completion goals, such as finishing a specific trail ultramarathon. For the last several years, however, my main goal has been the same: Lose no days of running to injury. Focusing on this goal is how I get the most satisfaction out of this phase of my running life.

My physical and mental health is best supported by consistently running a decent amount; my current sweet spot is between 2,500 and 3,000 miles a year. But I don't want to just blindly run up the odometer. I want those miles to be as enjoyable as possible—I want to feel good running, and I want to feel good about my running. That's where "lose no days of running to injury" comes in. Rather than the call to obsessiveness it might sound like, it's how I can best stay healthy.

Like any good goal, this one is not just personally meaningful but quantifiable and with obvious steps to take to reach it. Losing no days to injury basically means taking care of myself—not letting myself get too worn down by running or work, eating and sleeping well, not gaining unneeded weight, and striving to maintain a body that can hold up to the amount of running I want to do.

That last point is where the goal really helps me. It means that pretty much every day I do strengthening, core stability, balance, or mobility exercises. Some I do immediately before and after running; others I do throughout the day. I still have my trouble spots, I still wish I were a little more flowing when running, and I still sometimes miss days to injury. (I don't run if I sense that I can't do so with my normal gait—running in that compromised state will both exacerbate the current issue and set me up for compensatory problems elsewhere.) But as someone who has already run more than 110,000 miles, committing to doing nonrunning exercises daily has been the key to consistent, enjoyable running in middle age.

Another practice I credit with meeting the miss-no-days goal is having lots of variety in my running. That's variety in terms of distance, intensity, terrain, and topography. Most of my weeks look a lot like a sample week from the training schedules later in this book. I regularly mix long runs, short recovery days, tempo runs, interval workouts, turnover sessions, and general aerobic runs. It's when I get away from multipace running—when I string together too many medium-length, medium-intensity days—that I start to feel flat, stiff, and achey. A bonus: When I do decide to focus on a competitive goal, the default setting of variety sets me up well for more structured training.

On the weekend I wrote this sidebar, I did a 16-miler on Saturday and runs of 5 and 4 miles on Sunday. The last one was on a dirt road alongside a snowy stream at twilight: I had to restrain myself to not go farther or faster. If doing nonrunning exercises most days means I can regularly have similar experiences into my late 50s and beyond, I'll happily take that trade-off.

—Scott Douglas

Common sense involves not only listening to your body's signals, but also accepting that the best way to heed those signals could be different from when you were younger. In your 20s you could probably run through sudden small aches and pains. Now it's more likely that the same approach will lead to the issue being noticeable before, during, and after running, and you realizing your training has been compromised for the last few weeks. Older runners simply have a smaller margin of error in finessing their way through these situations.

It's almost always best to err on the side of caution. If you feel an injury coming on—especially one that gets worse the longer you run—don't delude yourself. Attempting to run through it will usually make the injury worse; instead of one or two days off now, you might find yourself having to miss weeks to recover. Cross-train until you feel you can run normally and, if required, get some treatment.

Similarly, if you feel a chest cold coming on, don't push through a challenging run in the rain or snow. Instead, go home and get warm and, hopefully, ward off a chest infection that might compromise your training for several weeks.

Common sense also includes subtle modifications to your running routine. The days of rolling out of bed and straight into an early-morning run are over. (Not that doing so was ever a good idea, but the consequences are likely to be much greater now.) If, as is common, your schedule requires fitting in marathon training before work, include prerun prep time when deciding when to wake. Use the dynamic flexibility warm-up described in chapter 4 to ensure that you start your workout with good running form; stiffly stumbling around the first few miles increases your risk of injury. In addition, allow adequate time for a comprehensive warm-up before hard workouts.

Common sense and discipline overlap in that the latter often means making what you know are the right choices, even though in the moment those choices aren't as fun and carefree as you might wish they were. Discipline for older marathoners also involves being dedicated about maintaining your running body through regular flexibility, core stability, and strength training work. If you have a more personalized program from a physical therapist or other sports medicine professional, discipline entails sticking to it even when the acute issue that led to seeing the professional seems to have improved. As coach, author, and U.S. masters record-holder Pete Magill puts it, if you think you don't have the time for this ongoing maintenance work, you will soon, when you're injured and can't run.

Being a disciplined older runner isn't just about avoiding injury (although that should be a powerful enough inducement). In chapter 4, we saw that four-time Olympian Meb Keflezighi maintained a high level of performance into his 40s by stretching before and after every run, doing core stability and strengthening work almost daily, and performing running form drills six days a week. Keflezighi also replaced some of his shorter recovery runs with ElliptiGO rides so that he was better recovered for his key workouts. You may not have as much time as Keflezighi to focus on the little things that help you run strong and injury-free, but within your personal context you can show a similar level of discipline.

Chapter 6
Tapering for Peak Marathon Performance


YOSHIKAZU TSUNO/AFP/Getty Images

Training provides the long-term improvements in fitness that are necessary for marathon success. As you're probably aware, though, training also tends to leave you a bit tired most of the time. As we've noted, this doesn't mean you're overtrained—a moderate amount of residual fatigue is fine during the many weeks of training in preparation for the marathon. The periodic recovery weeks in your training schedule are designed to reduce but not totally eliminate the accumulated fatigue of training.

When the marathon approaches, however, you need to cut back your training for a more prolonged period so you're optimally rested for the marathon. Tapering your training is critical for reaching the starting line in peak fitness and with maximal energy reserves. The challenge during the last several weeks leading up to the marathon is to find the best balance between continued training to get into the best possible racing shape and resting to eliminate the fatigue of training. In this chapter, we'll look at the best way to strike that crucial balance.

BENEFITS OF TAPERING

Put simply, tapering corrects the accumulated wear and tear of training. More specifically, it appears that tapering leads to improvements in running economy (how much oxygen you need to run at a given pace) and muscle strength and power. As we saw in chapter 1, improvements in running economy have a direct relationship to improvements in marathon race pace, so tapering is money in the bank in improving your marathon performance. Renowned exercise physiologist Tim Noakes, MD, emphasizes that recovery of the shock-absorbing function of the muscles is an important benefit of tapering for marathon runners, which may explain the improvements in running economy. Interestingly, Noakes also suggests that recovery during a taper may allow improved recruitment of muscle fibers during the latter stages of the marathon. Tapering also allows repair of the ongoing microcellular muscle damage from training and full replenishment of the glycogen stores in your muscles and liver, as well as bolstering your immune system. Other indicators of recovery from stress during tapering include decreases in mood disturbance, positive changes in hormonal markers of stress, and improved sleep. How much benefit you gain from a taper likely depends on how much you have ramped up your marathon training and for how long, as well as your individual capacity to adapt to and recover from training.

Scientific studies on tapering for distance runners typically find improvements in performance of 2 to 3 percent, which equates to about 3.5 to 5.5 minutes for a 3-hour marathoner. The potential gains from tapering are substantial. What's the most effective way to cut back your training before the marathon? Read on to find out.

HOW LONG SHOULD YOU TAPER?

Several studies investigating the relationship between racing performance at various distances and taper duration concluded that the optimal length of a taper is from 7 days to 3 weeks. For the marathon, the general consensus is to taper for a minimum of 2 weeks, with 3 weeks being optimal. Too short a taper will leave you tired on marathon day, whereas tapering for too long will lead to a loss of fitness. When you consider that any one workout will give you less than a 1 percent improvement in fitness but that a well-designed taper can provide an improvement in race performance of several percent, it's wise to err on the side of tapering too much rather than not enough. For the marathon, a well-designed 3-week taper will leave you optimally prepared and recovered for the race.

KEY PRINCIPLES FOR MARATHON TAPERING

- Begin tapering 3 weeks before your marathon.
- Maintain training intensity.
- Reduce mileage.
- Make recovery days easy, or take days off.
- Optimize recovery strategies with proper diet and hydration.
- Eliminate muscle tightness with stretching, physical therapy (if required), massage, and rest.

HOW SHOULD YOU REDUCE YOUR TRAINING TO IMPROVE RACING PERFORMANCE?

Both scientific and anecdotal evidence indicate that the key to effective tapering is to substantially reduce your mileage while maintaining the intensity of your training. Reducing the amount you run reduces accumulated fatigue to improve your marathon performance, while interspersing efforts that you have been doing throughout your buildup, including $\dot{V}O_2max$ intervals and strides, maintains the adaptations you have worked hard to gain over the past several months. (During your taper, you should do shorter sessions at those paces, so while you're maintaining the intensity of training, you're still reducing the quantity of higher-intensity training.) We also recommend a tune-up race 2 weeks before the marathon as a key session for putting the final polish on your racing fitness (and, ideally, providing psychological reinforcement that you're almost ready to roll).

How much you reduce your overall mileage depends on your current training volume, past experience (know thyself), and overall health. In general, older runners tend to require slightly more time to taper than younger runners. Based on research, many discussions with elite marathoners and coaches, and personal experience, we recommend the following for cutting back your mileage.

- Third week premarathon: Reduce mileage by 20 to 30 percent.
- Second week premarathon: Reduce mileage by 40 percent.
- Marathon week (6 days before race): Reduce mileage by 60 percent.

For example, a marathoner whose training peaks at 70 miles (113 km) per week would reduce mileage by 20 to 30 percent (to 49 to 56 miles [79 to 90 km]) in the third week before the race, by 40 percent (to 42 miles [68 km]) the following week, and by 60 percent (to 28 miles [45 km]) during race week. For race week, the 60 percent mileage reduction is for the 6 days leading up to the marathon.

Paula Radcliffe

Fastest marathon: 2:15:25 (world record)
Marathon highlights: 1st place, 2005 World Championships; 2002 Chicago Marathon; 2005,

2003, and 2002 London Marathon; 2008, 2007, and 2004 New York City Marathon

It goes without saying that any world-record holder in the marathon is a supreme athlete. But that doesn't mean that they're all perfect, nor does it mean that they don't make mistakes we can learn from. Although Paula Radcliffe's career includes some very public misfortune, it also includes many positive lessons.

Nick Potts - PA Images/PA Images via Getty Images

As we note in chapter 7, her two world records in the marathon have been models of optimal pacing; in both performances, this British runner ran first and second halves that were within a minute of each other and ran her fastest miles at the end.

It's also important to note that Radcliffe set her current shorter-distance PRs, such as 30:01 for 10,000 meters, only after becoming a marathoner. This is despite having been a serious runner for more than a decade before running her first marathon in 2002. For many runners, the great aerobic fitness they develop during a marathon buildup can continue to be cashed in after marathon season is over and they've returned to shorter road races. And who wouldn't be inspired by Radcliffe's victory at the 2007 New York City Marathon just nine months after giving birth? Like many women, Radcliffe claims that she felt physically stronger running after pregnancy.

Despite her world records and big-city victories, Radcliffe will also always be known for dropping out of the 2004 Olympic Marathon and sobbing on the curb. Soon after the race, she explained that taking anti-inflammatories for a leg injury had upset her stomach, rendering her unable to fuel properly. Subsequently, she noted that the stress of the event—expectations placed on her by the British press and by herself—had gotten to her. More than any other race, the marathon has the power to overwhelm. Try to remember that you're doing it because you want to (at least we hope you are!) and that your performance in the race has no bearing on whether you're a contributing member of society or all-around decent person.

There's also a cautionary note in Radcliffe's late career. After winning New York City soon after giving birth, she was continually beset by injury. Trying to rush back to fitness to get to the start line of a given marathon compounded her bodily woes. In early 2008 a toe injury prevented her from starting April's London Marathon. She then suffered a stress fracture in her thigh while trying to make up for lost time before the Beijing Olympics. She was able to resume running on land only in the month before the marathon there; despite daily cross-training, she simply lacked the running-specific fitness to race for 26.2 miles, and she finished twenty-third. After the race, Radcliffe said that if it had been any race but the Olympics, she wouldn't have started. Most of us can be much more flexible in planning our races, so if your training suffers a setback owing to injury or significant illness, be open to the idea of refocusing on another, later marathon.

Radcliffe gained some redemption after the 2008 Olympics by winning that year's New York City Marathon. That victory turned out to be the last marathon title of her career. In 2009 she had bunion surgery. Until her final competitive marathon in 2015, Radcliffe battled a series of injuries that likely resulted from compensating for previous injuries. She was named to the British Olympic Marathon squad for the 2012 Games but withdrew before the race because of a foot injury.

Again, as a professional, Radcliffe had to push her body to be ready to take on the world's best on specific dates. As a result, she sometimes felt compelled to push hard in training when rest and moderation might have served her better. Few of us have those date-dependent obligations. We can learn from Radcliffe's early marathon years to strike when the iron is hot and from her later years to not rush marathon training and racing.

Three weeks before your marathon is arguably the most important time for a successful taper. This is the week that many marathoners do too much because the marathon still seems a long way off. If you work too hard during this week, however, you may find yourself feeling flat with 2 weeks to go and struggling to rest up as quickly as possible for the race. It's much better physiologically and psychologically to allow your body to start to freshen up during this week. This will put you in a much more relaxed state of mind, feeling that your marathon preparation is on track rather than stressing that all of your efforts are going to be wasted.

Marathoners tend to progressively decrease their training efforts during their marathon taper. That method presents two problems. First, by steadily decreasing training effort over those 3 weeks, they risk a small loss in fitness (adaptations to training are lost at about the same rate that they are gained) before the marathon.

Another concern is psychological. The steady-reduction approach doesn’t provide any psychological reinforcement. Marathoners generally need reminders that they’re still fit, or their confidence may become shaky. The more effective approach to tapering is to intersperse harder efforts within an overall trend of recovery. Figure 6.1 shows a 3-week marathon taper in which harder efforts are included every few days. This type of taper will leave you fit, rested, and confident for the marathon.

Leading up to the marathon, it is paramount to believe in your training program by adjusting your taper to fit your individual needs. Keep a record of your taper leading up to each of your marathons and how you felt and performed in those races. Over time, you’ll be able to identify patterns that will allow you to fine-tune your taper and gain confidence that your taper has given you the maximal edge in performance. You can then apply those insights to customize the tapering portion of your training schedule. For example, many runners prefer a day off quite soon before the marathon. If you’ve found that works for you, we recommend taking that complete rest day 2 or 3 days before the marathon. It’s almost always best to do a light jog the day before the marathon—you’ll feel better on race day, you’ll have a chance to get a last check on any tight muscles, and perhaps most important, you’ll do something other than stare at the walls all day fretting about your race.

Based on the optimal tapering criteria we’ve just discussed, here’s a sample tapering schedule for a marathon (table 6.1). This tapering program is taken from the 18-week training schedule in chapter 10 of this book. By following this schedule, your mileage would have peaked at 70 per week (113 km), and you would have run your last 20-miler (32 km) on Sunday before the start of the taper. Let’s go through this schedule day by day to see the rationale for each day’s training.

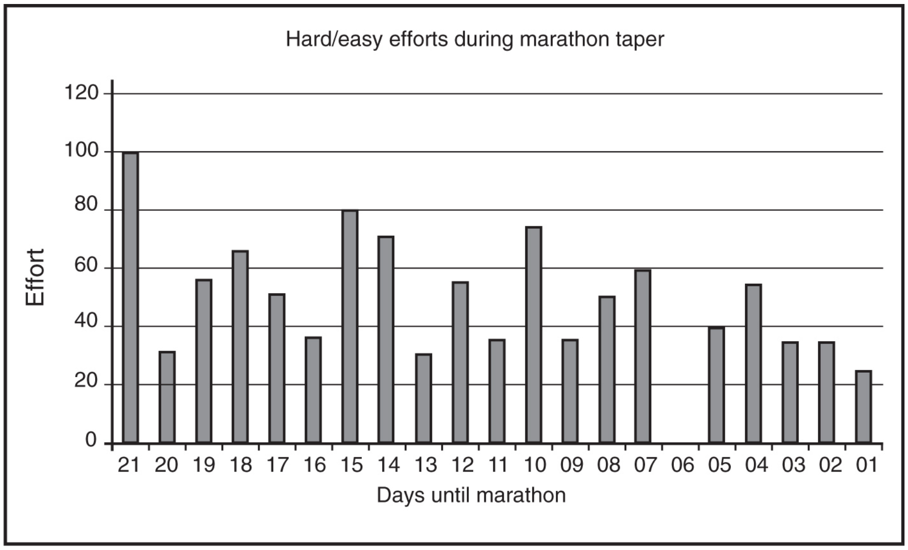


Figure 6.1 Marathon tapering with the right amount of hard efforts.

TABLE 6.1
Sample 3-Week Marathon Taper

	WEEKS TO MARATHON		
	2	**1**	**Race week**
Monday	Rest or cross-train	Rest	Rest
Tuesday	Recovery + speed 7 miles (11 km) with 8 × 100 m strides	Recovery + speed 7 miles (11 km) with 8 × 100 m strides	Recovery 7 miles (11 km)
Wednesday	Medium-long run 12 miles (19 km)	Recovery 4 miles (6 km)	Dress rehearsal 7 miles (11 km) with 2 miles (3 km) at marathon pace
Thursday	Recovery + speed 5 miles (8 km) with 6 × 100 m strides	$\dot{V}O_2max$ 8 miles (13 km) with 4 × 1,200 m at 5K race pace; jog 50-90% interval time	Recovery 5 miles (8 km)
Friday	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery + speed 5 miles (8 km) w/ 6 × 100 m strides

Saturday	8K-10K tune-up race (total 9-11 miles [14-18 km])	Recovery + speed 6 miles (10 km) with 8 × 100 m strides	Recovery 4 miles (6 km)
Sunday	Long run 17 miles (27 km)	Medium-long run 13 miles (21 km)	Goal marathon
Weekly volume	55-57 miles (88-92 km)	43 miles (69 km)	28 miles (45 km) (6 days prerace)

The first week of the taper starts with 2 recovery days to recover from the long run on Sunday. The second day includes eight repetitions of 100-meter strides to improve your leg turnover. Wednesday's workout is a 12-miler (19 km) to provide a mild endurance stimulus. Thursday and Friday are recovery days, leaving you well rested for Saturday, when you run your last tune-up race before the marathon. The 8K to 10K tune-up race provides a boost to your racing fitness that will make marathon pace feel relatively easy, yet it is short enough that recovery will occur quickly. Sunday is a 17-miler (27 km) to again provide a moderate endurance stimulus to help maintain the adaptations, such as increased glycogen storage and blood volume, from your previous long runs. As discussed in chapter 1, having raced on Saturday, your long run on Sunday should be at a more relaxed pace than your usual long runs.

The second week of the taper starts with 3 recovery days, with Tuesday including a few strides to enhance your leg turnover. Thursday calls for your last workout at close to $\dot{V}O_2max$ pace. This is done 10 days before the marathon to allow time for recovery and supercompensation. Friday and Saturday are recovery days, with Saturday again including a few strides to enhance your leg turnover. The week ends with a 13-miler (21 km) on Sunday, once again providing the body with a reminder to maintain the adaptations built up over many weeks of long runs.

Marathon week is all easy recovery with the exception of Wednesday. Wednesday is a dress rehearsal for the marathon. Wear the shoes, socks, shorts, and so on that you'll wear in the marathon. This is your last chance to check that everything is right for the race. After an easy 3 miles (5 km), run 2 miles (3 km) at marathon race pace, then 2 more miles easy. You should feel reasonably fresh but will probably not yet feel fully rested. If you have any tight muscles, there's still time to get a massage, stretch, or see a physical therapist to get your legs ready for race day.

By tapering in this way, you'll reach the marathon start line as prepared as possible. Then all that remains is the little matter of covering 26.2 miles (42.2 km) as fast as you can. What pacing and nutrition strategies to use during the marathon to run your best is the focus of the next chapter.

TAPERING YOUR OTHER TRAINING

When you start cutting back your mileage, it can be tempting to increase whatever nonrunning training you do. For the most part, try to resist that urge. The various forms of supplementary training we looked at in chapter 4 have the same general purpose as your running training—to get you to the marathon start line in optimal fitness for racing 26.2 miles (42.2 km). Approach your core, resistance, flexibility, and cross-training as you do your running when the marathon nears. That is, realize that the main work is done, and your goal now shifts to maintaining the gains you made while allowing your body to rest up for race day.

WHERE'S THE PASTA FEED?

In chapter 2, we discussed the importance of carbohydrate loading for the marathon. It's important that your muscles and liver be optimally stocked with glycogen when you reach the start of the race. Of similar importance is arriving at the starting line well hydrated. See chapter 2 for in-depth information on these topics.

Easy recovery runs are an important part of tapering.

Suzanne Kreiter/The Boston Globe via Getty Images

Keep your resistance workouts to a minimum in the last 10 days before your marathon, and eliminate them in the last few days. It's OK to continue gentle versions of core training and cross-training until a few days before the race. Flexibility training is fine to do right up to race day, but don't go overboard. If you're used to a few 10-minute stretching sessions per week, don't suddenly devote an hour a day to it in the week before your marathon.

The same goes for form drills. If you're used to doing them, it's fine to do a short sequence in the week before the marathon. As with flexibility training, the drills will help you feel looser during your taper, which, if nothing else, can provide peace of mind while you're reducing your running. Again, though, don't suddenly add new exercises or increase the amount of drills you do during your taper. The hay is already in the proverbial barn.

SEEING SUCCESS

As race day approaches, it’s normal to feel anxious. The marathon can seem more like a concept than a reality when it’s 10 weeks away, but when it’s just a matter of days away, it can become all too real a presence in your thoughts. That’s especially true when you’re tapering your training and might be a little more on edge as a result. (And because, if you’re like many marathoners, you’re worried that all the improvements made during training will quickly evaporate after just a few rest days.)

To keep your mind at ease, practice visualization during your taper. In some of the time that you would usually allot to running, sit or lie in a quiet spot and mentally run through your race. Anticipate potential problems—getting boxed in during the early miles, missing an aid station, sudden rain, and so on—and see yourself overcoming them. Also, visualize yourself running relaxed in the early stages of the marathon and then running strongly over the final 10K. If you have a time goal for your marathon, picture yourself crossing the finish, with the clock showing your goal time.

PRESERVING ENERGY (AND SANITY) BEFORE THE MARATHON

If at all possible, during the last week before the marathon, reduce not just your training but also the amount of stress in your life. Assuming the cooperation of your family, friends, boss, and coworkers, try to do the following:

- Avoid having major deadlines at work or other energy-draining undertakings.
- Wash your hands frequently to lower your risk of catching a cold.
- Get plenty of sleep early in the week, especially if you usually have difficulty sleeping well in the few days before a big race.
- Let others do the driving.

- Minimize the amount of time you spend at the prerace expo.
- Save sightseeing for after the marathon.
- Spend a few minutes each day in a quiet spot visualizing a successful race.

Chapter 7
Race-Day Strategy


Sandy Huffaker/Corbis via Getty Images

Your overall preparation for the marathon occurs over several months. During that time, you meticulously plan and diligently train so you're in peak condition for the race. To do your best, however, you also need to have a plan for the marathon itself. That plan is the focus of this chapter. How much should you warm up for the marathon, and what should that warm-up consist of? How should you handle the first few miles, the first half of the race, the long stretch up to 20 miles (32 km), and the final 6 miles and 385 yards (10 km)? Let's take a look at race-day strategies that help you get everything out of your months of preparation so you cross the finish line exhausted but satisfied.

WARMING UP

Warming up for any race is important. The purpose of a warm-up is to prepare your body to run at race pace. This involves increasing your metabolic rate, your body temperature, and the circulation of blood (and thus oxygen) to your muscles. The warm-up activates your aerobic system to work optimally from the start of the race.

There's a downside, however, to warming up for the marathon. One of the challenges in the marathon is to reach the finish line before becoming glycogen depleted. In chapter 2, we emphasized the importance of carbohydrate loading before the marathon and taking in carbohydrate during the marathon to ensure that you don't run out of carbohydrate before the finish. But during a warm-up, you burn a mixture of carbohydrate and fat, thereby slightly reducing your glycogen stores. The key, then, is to find the minimum amount of warm-up necessary to prepare your body to handle race pace as soon as the starter's gun is fired so you save as much of your carbohydrate reserves as possible for the 26.2 miles (42.2 km) ahead.

The optimal warm-up for the marathon depends on the level of the marathoner. If your main goal is to finish, no warm-up is necessary. You can warm up during the first couple miles of the race. If you will attempt to run the distance significantly faster than normal training pace, you should do a warm-up.

A typical marathon warm-up consists of about a mile or 10 minutes of jogging, followed by stretching soon before the start. That sequence accomplishes the basic goal of a warm-up, but for the marathon we suggest a variation: two runs of about 5 minutes each with some gentle stretching in between. This warm-up works well for the marathon because you get a sense of how your body is feeling during the first 5-minute jog. You can then focus the rest of your warm-up on any minor adjustments so you feel as good as possible when you line up for the start.

You should start warming up about 30 to 40 minutes before the start of the race. Start your first warm-up run slowly, and gradually increase your pace so you finish at about 1 minute per mile (per 1.6 km) slower than marathon race pace. Next, do some dynamic stretching for 5 to 10 minutes, including loosening up your shoulders and neck. Follow that with another 5 minutes of running, this time gradually picking up the pace until you reach marathon pace for the final 30 seconds or so. On a warm day, you may want to drink a few ounces before heading to the starting area.

That's it. Try to time your warm-up so you finish no more than 10 minutes before the race starts. If you warm up too long before the race, you'll lose some of the benefits of the warm-up yet will have still used up some of your carbohydrate stores. The ability to time your warm-up like this is an advantage of running a smaller marathon, as compared with a megarace, where you're more likely to be herded to your starting position long before the race begins.

Try to stay warm, dry, and loose before the start of your marathon.
Daniel Berehulak/Getty Images

Before the start of the Olympic marathon, the athletes do a bit of nervous jogging around, but almost no one does more than 10 minutes of easy running plus one or two accelerations up to race pace. This is enough of a warm-up for these runners to handle a 5-minute-per-mile pace for the first mile. A similar routine will get you to the starting line prepared to handle your goal marathon race pace.

YOUR PACING STRATEGY

Assuming that you have a time goal for the marathon, how should you go about trying to achieve that time? Some marathoners go out hard and then try to hang on as well as possible in the second half. Others try to run an even pace throughout. A few take it easy early on and then run the second half faster. Let’s consider the physiology of the marathon and the implications for your optimal pacing strategy.

In chapter 1, we saw that your marathon pace is very close to your lactate-threshold (LT) pace, which is determined by your oxygen consumption at your LT and your running economy. If you run faster than your LT pace, lactate accumulates in your muscles and blood; do this for more than a few minutes, and the hydrogen ions associated with the lactate deactivate the enzymes for energy production and make you slow down. When you exceed your LT pace, you also use more glycogen, so your limited glycogen stores are depleted more quickly than necessary.

These basics of marathon physiology indicate that the best strategy for the marathon is relatively even pacing. If you run much faster than your overall race pace for part of the race, you’ll use more glycogen than necessary and will likely start to accumulate lactate. If you run much slower than your overall race pace for part of the race, you’ll need to make up for this lapse by running faster than the most efficient pace for another portion of the race. The optimal pacing strategy, then, is to run nearly even splits, taking into account the idiosyncrasies of the course you’ll be running.

Most runners shouldn’t try to run dead-even splits, however, because during the marathon you’ll gradually fatigue your slow-twitch muscle fibers and will start to recruit more of your fast-twitch A fibers to maintain your pace. Unfortunately, these fast-twitch fibers tend to be less economical than your slow-twitch fibers in their use of oxygen. Therefore, your running economy will tend to decrease slightly during the race, meaning that your LT pace will decrease slightly as well. The result is that your optimal pace will be slightly reduced during the later stages of the marathon.

For example, if your goal is to run 2:39 for the marathon, even splits would require you to run 1:19:30 for each half of the race. To run even splits, you would have to increase your oxygen consumption and lactate level as your fatigue level increases during the second half of the race. A more efficient pacing strategy would be to go through halfway in 1:18 to 1:19 because doing so would allow you to slow by 2 to 3 percent during the second half and still achieve your goal. If you ran negative splits for the marathon (i.e., the second half faster than the first half), chances are that you ran more slowly than optimally during the first half of the race and could have had a faster finishing time.

For world-class marathoners, whose genetics and training put them on a higher plane, the optimal pacing strategy is likely a bit different. These select few are so highly trained that they have a lower tendency to recruit less economical muscle fibers as the race progresses. In addition, they can pick up the pace over the last several miles and gradually accumulate lactate to the finish. For the best marathoners in the world, therefore, the most effective pacing strategy is to run the second half of the marathon at the same pace as, or even slightly faster than, the first half.

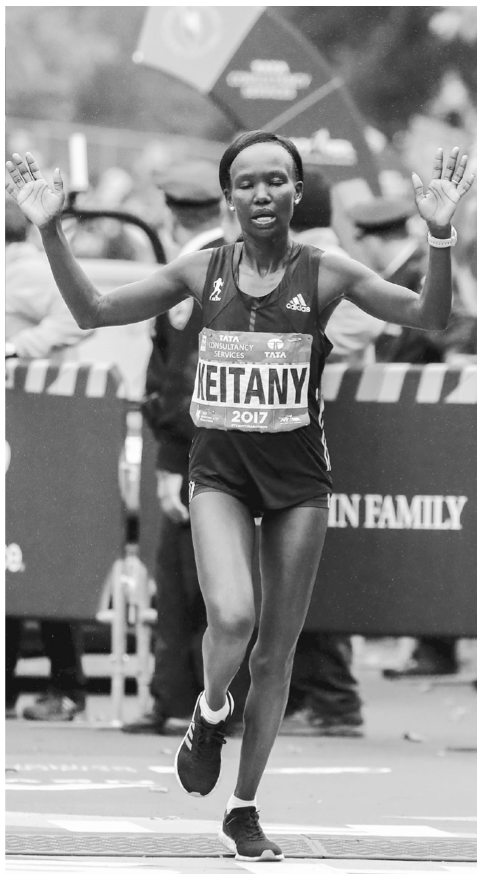
Most of the recent world records have followed this model of slightly faster second halves. In setting the world best of 2:01:39 at the 2018 Berlin Marathon, Eliud Kipchoge ran the first half in 61:06 and the second half in 60:33. Similarly, in her world record at the 2003 London Marathon, Paula Radcliffe ran 2:15:25 by running the first half in 68:02 and the second half in 67:23.

Perhaps you'll find it reassuring that even the best runners in the world pay for it when they start a marathon too quickly. At the London Marathon in April 2018, Kipchoge attempted to break Dennis Kimetto's then-world record despite bright sun and Fahrenheit temperatures in the high 60s to low 70s (19 to 22 degrees Celsius). Following overeager pacers, Kipchoge ran 13:48 for the slightly downhill first 5K and passed 10K in 28:19—fast enough to win most open 10K road races. Kipchoge slowed slightly but still reached halfway in 1:01:00, at the time the fastest opening half in history for a marathon on a record-eligible course. Even Kipchoge succumbed to the too-fast start in less-than-ideal conditions. As expected, he won, but in 2:04:17, or 1:20 slower than the world record he was targeting. His second half of 1:03:17 was more than 2 minutes slower than his first half.

Mary Keitany

Fastest marathon: 2:17:01 (London, 2017)
Marathon highlights: 4 New York City Marathon titles; 3 London Marathon titles; fastest marathon in a women-only race

Mary Keitany is the top female marathoner of her generation. She runs fast (her personal best of 2:17:01 puts her second on the all-time list) and she runs to win (only the legendary Grete Waitz has more New York City Marathon titles). She's also no slouch at shorter races, with 10K and half marathon bests that make her among the fastest in history at those distances. We'll focus here on two aspects of her marathon career, one in which she's helping to change the conventional wisdom, the other in which she confirms it.



Elsa/Getty Images

Keitany is running stronger than ever in her late 30s. She set her personal best in winning the 2017 London Marathon at age 35. Her time of 2:17:01 is the fastest ever in a women-only race. Her winning time at age 36 in the 2018 New York City Marathon was the fastest of her four victories (and seven total races) there. Keitany has also set personal bests at 10K, 15K, 20K, and the half marathon since turning 35.

Keitany shows that what constitutes marathoners' peak years should be rethought. When Carlos Lopes won the 1984 Olympic Marathon, he got at least as much attention for his age on race day, 37, as he did for the ease with which he defeated what at the time was one of the greatest marathon fields ever. In the decades that followed, the prevailing narrative remained that runners' best races were likely to happen in their late 20s. But Keitany and many others have now shown that doesn't need to be the case. (The woman who prevented Keitany from winning five consecutive New York City titles, Shalane Flanagan, did so at age 36.)

With modern recovery practices like the ones detailed in chapter 3, marathoners can train and race ambitiously for more years without as much breakdown and injury. Doing so not only allows you to build that much more of an aerobic base, but also gives you the chance to draw on more experiences on race day. (And, ideally, the greater wisdom that can come with age.) Let the example of Keitany and others help you rethink for how long you can aim high in the marathon.

This is not to say that Keitany is immune to reality. The second way in which her career relates to conventional wisdom is that even if you're one of the best marathoners in the world, you'll pay dearly if you run the first half too fast.

In 2011, in her second New York City Marathon (and her third career marathon), Keitany shot off to an immediate solo lead. She passed 10K in 31:54 (sub-2:15 marathon pace) and halfway in 67:56; the latter was faster than Paula Radcliffe ran for the first half of her 2:15:25 world record. With New York City universally considered a much tougher course than the London route where Radcliffe set her record, Keitany's brashness was even more striking.

By the time Keitany reached Central Park for the final few miles, she was running more than a minute per mile slower than early in the race. She lost her lead in the 25th mile and finished third in 2:23:38. Her second half took 75:43, almost eight minutes slower than her first.

A similar scenario played out during Keitany's title defense at the 2018 London Marathon. Aiming for Radcliffe's world record, she hit halfway in 67:16. It was too fast on a sunny day with temperatures of about 70 degrees Fahrenheit (21 Celsius). Keitany finished fifth in 2:24:27, with a second half of 77:09.

Keitany's marathon wins, especially in New York City, have followed a much different pacing scenario. In 2015 she won New York City with first- and second-half splits of 72:54 and 71:31, respectively. She ran an even bigger negative split in her 2018 victory there, with halves of 75:50 and 67:58.

As noted elsewhere in this chapter, the most efficient pacing strategy entails running close to even splits for the two halves of a marathon. Theoretically, Keitany could have run faster in New York City in 2018 with more even pacing. Her top priority, however, was to win the race in whatever time it took to do so given how the race played out. It's likely you won't find yourself in this situation! So the main lesson here from one of the greatest marathoners ever is don't waste months of preparation with a too-fast first half. If Mary Keitany doesn't run up to her potential when she does so, neither will you.

ALTERING YOUR STRATEGY MIDRACE

Although in most cases you should stay with your pacing plan, occasionally the weather or the tactics of other runners merit slightly altering your strategy. If you're running into a headwind, there's a substantial advantage to running in a group of runners and letting others block the wind. Though you may need to do your share in leading the group, you'll still save considerable energy compared with running by yourself into the wind. On a windy day, therefore, you may need to run moderately faster or slower than planned to stay with a group.

Even on a calm day, the best strategy may be to deviate slightly from your goal pace rather than running most of the way by yourself. In a big-city marathon such as Boston, New York, or Chicago, being stuck by yourself isn't a problem. At almost any pace, you'll be among a number of runners, and you can work with them to reach your goal time. In a smaller marathon, however, you have a reasonably high chance of running by yourself for many miles. In that situation, you must make a judgment call as to whether to go a few seconds per mile faster or slower than planned to stay with a group. Although drafting behind other runners will give you a small energy advantage, most of the benefit of staying with a group is psychological. You don't have to set the pace, and you can relax and go along with the group.

Most runners find it quite difficult mentally to run by themselves for long stretches of the marathon. So what's the trade-off between having company and having to compromise your strategy? A rule of thumb is to deviate from your goal pace by no more than 8 to 10 seconds per mile (1.6 km) if you would otherwise be running by yourself during the first 20 miles (32 km) of the race. (Of course, you won't know until afterward whether you would have had to run by yourself.) Running 8 to 10 seconds per mile faster than planned may not sound like much, but this difference in effort can put you over the edge after a couple of miles. The best way to judge whether to pick it up to latch onto a group is by how you feel at the time. If you feel as though you can handle it, go for it. If your breathing is uncomfortable and you can sense that you're working at a higher intensity than you can maintain until the finish, relax and let the others go. You may find that the group will soon break up and that you'll once again have others with whom to run.

During the final 6 miles and 385 yards (10 km), you can afford to be more independent. If no one else is running at the correct pace for you after you've passed the 20-mile (32 km) mark, you need to muster the courage to go it alone. Chances are that forging out will work well psychologically because if you have prepared well and run a fairly even pace, you'll be passing other runners throughout the final miles. Nothing lifts the spirits quite like passing another runner late in the marathon.

WHAT ABOUT ORGANIZED PACE GROUPS?

Many big marathons offer pacers to help guide runners toward specific times. Unlike the pacers elites use, these go the whole marathon distance. Should you use this service?

It depends.

First, of course, is the matter of whether your marathon provides a pacer at or near your goal time. Pacers for sub-3:00 times are rare. Bigger races often provide pacers in 5-minute increments (e.g., 3:10, 3:15, 3:20, etc.), while pacers at smaller marathons might be available in 10- or 15-minute increments. The more pace-group options there are, the more it's worth considering joining one.

It's rare for pacers to not finish near their target times. Most are capable of running a marathon significantly faster; their pacing assignment is usually at an easy to moderate long-run effort for them. It can be comforting to tell yourself that if you stick with this person, you're almost guaranteed to finish in the targeted time.

One big consideration is the topography of your marathon course. Pacers tend to aim for even pace, regardless of a course's hills, turns, and weather. Sometimes those factors warrant even *effort* rather than even *pace* in the first two-thirds of a marathon. Following an even pace in these situations might not result in your best possible time that day.

Another item to consider is how comfortable you are running in a potentially large group. If you've done most of your marathon training solo or with one or two others, it can be jarring to suddenly be part of a tight pack of 30 people running the same pace. There might be a lot of talking, especially in the early miles. You might have a harder time getting a clear shot at fluids at aid stations. Whether being part of a big group is appealing or a turnoff is an individual matter.

Our general recommendation: If there's a pace group available near your goal time, consider starting with it. Doing so is a good way to ensure you don't run the early miles too quickly. If you find the group distracting, drift away from it. And if you're having a great day, don't be afraid to strike out ahead over the last 10K.

THE FIRST HALF

You're finally at the starting line, warmed up, and ready for the task ahead. It's all too easy to get carried away and run the first mile (1.6 km) too fast. A better approach is to run the first mile at or a bit slower than your goal pace. Because you won't have done much of a warm-up before the start, your body won't be prepared to go faster than race pace. Also, if you run too fast at the beginning of the race, your body will burn off extra glycogen and accumulate lactate that could negatively affect the rest of your race.

Once the first mile is out of the way, the best strategy during the next few miles is to settle into a good rhythm. Try to run fast but relaxed. Establishing a relaxed running style early in the race will go a long way toward helping you avoid tightening up so you can maintain your goal pace to the finish. Go through a mental checklist periodically to make sure your shoulders are relaxed, your body is upright, and so on to help you maintain good running style throughout the race.

WHAT SHOES SHOULD YOU WEAR?

Marathoners vary widely in the types of shoes in which they prefer to race. On the theory that even an extra ounce adds up over the course of 26.2 miles (42.2 km), some like to wear as light a shoe as possible. On the other hand, some runners figure that during such a long run, they'll need as much cushioning and support as they can get.

Most competitive marathoners should choose race-day shoes on the light end of the spectrum. Most shoe companies make a lightweight trainer that works well in the marathon—these are minimalist enough so that you can feel light on your feet but are built up enough in the heel and midsole to provide some protection, especially as you fatigue late in the race.

Most elites, of course, race the marathon in flats. Bear in mind that these runners are usually whippet thin and have excellent biomechanics. Flats have less support, less cushioning, and less heel lift than training shoes. The lack of support increases the risk of injury and can make muscles that have to work harder fatigue because of the decreased support. In addition, the lower heel lift puts more strain on Achilles tendons and calf muscles.

In the last few years, many companies have introduced a broader range of racing flats so marathoners have more choices between the shoes they race 5Ks in and their training shoes, no matter how light the latter are. Usually weighing around 8 ounces (230 g) with a decent amount of cushioning and some heel support, these longer-distance flats are a good choice for marathoners attempting to race the marathon significantly faster than normal training pace. Regardless of which shoes you choose for race day, be sure to try them out on tempo runs and at least one of your longer marathon-pace training runs in addition to the short dress rehearsal run during taper week.

Following are some rough guidelines about the most likely candidates to wear racing flats in the marathon.

Men	**Women**
Faster than 2:40	Faster than 2:55
Weighs less than 160 pounds (73 kg)	Weighs less than 140 pounds (63 kg)
History of being relatively injury free	History of being relatively injury free
Good biomechanics	Good biomechanics

Take a carbohydrate drink at the initial aid station. It's important to drink right from the start rather than wait until you think you need carbohydrate or fluid. If you wait until you feel tired and light-headed to take in carbohydrate, it will be too little too late. Taking in carbohydrate and fluid early will help reduce dehydration and postpone or prevent carbohydrate depletion, which means you will be able to maintain your goal pace longer. As we discussed in chapter 2, a few seconds lost at each aid station can translate into several minutes gained toward the end of the marathon.

Mentally, the first half of the marathon is the time to cruise. Try to save your mental and emotional energy for the second half of the race. All other factors being equal, if there is a group of runners in the lead pack at halfway, the winner will be the one who has cruised along at the back of the pack saving his or her energy for the demands of the second half of the race. The same principle holds true for slower packs as well. Regardless of your ultimate finishing place in the marathon, you should realize that the second half is going to be harder than the first half; just try to get the first half out of the way at the correct pace without using any more mental energy than necessary.

ON TO 20 MILES (32 KM)

From the halfway mark to 20 miles (32 km) is the no-man's-land of the marathon. You're already fairly tired and still have a long way to go. This is where the mental discipline of training will help you maintain a strong effort and a positive attitude. It's easy to let your pace slip 5 seconds per mile (1.6 km), and then 10 seconds per mile or more, during this stretch. By using all the available feedback on your pace—whether in the form of mile or kilometer splits—you'll know exactly how you're progressing, and you should be able to concentrate and maintain your goal pace during these miles.

Slowing during this portion of the marathon is often more a matter of not concentrating than of not being able to physically maintain the pace. Focusing on your splits gives you an immediate goal to concentrate on. If you're consulting your GPS watch, bear in mind that its mile or kilometer marks might vary slightly from the race's owing to how road race courses are measured and the usual variances in GPS accuracy. Use the race's markers as your main pace barometers because your official final time will reflect the course measurement, not what your watch says.

If you do unaccountably slow during one of these miles, don't suddenly increase your pace to get back on track. If you're using your GPS's current-pace data, aim to get back to your goal pace. When the next mile split confirms you're back on pace, chip away at the few lost seconds over the next few miles. By focusing on these incremental goals along the way, you'll prevent a large drift in your pace and should be able to stay very close to your goal.

It's not unusual to have a few miles when you just don't feel good. These bad patches are a test of mental resolve. Often these stretches will last a while and then mysteriously go away. For example, you might feel tight and uncomfortable from miles 15 to 17 but then get back in the groove again and feel good to the finish. The key is to have the confidence that you'll eventually overcome this bad patch.

WHEN NOT TO FINISH

Most of the time, you should finish the marathon even if you're not running as well as you had hoped. The marathon is a test of endurance. If you casually drop out of a marathon once, it will be all too easy to drop out again. Of course, in certain situations, struggling to finish a marathon may compromise your health or your future marathon success. Here are some scenarios where dropping out is your best choice.

- If you're limping, your running mechanics are thrown off. You'll merely aggravate your injury by continuing.
- If you have a specific pain, and that pain is increasing progressively during the race, you're doing yourself harm and should stop.
- If you're light-headed and unable to concentrate, you should stop.

- If you’re overcome by muscle cramps, a torn muscle, heat exhaustion, or the like, stop.

Pete learned this lesson years ago during the San Francisco Marathon. After working quite hard from 13 to 16 miles, he had a stretch of about 3 miles when his breathing felt out of sync on a particularly windy stretch of road, and he struggled to stay with the other two leaders. Pete kept telling himself to relax and that the other guys might be hurting, too. Fortunately, he settled back into a comfortable rhythm by 19 miles, felt strong enough to drop the other two runners by the 20-mile mark, and cruised home to victory. If Pete had let himself think negatively during the bad patch and let the other two runners get away, he wouldn’t have won that race.

Bad patches between halfway and 20 miles can also stem from encroaching muscular fatigue. Do periodic body scans to see if you’re starting to run less efficiently. Go from top to bottom, focusing on one element of good form at a time. Is your head lined up over your shoulders? Are you relaxed in the face and neck? Are your shoulders low and even? Are your hands loosely cupped? Is your trunk tall and not bent over at the waist? Are your hips relaxed? Are your feet landing under rather than ahead of your center of mass?

You can do these scans in just a few seconds. If an area feels tight or out of alignment, envision how it felt in the early, relatively easy miles, and try to regain that form. Fixing these little form deviations will make the current stretch feel a little easier and will lessen the chance of an even bigger form breakdown late in the race.

You don’t need to constantly monitor your form. A quick check every mile or so is plenty. Keep doing these body scans the rest of the race, both to maintain your technique and to provide a different psychological focus.

Taking in carbohydrate as often as possible during the second half of the race can help you maintain your mental focus. The only fuel for your brain is glucose (carbohydrate), and when you become carbohydrate depleted, the amount of glucose reaching the brain starts to decrease. If you’ve carbohydrate loaded, this shouldn’t start to affect you until well past the 20-mile (32 km) mark. Taking in carbohydrate during the race and particularly between miles 13 and 20 (km 21 and 32), however, will help ensure that you stay alert and think clearly throughout the race.

DROPPING OUT

In my marathon career, I started 18 marathons and finished 16, including 8 victories. Of the two dropouts, one was because of injury and the other was because of stupidity. Both occurred in 1986.

The dropout because of stupidity was the Boston Marathon. This was the first professional Boston Marathon, with lots of media excitement and financial incentives. I ignored my usual race plan of running even splits and got carried away early. During the first 10 miles, 1983 Boston Marathon champion Greg Meyer and I exchanged the lead several times. Whenever Greg would take the lead, I would try to take it back.

This was overly aggressive racing, especially on my part, for so early in the marathon. Meanwhile, Rob de Castella, who won that day, sat in behind us, probably smiling to himself at the lack of patience of the two Americans. By 12 miles, my breathing wasn't in its usual rhythm, my legs were already pretty beat up, and my intestines were becoming increasingly uncomfortable. During the next mile, I fell off the lead bunch and started to tighten up. Knowing that I had gone too hard too early, I stopped just past the halfway mark and quietly cursed myself. It was a lesson well learned and a mistake I never made again. Note that stupidity doesn't fall under the list of legitimate reasons to drop out of a marathon.

The only positive aspect of dropping out so early was that I recovered fully in about a week. A few weeks later, I used my fitness and frustration to set a personal best of 28:41 for 10,000 meters on the track, and in July I redeemed myself over 26.2 miles by winning the San Francisco Marathon in 2:13:29.

My other dropout was in the 1986 Twin Cities Marathon, which was also the trial race for the next year's world championships. I went into the race with a tight hamstring from stretching too hard after a track workout several weeks earlier. It felt OK early in the race but gradually tightened up in the drizzly 40-degree weather. At 20 miles, I was at the back of the lead pack when the hamstring tightened completely. I couldn't run another step. After walking for about a mile, I gratefully accepted a ride to the finish. That dropout was easier mentally because the decision was out of my hands.

Having had a frustrating year in the marathon, I was determined to get a decent race under my belt as quickly as possible. My physical therapist said that the hamstring wasn't too badly damaged and that I should run easily for about 10 days. With regular massage, it loosened up, and I decided to run the New York City Marathon, which was 3 weeks after Twin Cities. I ran conservatively and gradually moved from 30th place at halfway to finish 9th in 2:14:09. It had been a year of lessons learned.

—Pete Pfitzinger

THE FINAL 6 MILES AND 385 YARDS (10 KM)

Having made it to 20 miles (32 km), you're at the most rewarding stage of the marathon. This is the part that you have prepared for during your long months of training. This is when your long runs, during which you worked hard over the last stages, will really pay off. Until now, everything required the patience to hold back. Now, you're free to see what you've got. During these final 6 miles and 385 yards (10 km), you get to dig deep and use up any energy that you have left. This is what the marathon is all about. This is the stretch that poorly prepared marathoners fear and well-prepared marathoners relish.

The key from 20 miles (32 km) to the finish is to push as hard as you can without having disaster strike in the form of a cramp or very tight muscles. You will have prepared yourself for this during your long runs, your marathon-pace runs, and, to a lesser extent, your tempo runs. You need to use your body's feedback to determine just how hard you can push. Chances are that by now, your calf muscles, hamstrings, quads, or some combination of these are on edge and will limit how fast you can go. You need to test the waters a bit and push to what you perceive to be the limit that your muscles will tolerate. This is a progressive meting-out process in which you can take progressively greater risks as the finish line nears.

Although doing the how-many-miles-to-go math can be daunting early on in the marathon, in this final stage it can help keep you focused. As the finish approaches, telling yourself, "Less than 3 miles to go," or "Just 15 minutes more," can be motivating. If you're struggling a bit toward the end, picture yourself finishing a run on your favorite training loop so the remaining distance seems more manageable.

If you've been taking in fluid and carbohydrate throughout the race, your muscles should be in pretty good condition. Keep drinking until 25 miles (40 km). Keeping up your blood sugar level will keep you alert so you can concentrate well to the end. If your stomach is bothering you in the final miles, use the rinse-and-spit drink technique discussed in chapter 2.

When you see the finish line approaching, give a little more effort so you run strongly over the line. Show yourself that you have mastered the marathon and are able to kick it in a bit to the finish. Then enjoy the fruits of your labor.

In these first several chapters, we've looked at preparing for and running the marathon from all the necessary angles. Now it is time to put theory into practice. The rest of this book contains training schedules that implement the physiological principles of marathoning. The knowledge gained from this first section of the book, combined with the marathon-specific fitness that following the schedules will bring you, should leave you well prepared for marathon success.

PART II

Training Programs

Chapter 8
Following the Schedules

As we noted in the preface, many readers want to get right to the training schedule of their choice and start working. That's fine, but before getting too far into your training, you'll want to read this chapter. In it, you'll learn the best way to do each of the types of runs called for in the schedules. You'll also see what to do with your schedule when the almost inevitable roadblocks pop up during your training.

The training schedules in chapters 9 through 13 include a specific workout for each day as well as a category of training for that day. The workouts are divided into the following eight categories: long runs, medium-long runs, marathon-pace runs, general aerobic runs, lactate-threshold (LT) runs, recovery runs, $\dot{V}O_2$max intervals, and speed training. Each run is explained here, including how to get the most benefit from a given workout. For an in-depth explanation of the physiological benefit and role of each type of training, see chapter 1.

LONG RUNS

In the training schedules, a long run is any run of 16 miles (26 km) or longer. The intention of long runs is (obviously) to improve your endurance in preparation for the marathon's 26.2 miles (42.2 km).

To gain the most from your long runs, do them in the correct intensity range. Long runs shouldn't be slow jogs during which you just accumulate time on your feet. As discussed in chapter 1, the appropriate pace for a specific long run depends on the purpose of that run within your training program. The most beneficial intensity range for most of your long runs is 10 to 20 percent slower than your goal marathon race pace. For most marathoners, long-run pace coincides with about 75 to 84 percent of maximal heart rate or 66 to 78 percent of heart rate reserve. In terms of your breathing, this effort should feel about the same or slightly harder than a general aerobic (or average) run but considerably easier than marathon race pace. (Your perceived effort will probably increase toward the end of the run because of muscular fatigue.) In this intensity range you find the optimal balance between running hard enough to simulate the muscle patterns and posture you will use at marathon race pace and running moderately enough that you can recover relatively quickly for your other important training sessions.

Start out at the slow end of the range. Gradually pick up the pace so you run the last 5 to 10 miles (8 to 16 km) at about 10 percent slower than your goal marathon race pace. Gradually picking up the pace during your long runs and finishing strongly will also provide positive psychological reinforcement that you're in control of the marathon. To gain the greatest benefit, design your long-run courses to simulate the hill profile of your marathon. (See the section on hill running later in this chapter.) If your long-run course is much hillier than your marathon, your pace will be somewhat slower.

The schedules also include marathon-specific long runs at goal marathon race pace (discussed later in the chapter) and slower long runs the day after a tune-up race. After a race or hard workout on Saturday, your Sunday long run should be at a relaxed pace because you are likely to be somewhat tired and have stiff muscles, which will increase your likelihood of injury. Start these long runs like a recovery run. If your muscles loosen up as the run progresses, increase the training stimulus by increasing your pace to about 15 to 20 percent slower than marathon race pace.

MEDIUM-LONG RUNS

A medium-long run is any run of 11 to 15 miles (18 to 24 km). Medium-long runs reinforce the physiological benefits of your long runs. To gain the greatest physiological benefits, the pace for these runs should be similar to the pace for long runs. If you do a hard training session the day before a medium-long run, do the medium-long run toward the slower end of the intensity range.

Avoid the temptation to do your medium-long runs too hard on days when you feel fresh because this will prolong your recovery time and reduce the quality of your other key workouts. As with long runs, design your courses for medium-long runs to simulate your marathon.

MARATHON-PACE RUNS

Marathon-pace runs are medium-long or long runs during which you run most of the miles at your goal marathon pace. These runs provide the precise physiological benefit of allowing you to practice the pace, form, and so on of race day. They're also a great confidence booster.

Start these runs comfortably, as you would other medium-long or long runs, and then run the last portion at marathon race pace. For example, if the schedule calls for 16 miles (26 km) with 12 miles (19 km) at marathon race pace, gradually pick up the pace during the first 4 miles (6 km), and then run the last 12 miles (19 km) at marathon goal pace. The objective of these runs is to prepare your body as specifically as possible for your upcoming marathon, so design your course to simulate your marathon as closely as possible. For most well-trained marathoners, marathon pace coincides with about 82 to 88 percent of maximal heart rate or 76 to 84 percent of heart rate reserve.

GENERAL AEROBIC RUNS

General aerobic runs include your standard, moderate-effort runs of up to 10 miles (16 km). They are slower than LT runs, shorter than medium-long runs, and faster than recovery runs. The intention of general aerobic runs is to enhance your overall aerobic conditioning through boosting your training volume; these runs improve your marathon readiness because many of the beneficial adaptations that improve endurance are related to the total volume of your training.

For most runners, the optimal intensity range for these runs is about 15 to 25 percent slower than marathon race pace. Usually, this pace range coincides with about 72 to 81 percent of maximal heart rate or 62 to 75 percent of heart rate reserve. Because the primary purpose of these runs is to increase your training volume, if you're too tired to do a hard training session the next day, that means you're doing your general aerobic runs too hard.

Galen Rupp

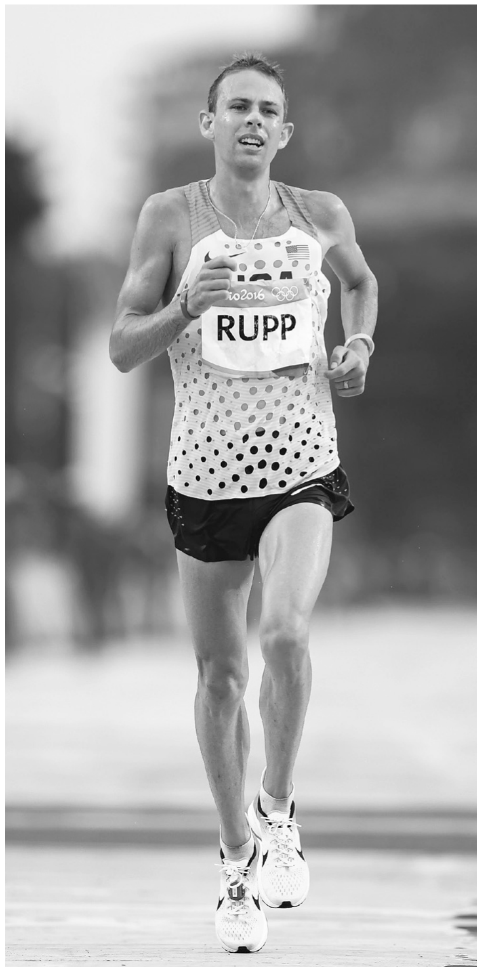
Fastest marathon: 2:06:07 (Prague, 2018)
Marathon highlights: Bronze medal, 2016 Olympic Marathon; 1st place, 2017 Chicago Marathon; 2nd place, 2017 Boston Marathon

Just how quickly did Galen Rupp master the marathon? In his first four races at the distance, he placed first, third, second, and first, respectively.

These weren't ease-into-it races. He debuted at the 2016 U.S. Olympic Marathon Trials, won the Olympic bronze medal that summer in his second marathon, and followed those achievements the next year with a Boston runner-up finish and a win at Chicago, the latter the first by an American man in 15 years.

It helps, of course, that Rupp's longtime coach is Alberto Salazar, who won Boston once and New York City three times.

Still, it was Rupp, not Salazar, doing the running. His immediate success shows that if you're accomplished at shorter distances, you can turn to the marathon with the necessary respect but without fear.



Matthias Hangst/Getty Images

When Rupp stood on the start line of his first marathon, he was already a two-time Olympian, the 2012 Olympic silver medalist at 10,000 meters, and the U.S. record holder at the distance. His few forays into road racing had also been successes, highlighted by two half marathons run in 1:01:20 or faster.

With this background, Rupp was physically and mentally prepared to tackle the marathon. He was physically ready in that he had years of mixed-pace training behind him, including regular long runs. His marathon preparation was more of a subtle shift—toward longer long runs and less frequent short-interval sessions—than a dramatic change. Mentally, Rupp was ready in that he knew how to race for both place and time. The marathon would present new challenges, but Rupp had developed the psychological tools needed to handle them.

We're not saying to go for broke in your first marathon even if you have a strong background in shorter races. Rupp debuted in a race that he knew he probably wouldn't start at a world-class pace. Even the apparent audacity of running the Olympic Marathon in his second go at the distance came with a reasonable expectation of a conservative start. In both races, however, when it was time to race, Rupp covered and made moves as he would in shorter races. Confidence came from the combination of general running experience and specific marathon preparation.

One interesting element of Rupp's marathon training is that many of his long runs are what some would charitably consider mind-numbing, done either on a treadmill or via short loops of a grass field. Rupp says the set-ups allow for practice at drinking and softer footing. They're also a way to build mental tenacity for the inevitable what-a-grind feelings of racing a marathon.

There's also something to learn from Rupp's first unsuccessful marathon.

Rupp was one of the many elites who didn't finish the 2018 Boston Marathon. While everyone struggled in the cold, driving rain, Rupp was especially affected because of his asthma. He lost contact with the leaders before the start of the Newton hills and dropped out a little before the 20-mile mark.

Rupp knew he was in great shape before Boston; he'd run under an hour in a tune-up half marathon. With the relatively slow pace at Boston for the portion he completed, Rupp's effort there was akin to a hard training run, not a long race. So he recovered, regrouped, and entered the Prague Marathon. Twenty days after a bad day at Boston, Rupp won Prague in 2:06:07, a three-minute personal best that made him the second fastest American in history.

You don't necessarily want to go into a goal marathon with a back-up plan. But if things don't go your way and you emerge relatively unscathed, consider finding another race and capitalizing on your fitness. The schedules in chapter 13 can help you with that undertaking.

LACTATE-THRESHOLD RUNS

Lactate-threshold (LT) runs are tempo runs in which you run for at least 20 minutes at your LT pace. The effort should be the pace that you could race for about an hour. For most marathoners, this pace range corresponds with about 82 to 91 percent of maximal heart rate or 76 to 88 percent of heart rate reserve. Another way to estimate LT pace for experienced runners is about 10 to 15 seconds per mile slower than 10K race pace. Tempo runs provide a strong stimulus to improve your LT pace, which leads to similar improvements in your marathon race pace. The LT sessions are done after a 2- to 3-mile (3-5 km) warm-up and should be followed by a 10- to 15-minute cool-down. The tempo runs in the schedules range from 4 to 7 miles (6-11 km) long. As an example, if the schedule calls for 10 miles (16 km) for the day and a 5-mile (8 km) threshold run, warm up for 3 miles (5 km), do the tempo run, then cool down for 2 miles (3 km).

RECOVERY RUNS

Recovery runs are relatively short runs done at a relaxed pace to enhance recovery for your next hard workout. These runs aren't necessarily jogs, but they should be noticeably slower than your other workouts of the week. The optimal intensity for recovery runs for most marathoners is to stay below about 76 percent of maximal heart rate or 68 percent of heart rate reserve. On a subjective basis, on recovery runs you should feel as if you're storing up energy rather than slowly leaking it. You should finish the run refreshed. Going too hard on recovery days—when your body is most tired—means you'll be more tired than you should when it counts later in the week.

Try to find flat courses for your recovery runs, but if your recovery runs include some hills you will need to extend the range by a few beats per minute on the uphills or run exceedingly slowly. Whenever possible, do your recovery runs on soft surfaces to help speed recovery that much more.

$\dot{V}O_2$MAX INTERVALS

The $\dot{V}O_2$max intervals in the schedules range from 600 meters to 1,600 meters in duration and are run at current 5K race pace. Though $\dot{V}O_2$max work is an important part of your marathon preparation, it's not as crucial in the marathon as it is in races such as the 5K and 10K. The $\dot{V}O_2$max sessions in these schedules, then, feature repeats that strike a balance between being long enough to provide a powerful training stimulus and short enough so you can recover quickly for your other important workouts of the week.

The same reasoning applies for the prescribed pace in these $\dot{V}O_2$max workouts: Whereas runners focusing on shorter races need to do some of their intervals closer to 3K race pace, marathoners gain maximum benefit from sticking to 5K race pace. By sticking to the lower to middle end of the effective intensity range (i.e., about 93 to 95 percent of maximal heart rate or 91 to 94 percent of heart rate reserve), you'll provide a strong stimulus to improve your $\dot{V}O_2$max while recovering quickly for your other important workouts. For that reason, the training intensities for $\dot{V}O_2$max workouts in table 8.1 on page 166 call for only the more conservative 5K pace ranges.

The optimal amount of rest between intervals is debatable. One school of thought is to minimize rest so your metabolic rate stays high during the entire workout. This strategy makes for very difficult workouts (which can be good), but you risk shortening your workouts. Another school of thought is to allow your heart rate to decrease to a predetermined level such as 70 percent of your maximal heart rate or 65 percent of your heart rate reserve during your recovery between intervals, which provides close to the optimal balance of effort and recovery.

For the lower-tech crowd, a useful rule of thumb is to allow 50 to 90 percent of the length of time it takes to do the interval for your recovery. For example, if you're running 1,000-meter repeats in 3:20, you would run slowly for 1:40 to 3:00 between intervals. We use this method of measuring recovery in the schedules.

SPEED TRAINING

Speed runs are repetitions of 50 to 200 meters that improve leg speed and running form. These workouts train your nervous system to allow you to maintain a faster rate of leg turnover during your races. For marathon training, strides of 100 meters are long enough to provide the desired benefits.

These sessions are done after a thorough warm-up and often toward the end of a general aerobic run or a recovery run. Allow yourself plenty of rest between repetitions so you can run each one with good technique.

A typical session of strides is 10 repetitions of 100 meters in which you accelerate up to full speed over the first 70 meters and then float for the last 30 meters. It's critical to remain relaxed during these accelerations. Avoid clenching your fists, lifting your shoulders, tightening your neck muscles, and so on. Concentrate on running with good form, and focus on one aspect of good form, such as relaxed arms or complete hip extension, during each acceleration.

A typical rest is to jog and walk 100 to 200 meters between repetitions. The most important considerations are to maintain good running form and to concentrate on accelerating powerfully during each repetition.

As discussed in chapter 1, another way to improve your speed is by running short hills of 10 to 12 seconds up a moderately steep hill, then walking or jogging back to the start. These short efforts build muscle strength and power and improve your running economy. A very effective workout consists of combining short hill sprints with 100-meter strides on the flat. A typical workout consists of a 15-minute warm-up, followed by 6 to 8 uphill sprints of 10 to 12 seconds, and then 8 strides of 100 meters, finishing with a cool-down jog.

The prescribed training intensities used in this chapter and in chapters 1 and 3 are summarized in table 8.1. These intensity ranges are appropriate for most experienced marathon runners. Less experienced runners should generally train at the lower end of the recommended ranges, while elite runners will generally train at the high end of the ranges. (Heart rate isn't relevant during the short speed sessions, so we've left them out of this table.)

TABLE 8.1

Heart Rate Intensities for Marathon Training Workouts

	Maximal heart rate (%)	Heart rate reserve (%)
Long/Medium-long	75-84	66-78
Marathon pace	82-88	76-84
General aerobic	72-81	62-75
Recovery	<76	<68
Lactate threshold	82-91	76-88
$\dot{V}O_2$max (5K pace)	93-95	91-94

DOING DOUBLES

Marathoners have a tendency to start running twice a day before their weekly mileage warrants it. Doing doubles sounds like serious training, so runners often assume it must be better marathon preparation. The reality is quite different; as you increase your training mileage in preparation for a marathon, you should resist the urge to switch from single runs to doubles.

In chapter 1, we discussed the various training adaptations that are specific to improving your marathon performance. Marathon training focuses on endurance-based adaptations such as depleting your glycogen reserves to provide a stimulus for your body to store more glycogen and training your muscles to utilize more fat at a given speed. You'll provide a greater stimulus for these adaptations through a single 12-mile (19 km) run than by doing a 7-miler (11 km) and a 5-miler (8 km) at the same pace.

It might sound counterintuitive, but runners preparing for shorter races should run more doubles at a given level of weekly mileage than marathoners. Runners focusing on 5Ks, for example, should start adding doubles when their weekly mileage gets above 50. That's because the 5K specialists' main training emphasis is high-quality interval sessions, and more frequent, shorter runs will help keep their legs fresh for these workouts.

For marathoners, the basic guideline is to not do double workouts until you've maximized the amount you're running in single workouts. If you're preparing for a marathon and are running less than 75 miles (121 km) a week, you shouldn't regularly run doubles. If you're running less than 75 miles a week, by the time you get in your long run and a midweek medium-long run, there's no reason to double more than once or twice a week to get in the remaining miles. It's better to get in longer runs and give your body 22 or 23 hours of recovery between runs.

Once you get above 75 miles a week, however, double workouts have a definite role in your marathon program. As with any other aspect of training, doubles should be introduced gradually. Start by adding one double per week and then another as you gradually increase your mileage. The schedules in chapters 9 through 13 reflect this approach to adding doubles, with double days called for only in the higher-mileage programs.

How, then, should you introduce doubles into your program? The training schedules in this book add second runs to a day's training for specific reasons. One main category of second runs is on hard days. An easy run in the morning will loosen you up for an evening $\dot{V}O_2max$ session or tempo run. Similarly, 30 minutes of easy running in the evening will help you recover from a morning tempo run.

A second main use of doubles in the schedules is on recovery days. When your mileage increases to where your recovery days call for more than 8 miles (13 km) of running, it's time to switch those days to easy doubles. It's easier on your body and your recovery will be enhanced if you do two runs of 5 miles (8 km) rather than a single 10-miler (16 km). Avoid the temptation to add mileage to your recovery days for the sole purpose of boosting your weekly mileage. Extra mileage on these days is counterproductive because your recovery will be less complete for your subsequent hard days.

The schedules may also call for an easy second run on the day of your medium-long run. These runs will provide an incremental training stimulus by depleting your carbohydrate stores and training your muscles to rely more on fat at a given speed. It's preferable to do the second, short run in the evening after a medium-long run in the morning. If your schedule is such that you'll be doing your medium-long run in the evening, be sure to run very easily in the morning. As we discuss earlier in this chapter and in chapter 1, medium-long runs bring you the most benefit if they're done at a good pace, so don't let a short morning run detract from the medium-long run's quality. A better-quality medium-long run is preferable to a double in which the medium-long run is a slog.

WHEN DOUBLES AREN'T WORTH IT

The minimum time for an added second run should be 25 minutes. If you run less than that, it's hardly worth the extra time and effort—both physiologically and in taking time from your busy life—to change, get yourself out the door, stretch, shower, and so on. That's especially the case if a too-short, not-crucial run means cutting into precious sleep time. In some situations, it's wiser to add cross-training to your program than to increase your risk of injury with more miles of running. Various options for cross-training are discussed in chapter 4.

The schedules never call for a second run on the day of your weekly long run. That would be a perfect example of mileage for mileage's sake because an evening run after your long run will only slow your recovery. As soon as you finish your long run, your objective switches to recovering as quickly as possible for your upcoming hard training days.

A WORD ABOUT HARD DAYS

Looking at these schedules, you might be wondering, *Where are all the speed workouts*? After all, it's normal to think that anyone preparing for a marathon should be training as hard as possible, and what better way to be sure you're doing so than by hitting the track at least once a week for lung-searing intervals, right?

In chapter 1, we explained at length the principles underlying these schedules. Briefly put, we designed the schedules to provide the optimal stimuli to the physiological systems that most determine marathoning success—endurance, LT, and $\dot{V}O_2max$, in that order of importance. In the long run, so to speak, it's your long runs and tempo runs that have the most relevance to your performance on marathon day, not how often you've churned out a sterling set of half-mile repeats.

Knowing the purpose of each workout helps you run it at the proper intensity.

David L. Ryan/The Boston Globe via Getty Images

During your long buildup, understanding the components of marathon success can provide confidence that you're training properly. Use the explanation of marathon physiology from chapter 1 not only to explain to your training buddies why you won't be joining them for 400-meter repeats next week but also to remind yourself why you're doing yet another 15-miler (24 km) in the middle of the workweek. If your running friends continue to chide you that you're not training hard enough, invite them to follow the schedules with you for a few weeks, then report back. We suspect they'll have gotten the message by then.

WHAT ABOUT HILL WORKOUTS?

In the training schedules, other than short hill sprints, we don't prescribe specific hill training sessions. That's because how much to focus on hill training depends on the topography of your marathon. For one of the pancake-flat courses designed to yield fast times, such as London, Chicago, or Berlin, you'll need to be prepared to run for more than 2 hours over unvarying terrain. If, however, you'll be racing on a hilly course, the more closely you can simulate the terrain of the race in your training, both up and down, the better. (The classic course for which race simulation is essential is the Boston Marathon, which has sucked the lifeblood from many an unprepared runner.) By planning training runs to include hills of roughly the same length and steepness as your upcoming race, you'll give yourself the best chance for an optimal performance on race day.

Any of the workouts in the training schedules can be run on hills. By training on hills and simulating your marathon course, you add variety to your training and make your preparation more specific to increase your likelihood of achieving your marathon goal.

Once or twice per week, your tempo runs, long runs, medium-long runs, and general aerobic runs should mimic the hill profile of your upcoming marathon. Simply adjust your pace to keep the effort at the correct intensity. (Allow your heart rate to increase by 5 to 10 beats per minute on the uphills, but be sure to ease up after the hills to get back into the appropriate range.) You can even do some of your $\dot{V}O_2$max sessions up and down hills, although it's easy to blow up by going too hard early in the workout. For uphill $\dot{V}O_2max$ workouts, your recovery will be somewhat longer than usual as you run back down the hill. That's fine—the benefit of the uphill training outweighs this minor adjustment.

If you live in the flatlands but are training for a hilly marathon, don't despair—with a bit of creativity you can gain the benefits of hill running. Runners in Miami have been known to run the ramps of a parking garage on Sunday mornings, and you can replicate almost any uphill workout on a treadmill.

Correct uphill running technique is relatively simple. The most common error running uphill is leaning forward, which is counterproductive to maintaining speed. Looking ahead and not down will help you retain a more upright posture. Let your stride shorten and your knees lift naturally so that you feel as efficient as possible. You will tend to use your arms more as you lift your knees, but try to keep your shoulders and arms relaxed. On downhills, try not to brake. Keep your center of gravity perpendicular to the hill so that gravity can help you get down it as quickly as possible.

WHAT TO DO WHEN YOUR TRAINING GETS INTERRUPTED

Part of the challenge of the marathon is that preparing for it takes so long and the training required is so demanding that roadblocks along the way to your goal are nearly inevitable. It's important not only to organize your training and life so that as few impediments as possible crop up but also to deal with the ones that nevertheless occur. The most common roadblocks are injuries and illnesses, bad weather, and outside commitments. Let's consider each of these intrusions into your marathon preparation to see how to adjust the schedules.

Injuries and Illnesses

Injuries and illnesses are best caught early. Successful marathoners have the ability to recognize an injury or illness at an early stage before it becomes serious. Returning to training after an injury or illness requires careful analysis—too much too soon will result in additional time off. During this period, it's important to avoid the factors that caused the injury or illness in the first place, such as worn-out shoes, running on concrete, overtraining, or a lack of sleep. Be sure to read chapter 3 carefully to learn how to stay on top of your recovery so your chances of getting hurt or sick are lessened.

If you're forced to miss more than a few days of training, you need to decide whether to try to catch up or revise your marathon goal. This decision will be influenced by how much time you missed, how long you've been preparing, and how many weeks are left until your marathon. Missing 2.5 weeks of preparation when you have 16 weeks to go is no big deal, but missing that amount of time during the last 2 months of preparation will likely require you to modify your goal.

Table 8.2 provides guidelines for when you may need to revise your goals after an injury or illness. Typically, if you've lost less than 10 days of training, you can safely start back where you should have been on the schedules. If you've missed $\dot{V}O_2$max workouts, however, you may need to slow your pace during your next few $\dot{V}O_2$max sessions to reflect the lost time. If you've lost 10 or more days of training in the 8 weeks before your marathon, be open to revising your goal. When you resume full training, gather information from your timed sessions to get a sense of how much fitness you've lost and whether your marathon goal pace needs to be slowed by at least a few seconds per mile (1.6 km).

TABLE 8.2

Making Up for Lost Time

Number of days missed	8 weeks or more until marathon	Less than 8 weeks until marathon
<10	Resume schedule	Resume schedule
10-20	Resume schedule	Revise goal
>20	Revise goal	Revise goal

Mother Nature

In general, you'll just have to deal with bad weather. Sometimes, however, Mother Nature dishes up a blizzard or blistering-hot weather that's counterproductive to continued healthy training. If you can, find a treadmill indoors or choose an appropriate cross-training activity for a couple days until the weather becomes bearable.

As with other factors influencing your marathon preparation, weather might necessitate some not-so-minor changes in your life. For example, you might need to alter your normal schedule during oppressive summer heat so you can get in reasonable training early in the morning. Or if your area has been snowed under for weeks, you'll probably need to find a few well-plowed stretches where you can safely do multiple laps to get in your miles.

Try to anticipate weather when picking your marathon goal. If you don't run well in the heat and live in a sultry climate, it makes little sense to plan for a September marathon because your hardest training will need to occur during the least conducive weather of the year. Similarly, Boston in April can be a tough goal if you live in an area where winter running is a daily challenge.

The Real World

For most people, training for a marathon means more time and mental energy devoted to running. If that's true for you, don't set an ambitious marathon goal when you know the rest of your life will be busier than usual. Once you've picked your marathon and have decided how long you'll prepare for it, try to anticipate and eliminate factors that would significantly interfere with your training.

WHY (AND HOW) YOU MIGHT SYSTEMATICALLY TWEAK THE SCHEDULES

We've looked at how to adjust the schedules if you hit one or more common roadblocks during your buildup. Readers of previous editions of *Advanced Marathoning* have also purposefully adjusted the schedules. Based on emails we've received and online discussions, here are the most common tweaks to the schedules and our thoughts on them.

Going Longer than the Schedules' Longest Long Runs

Readers' Tweak: This is the schedule adjustment we most often hear about. Many people say they feel better prepared on race day having done one or more long runs that are close to marathon distance. The psychological benefits of these longer long runs are cited more often than the physical benefits—having gone longer in training makes the marathon distance less daunting.

Our Take: If you feel that one or two runs of up to 24 miles will boost your confidence and you don't have a history of injury related to training volume, by all means go ahead!

Doing More Tune-Up Races

Readers' Tweak: Readers who enjoy racing (and the feedback it provides on their fitness) add one or more tune-up races to those called for in the schedules. The most common way to do this is to replace a $\dot{V}O_2max$ workout or tempo run with a race. If the tune-up race is on a Saturday and is on the shorter end of the spectrum, runners will usually follow it with the long run prescribed for that Sunday. If the race is more toward half marathon distance, readers might do a longer-than-usual cool-down and count the day as the week's long run.

Our Take: The key here is to get in close to the number of long runs prescribed in the schedules. If you can add 1 or 2 more tune-up races while still getting in the long runs, by all means go ahead!

Doing More Frequent $\dot{V}O_2max$ Sessions and Other Forms of Speed Work

Readers' Tweak: Some readers simply enjoy hard track workouts more than tempo runs, and replace some of the latter with the former. These runners are typically relatively new to the marathon and feel that their speed is one of their primary assets.

Our Take: The key to marathon preparation is to prepare your body to run at a steady pace for 26.2 miles. Running a larger number of hard track workouts is counterproductive to marathon preparation because those sessions leave you tired for your more important training, and is therefore not recommended.

Reducing the Distance of the Midweek Medium-Long Run

Readers' Tweak: Primarily because of feeling pressed for time or low on energy, some readers purposefully go shorter than prescribed on the midweek medium-long run. Many keep this run at between 10 to 12 miles throughout their buildup.

Our Take: This is a tough one; we can empathize with the difficulty of fitting in the midweek medium-long run, particularly during the winter months. Those runs are really beneficial for marathon preparation, so just do your best to hit the target distance. (For example, squeezing in 12 miles is better than settling for 10 miles.)

Reaching a Peak Weekly Volume That's Between Those in the Schedules

Readers' Tweak: Some readers feel that one schedule doesn't have them running enough but that following the schedule with the next higher level of weekly volume will make them injured or too tired, so they aim for a weekly volume between the two schedules, usually while following the specific workouts prescribed in the lower-mileage schedule. For example, while mostly following the schedule for 55 to 70-miles (89-113 km) per week, readers might hit 75 miles (120 kilometers) for their peak weeks.

Our Take: If it works for you, this is a sensible adjustment, so by all means go ahead!

Running the Same Weekly Volume on Fewer Days of Running

Readers' Tweak: Some readers have found they feel better if they do the same weekly volume on fewer days of running. For example, in the up-to-55-miles (89 km) schedule, they'll reach the target volume on four rather than five days per week of running. A typical tweak is to not run on one of the recovery run days in the schedule and run a little farther on the other prescribed running days.

Our Take: We can see how this approach may fit your overall life schedule. If it works for you, by all means go ahead!

Switching the Schedules to Longer Than a 7-Day Cycle

Readers' Tweak: We've heard from several masters runners who spread the schedules' 7-day training blocks over 8 or 10 or even more days. (Making this change means extending the number of weeks in your marathon buildup.) This tweak allows for more recovery after long runs, tempo runs, and the other most fatiguing workouts.

Our Take: We wholeheartedly endorse this approach for older marathoners who need more time for recovery than younger runners. We examine this approach in detail in chapter 5.

Of course, regardless of how focused you are on your training, you're going to have the occasional day when meeting your training goal is exceedingly difficult, if not impossible. A sick child, an unsympathetic boss, or a traffic accident all have a way of dashing plans for a high-quality tempo run. If necessary, juggle the days in the training schedule you’re following so that you get in the most important workouts while still allowing for adequate recovery. A good rule of thumb is that if you can do 90 percent of the planned training schedule, your preparation is going well.

Now that we’ve looked at the principles behind successful marathon training and racing and how to implement those principles, let’s get to what you probably care most about—the training schedules, which constitute the rest of this book.

Chapter 9

Marathon Training on Up to 55 Miles (89 km) per Week

This chapter is for runners who typically train less than 40 miles (64 km) per week but who are willing to up their mileage to 55 miles (89 km) per week during marathon preparation. It includes two schedules: an 18-week schedule that starts at 33 miles (53 km) per week and a 12-week schedule that starts at 35 miles (56 km) per week. Each of these schedules increases weekly mileage progressively to a peak of 55 miles (89 km).

As discussed in chapter 1, it's useful to divide your overall training schedule into training blocks of several weeks each. The training schedules consist of four blocks, which focus on endurance, lactate threshold (LT) and endurance, race preparation, and tapering, respectively. A final schedule,

which contains a 5-week postmarathon recovery program, can follow either of the training schedules.

Of the two training schedules presented in this chapter, we recommend the 18-week schedule for most situations. Eighteen weeks is plenty of time to stimulate the necessary adaptations to improve your marathon performance. At the same time, 18 weeks is short enough that you can focus your efforts without becoming bored with the process.

At times, however, you simply don’t have 18 weeks to prepare for your marathon. The 12-week schedule includes the same training blocks as the 18-week schedule, but because of the short time for preparation, each block is abbreviated. If you go into a marathon in a rush, you must realize that your preparation won’t be as thorough as if you had longer to prepare. The 12-week schedule takes into account that sometimes circumstances don’t allow you the optimal length of time for preparation and strives to provide a compact yet effective training program.

BEFORE STARTING THE SCHEDULES

These schedules are challenging right from the start and get harder as your marathon approaches. So that you can progress as the training increases in quantity and quality, and to minimize your chances of injury, you should be able to complete the first week of the schedule without too much effort.

Be realistic in assessing whether you’re ready for the first week of the schedule. For example, if you’ve been running 20 miles (32 km) per week and your longest run in the last several weeks is 6 miles (10 km), now isn’t the time to jump suddenly to a 33-mile (53 km) week containing a 12-mile (19 km) run and a 4-mile (6 km) tempo run, as the first week of the 18-week schedule calls for. The idea behind the schedules isn’t to make you as tired as possible as soon as possible but to apply repeated training stress that you absorb and from which you benefit.

As a rule, you should be running at least 25 miles (40 km) a week before starting these schedules, and in the last month you should have comfortably completed a run close in length to the long run called for in the first week of the schedule.

READING THE SCHEDULES

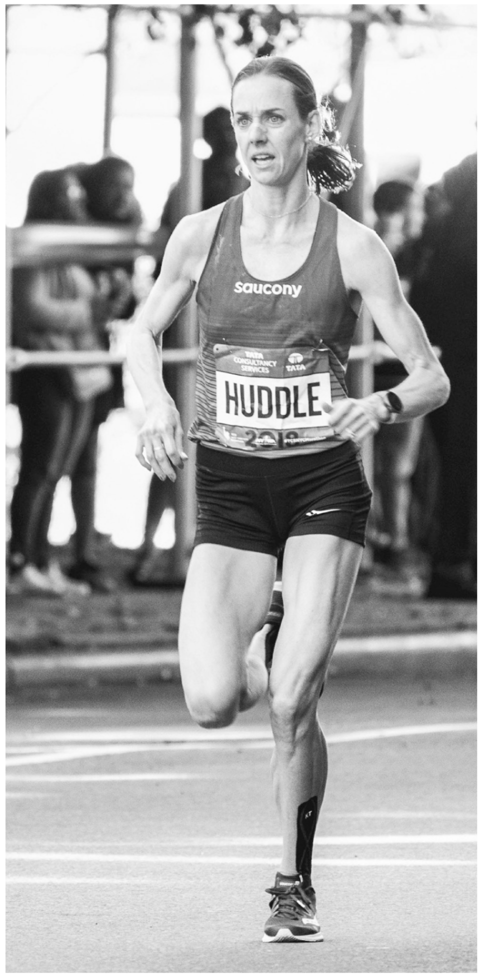
The schedules are presented in a day-by-day format. The main limitation with this approach is that it's impossible to guess the myriad of outside factors that may influence your day-to-day nonrunning life. Work schedules, family life, relationships, school commitments, and Mother Nature all play a part in determining when you get to do your long runs and other aspects of marathon preparation. You'll no doubt require some flexibility in your training and will need to juggle days around from time to time. That's expected, and as long as you don't try to make up for lost time by doing several hard days in a row, you should be able to avoid injury and overtraining. By following the principles covered in the earlier chapters, you'll be able to safely fine-tune the training schedules to suit your circumstances.

The schedules express each day's training in miles and kilometers; use whichever you're accustomed to. The mile and kilometer figures for each day (and the weekly total) are rough equivalents of each other, not a conversion from one to the other accurate to the third decimal point.

Molly Huddle

Fastest marathon: 2:26:33 (London, 2019)
Marathon highlights: 3rd place, 2016, and 4th place, 2018 New York City Marathon

Molly Huddle followed a classic route to the marathon, that of gradually moving up in distance. She didn't make her marathon debut until age 32. By that time she had already set U.S. records for 5,000 and 10,000 meters, made two Olympic teams on the track, and won dozens of national titles. Becoming a marathoner relatively late in her career allowed Huddle to draw on her vast competitive experience while still being mentally fresh for the new challenge.



Michael Brochstein/Sipa USA/AP Images

A thoughtful student of the sport, Huddle has spoken about two main types of racers, warriors and worriers. In this rough grouping, warriors are go-with-the-flow, always-up-for-a-challenge athletes. They relish the excitement of competition and often race better than their training might indicate they're capable of. Worriers thrive on routine and anticipating potential obstacles so they can plan how to overcome them. Instead of getting pumped up for a race, worriers do best by calming their nerves and hitting the start line relaxed.

Huddle places herself squarely in the worrier camp. But rather than be incapacitated by this part of her personality, she uses it to her advantage.

"There are so many variables in the marathon, both training and racing," Huddle says. "It's good to be as prepared as possible for them. That comes naturally to me." In training, Huddle enjoys looking at her overall program and seeing how each workout advances her fitness toward the overall goal. As race day nears, she manages performance anxiety by drawing confidence from that training. In the last 24 hours before a marathon, she uses a checklist of tasks to keep herself occupied and thereby calmer.

Huddle also takes an analytical approach after a marathon or other key race. Using a technique favored by the military and many successful businesses after a project has been completed, Huddle does a debriefing of her preparation and execution. (She waits a day or two after the race to let the emotions of the moment pass.) The goal is to decide what worked, what didn't, and where there's room for improvement.

First, she reviews the technical aspect of her race. Did her chosen gear cause problems? Did her breakfast agree with her? Did she time her warm-up properly? Does she need more practice fueling at race pace?

Then Huddle looks in detail at her training and how she raced. Given how the race went, she can determine if, before her next marathon, she needs more long runs, fewer hard tempo runs, easier recovery days, a longer or shorter buildup, and so on. She also reviews her race strategy and tactics: Were her goals realistic? Did she bide her time early on? Push hard enough in the final miles? Strike the right balance between running her race and covering others' moves? Huddle gets input from others, primarily her coach and her husband, on this part of her analysis. You probably also have people whose insights into your training and racing are worth hearing.

One reason why the 2018 Boston Marathon, her second go at the distance, was such a disappointment for Huddle was that the extreme weather made most of her postrace review pointless. In driving cold rain and fierce headwinds, Huddle suffered hypothermia and slipped from 4th to 16th place in the last few miles. The experience provided no real insights on whether her buildup, which included breaking the American half marathon record, was a model for subsequent marathons.

At the other end of the spectrum, Huddle does her debriefing even after a spectacular race. In noting what went well on a great day, she can tease out repeatable practices. She also uses these peak performances to reset her standards about what's possible next time. And then she gets to work on chasing that new goal.

FOLLOWING THE SCHEDULES

Each column of the schedules represents a week's training. For example, in the 12-week schedule, the column for 11 weeks to goal indicates that at the end of that week you have 11 weeks until your marathon. The schedules continue week by week until race week.

We have included a specific workout for each day as well as a category of training for that day. For example, in the 18-week schedule, on the Friday of the 7-weeks-to-goal column, the specific workout is a 12-mile (19 km) run, and the category of training for that day is medium-long run. This aspect of the schedules allows you to quickly see the balance of training during each week and the progression of workouts from week to week. Look again at the 18-week schedule—it's easy to see that with 7 weeks to go until the marathon, there are four recovery days (two of running, two of rest or cross-training), along with an LT session, a long run, and a medium-long run. Looking at the row for Sunday, it's easy to see how the long runs progress and then taper in the last few weeks before the marathon.

The workouts are divided into the following eight categories: long runs, medium-long runs, marathon-pace runs, general aerobic runs, LT runs, recovery runs, $\dot{V}O_2max$ intervals, and speed training. Each of these categories is explained in depth in chapter 8, and the physiology behind the training is explained in chapter 1.

RACING STRATEGIES

We discussed marathon race strategy at length in chapter 7. If you follow one of the schedules in this chapter, you're probably a midpack runner. Unlike the situation the runners at the front of the field often face, you'll probably have plenty of people around you to run with from start to finish. This can be good and bad.

On the plus side, obviously, you're less likely to face lonely stretches with nobody to run with. Use this probability to your advantage—soon after the start, try to find other runners who look capable of maintaining your goal pace through at least 20 miles (32 km), and encourage them to work with you. (If they fall apart at 21 miles, that's their problem, right?)

Running with others of similar ability makes the early miles easier.

In Pictures Ltd./Corbis via Getty Images

By following one of this chapter's schedules, you'll be better able to hold up past 20 miles (32 km) than most of the runners who begin the race at your pace. Your superior preparation will mean you'll have the pleasure of continually passing people until the finish. Look forward to this time. Pick a runner a few hundred yards or meters up the road, and set the short-term goal of catching him or her. Then go after your next victim, and keep doing so until the finish.

On the not-so-good side, you're more likely than those at the front of the field to feel crowded in the early miles. Try not to let this upset you. Tell yourself that the crowds are helping you not to go out too fast, and if need be, work up gradually to your goal pace.

Don't try to make up lost time suddenly if a break in the crowd appears. Instead, when you have clear running room, run no more than 10 seconds per mile (1.6 km) faster than goal pace until you're back on schedule; you will burn less glycogen and be less likely to accumulate lactate by catching up gradually. If the deficit you have to make up isn't too great, 5 seconds per mile (1.6 km) faster than goal pace is an even safer approach. Once you're back on track, ease back to goal pace.

AFTER THE MARATHON

The final schedule in this chapter is a 5-week recovery schedule for after the marathon; it completes the training program and leaves you ready to prepare for future challenges.

The recovery schedule is purposely conservative. You have little to gain by rushing back into training, and your risk of injury is elevated at this point, owing to the reduced resiliency of your muscles and connective tissue after the marathon.

The schedule starts with 2 days off from running, which is the bare minimum of time away from running you should allow yourself. If you still have acute soreness or tightness so severe that it will alter your form, or if you just don't feel like running, certainly feel free to take more than 2 days off. If ever there was a time to lose your marathoner's mind-set, the week after your goal race is it. Even most of the top runners in the world take days off after a marathon. They know that the nearly negligible benefits of a short run at this time are far outweighed by the risks. Not running now also increases your chances of being inspired to resume hard training when your body allows it.

Of course, some people don't consider themselves real runners unless they run pretty much every day of their lives. Plod through a few miles if you must, but be aware that you're likely prolonging your recovery.

What better aids recovery during this time is light cross-training, such as swimming or cycling. These activities increase blood flow through your muscles without subjecting them to pounding. Walking will also achieve this in the week after the marathon.

One way to ensure that you don't run too hard too soon after your marathon is to use a heart rate monitor. As discussed in chapter 3, a heart rate monitor can help prevent you from going too fast on recovery days. During the first few weeks after the marathon, keep your heart rate below 76 percent of your maximal heart rate or 68 percent of your heart rate reserve. Running at this intensity will help your body overcome the stress of the marathon as quickly as possible.

During this 5-week recovery schedule, the number of days of running per week increases from 3 to 5. At the end of the 5 weeks, you should be fully recovered from the marathon and, with a little luck, injury free and mentally fresh.

Up to 55 Miles per Week 18-Week Schedule

Training Block 1—Endurance

	WEEKS TO GOAL					
	17	16	15	14	13	(Recovery) 12
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	LT 8 miles (13 km) with 4 miles (6 km) at LT pace	Gen-aerobic + speed 8 miles (13 km) with 6 × 10 sec hill sprints + 8 × 100 m strides	Gen-aerobic 10 miles (16 km)	Gen-aerobic + speed 8 miles (13 km) with 6 × 10 sec hill sprints + 8 × 100 m strides	LT 9 miles (14 km) with 5 miles (8 km) at LT pace	Gen-aerobic + speed 8 miles (13 km) with 10 × 100 m strides
Wednesday	Rest or cross-train	Rest or cross-train	Recovery 4 miles (6 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)
Thursday	Gen-aerobic 9 miles (14 km)	Gen-aerobic 10 miles (16 km)	LT 8 miles (13 km) with 4 miles (6 km) at LT pace	Gen-aerobic 10 miles (16 km)	Gen-aerobic 10 miles (16 km)	Gen-aerobic 8 miles (13 km)
Friday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Saturday	Recovery 4 miles (6 km)	Recovery 5 miles (8 km)	Recovery 4 miles (6 km)	Recovery 4 miles (6 km)	Recovery 5 miles (8 km)	Recovery 4 miles (6 km)
Sunday	Med-long run 12 miles (19 km)	Marathon-pace run 13 miles (21 km) with 8 miles (13 km) at marathon pace	Med-long run 14 miles (23 km)	Med-long run 15 miles (24 km)	Marathon-pace run 16 miles (26 km) with 10 miles (16 km) at marathon pace	Med-long run 12 miles (19 km)
Weekly volume	33 miles (53 km)	36 miles (58 km)	40 miles (64 km)	42 miles (68 km)	45 miles (72 km)	37 miles (60 km)

Training Block 2—LT + Endurance

	WEEKS TO GOAL				
	11	10	9	(Recovery) 8	7
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	LT 10 miles (16 km) with 5 miles (8 km) at LT pace	Recovery + speed 7 miles (11 km) with 6 × 100 m strides	Recovery 6 miles (10 km)	Gen-aerobic 8 miles (13 km)	Recovery + speed 7 miles (11 km) with 6 × 100 m strides
Wednesday	Recovery 4 miles (6 km)	Med-long run 12 miles (19 km)	Med-long run 14 miles (23 km)	$\dot{V}O_2$max 8 miles (13 km) with 5 × 800 m at 5K race pace; jog 50-90% interval time	LT 11 miles (18 km) with 7 miles (11 km) at LT pace
Thursday	Med-long run 11 miles (18 km)	Rest or cross-train	Recovery 6 miles (10 km)	Recovery 5 miles (8 km)	Rest or cross-train
Friday	Rest or cross-train	LT 10 miles (16 km) with 6 miles (10 km) at LT pace	Rest or cross-train	Rest or cross-train	Med-long run 12 miles (19 km)
Saturday	Gen-aerobic + speed 7 miles (11 km) with 8 × 100 m strides	Recovery 5 miles (8 km)	Recovery + speed 6 miles (10 km) with 6 × 100 m strides	Gen-aerobic + speed 8 miles (13 km) with 6 × 10 sec hill sprints + 8 × 100 m strides	Recovery 5 miles (8 km)
Sunday	Long run 18 miles (29 km)	Long run 20 miles (32 km)	Marathon-pace run 16 miles (26 km) with 12 miles (19 km) at marathon pace	Med-long run 14 miles (23 km)	Long run 20 miles (32 km)
Weekly volume	50 miles (80 km)	54 miles (87 km)	48 miles (79 km)	43 miles (69 km)	55 miles (89 km)

Training Block 3—Race Preparation

	WEEKS TO GOAL			
	6	**5**	**4**	**3**
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	$\dot{V}O_2$max 8 miles (13 km) with 5 × 600 m at 5K race pace; jog 50-90% interval time	Gen-aerobic 8 miles (13 km)	$\dot{V}O_2$max 8 miles (13 km) with 5 × 600 m at 5K race pace; jog 50-90% interval time	Recovery + speed 7 miles (11 km) with 6 × 100 m strides
Wednesday	Med-long run 12 miles (19 km)	$\dot{V}O_2$max 9 miles (14 km) with 5 × 1,000 m at 5K race pace; jog 50-90% interval time	Med-long run 11 miles (18 km)	$\dot{V}O_2$max 10 miles (16 km) with 4 × 1,200 m at 5K race pace; jog 50-90% interval time
Thursday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train

Friday	Recovery + speed 5 miles (8 km) with 6 × 100 m strides	Med-long run 12 miles (19 km)	Recovery + speed 4 miles (6 km) with 6 × 100 m strides	Med-long run 11 miles (18 km)
Saturday	8K-15K tune-up race (total 9-13 miles [14-21 km])	Recovery 5 miles (8 km)	8K-15K tune-up race (total 9-13 miles [14-21 km])	Recovery 4 miles (6 km)
Sunday	Long run 17 miles (27 km)	Marathon-pace run 18 miles (29 km) with 14 miles (23 km) at marathon pace	Long run 17 miles (27 km)	Long run 20 miles (32 km)
Weekly volume	51-55 miles (82-89 km)	52 miles (84 km)	49-53 miles (79-85 km)	52 miles (84 km)

Training Block 4—Taper and Race

	WEEKS TO GOAL		
	2	**1**	**Race week**
Monday	Rest or cross-train	Rest or cross-train	Rest
Tuesday	$\dot{V}O_2max$ 8 miles (13 km) with 5 × 600 m at 5K race pace; jog 50-90% interval time	Recovery + speed 7 miles (11 km) with 8 × 100 m strides	Recovery 6 miles (10 km)
Wednesday	Recovery 6 miles (10 km)	$\dot{V}O_2max$ 8 miles (13 km) with 4 × 1,200 m at 5K race pace; jog 50-90% interval time	Dress rehearsal 7 miles (11 km) with 2 miles (3 km) at marathon pace
Thursday	Rest or cross-train	Rest or cross-train	Rest
Friday	Recovery + speed 4 miles (6 km) with 6 × 100 m strides	Recovery + speed 5 miles (8 km) with 6 × 100 m strides	Recovery + speed 5 miles (8 km) with 6 × 100 m strides
Saturday	8K-10K tune-up race (total 9-11 miles [14-18 km])	Rest or cross-train	Recovery 4 miles (6 km)
Sunday	Long run 16 miles (26 km)	Med-long run 12 miles (19 km)	Goal marathon

Weekly volume	43-45 miles (69-72 km)	32 miles (51 km)	22 miles (35 km) (6 days prerace)

Up to 55 Miles per Week 12-Week Schedule

Training Block 1—Endurance

	WEEKS TO GOAL			
	11	**10**	**9**	**8**
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	Gen-aerobic + speed 8 miles (13 km) with 6 × 10 sec hill sprints + 8 × 100 m strides	Med-long run 11 miles (18 km)	Gen-aerobic + speed 8 miles (13 km) with 6 × 10 sec hill sprints + 8 × 100 m strides	Recovery 5 miles (8 km)
Wednesday	Rest or cross-train	Rest or cross-train	Recovery 4 miles (6 km)	LT 10 miles (16 km) with 5 miles (8 km) at LT pace
Thursday	Gen-aerobic 9 miles (14 km)	LT 8 miles (13 km) with 4 miles (6 km) at LT pace	Med-long run 11 miles (18 km)	Med-long run 11 miles (18 km)
Friday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Saturday	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 4 miles (6 km)	Recovery 5 miles (8 km)
Sunday	Marathon-pace run 13 miles (21 km) with 8 miles (13 km) at marathon pace	Med-long run 15 miles (24 km)	Marathon-pace run 16 miles (26 km) with 10 miles (16 km) at marathon pace	Long run 17 miles (27 km)
Weekly volume	35 miles (56 km)	39 miles (63 km)	43 miles (69 km)	48 miles (77 km)

Training Block 2—LT + Endurance

	WEEKS TO GOAL		
	(Recovery) 7	**6**	**5**
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	Rest or cross-train	Recovery 5 miles (8 km)	Recovery + speed 6 miles (10 km) with 6 × 100 m strides
Wednesday	Med-long run 12 miles (19 km)	$\dot{V}O_2max$ 10 miles (16 km) with 5 × 1,000 m at 5K race pace; jog 50-90% interval time	Med-long run 12 miles (19 km)
Thursday	Rest or cross-train	Med-long run 12 miles (19 km)	Rest or cross-train
Friday	LT 9 miles (14 km) with 4 miles (6 km) at LT pace	Rest or cross-train	LT 12 miles (19 km) with 7 miles (11 km) at LT pace
Saturday	Recovery 5 miles (8 km)	Recovery + speed 6 miles (10 km) with 6 × 100 m strides	Recovery 5 miles (8 km)
Sunday	Long run 16 miles (26 km)	Marathon-pace run 15 miles (24 km) with 12 miles (19 km) at marathon pace	Long run 20 miles (32 km)
Weekly volume	42 miles (68 km)	48 miles (77 km)	55 miles (89 km)

Training Block 3—Race Preparation

	WEEKS TO GOAL		
	4	**3**	**2**
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	$\dot{V}O_2max$ 8 miles (13 km) with 5 × 600 m at 5K race pace; jog 50-90% interval time	Recovery + speed 7 miles (11 km) with 6 × 100 m strides	$\dot{V}O_2max$ 8 miles (13 km) with 5 × 600 m at 5K race pace; jog 50-90% interval time
Wednesday	Med-long run 11 miles (18 km)	$\dot{V}O_2max$	Recovery 6 miles (10 km)

		10 miles (16 km) with 4 × 1,200 m at 5K race pace; jog 50-90% interval time	
Thursday	Rest or cross-train	Rest or cross-train	Rest or cross-train
Friday	Recovery + speed 4 miles (6 km) with 6 × 100 m strides	Med-long run 11 miles (18 km)	Recovery + speed 4 miles (6 km) with 6 × 100 m strides
Saturday	8K-15K tune-up race (total 9-13 miles [14-21 km])	Recovery 4 miles (6 km)	8K-10K tune-up race (total 9-11 miles [14-18 km])
Sunday	Long run 17 miles (27 km)	Long run 20 miles (32 km)	Long run 16 miles (26 km)
Weekly volume	49-53 miles (79-85 km)	52 miles (84 km)	43-45 miles (69-72 km)

Training Block 4—Taper and Race

	WEEKS TO GOAL	
	1	**Race week**
Monday	Rest or cross-train	Rest
Tuesday	Recovery + speed 7 miles (11 km) with 8 × 100 m strides	Recovery 6 miles (10 km)
Wednesday	$\dot{V}O_2max$ 8 miles (13 km) with 4 × 1,200 m at 5K race pace; jog 50-90% interval time	Dress rehearsal 7 miles (11 km) with 2 miles (3 km) at marathon pace
Thursday	Rest or cross-train	Rest
Friday	Recovery + speed 5 miles (8 km) with 6 × 100 m strides	Recovery + speed 5 miles (8 km) with 6 × 100 m strides
Saturday	Rest or cross-train	Recovery 4 miles (6 km)
Sunday	Med-long run 12 miles (19 km)	Goal marathon
Weekly volume	32 miles (51 km)	22 miles (35 km) (6 days prerace)

Up to 55 Miles per Week Recovery

Training Block 5—Recovery

	WEEKS POSTMARATHON				
	1	2	3	4	5
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	Rest or cross-train	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Gen-aerobic 7 miles (11 km)	Gen-aerobic 7 miles (11 km)
Wednesday	Recovery 4 miles (6 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)
Thursday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Friday	Recovery 4 miles (6 km)	Recovery 6 miles (10 km)	Gen-aerobic + speed 7 miles (11 km) with 8 × 100 m strides	Gen-aerobic + speed 8 miles (13 km) with 8 × 100 m strides	Gen-aerobic + speed 8 miles (13 km) with 8 × 100 m strides
Saturday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Recovery 4 miles (6 km)
Sunday	Recovery 5 miles (8 km)	Recovery 7 miles (11 km)	Gen-aerobic 9 miles (14 km)	Gen-aerobic 10 miles (16 km)	Med-long run 11 miles (18 km)
Weekly volume	13 miles (21 km)	23 miles (37 km)	26 miles (42 km)	30 miles (48 km)	35 miles (56 km)

Chapter 10

Marathon Training on 55 to 70 Miles (89 to 113 km) per Week

Cameron Spencer/Getty Images

This chapter is for mid- to high-mileage marathoners who train 55 to 70 miles (89 to 113 km) per week. It includes two schedules: an 18-week schedule that starts at 54 miles (87 km) per week and a 12-week schedule that starts at 55 miles (89 km) per week. Each schedule increases weekly mileage progressively to a peak of 70 miles (113 km).

As discussed in chapter 1, it's useful to divide your overall training schedule into training blocks of several weeks each. The training schedules consist of four blocks, which focus on endurance, lactate threshold (LT) and endurance, race preparation, and tapering, respectively. A final schedule,

which contains a 5-week postmarathon recovery program, can follow either of the training schedules.

Of the two training schedules presented in this chapter, we recommend the 18-week schedule for most situations. Eighteen weeks is plenty of time to stimulate the necessary adaptations to improve your marathon performance. At the same time, 18 weeks is short enough that you can focus your efforts without becoming bored with the process.

At times, however, you simply don't have 18 weeks to prepare for your marathon. The 12-week schedule includes the same training blocks as the 18-week schedules, but because of the short time for preparation, each block is abbreviated. If you go into a marathon in a rush, you must realize that your preparation won't be as thorough as if you had longer to prepare. The 12-week schedule takes into account that sometimes circumstances don't allow you the optimal length of time for preparation and strives to provide a compact yet effective training program.

BEFORE STARTING THE SCHEDULES

These schedules are challenging right from the start and get harder as your marathon approaches. So that you can progress as the training increases in quantity and quality and to minimize your chances of injury, you should be able to complete the first week of the schedule without too much effort.

Be realistic in assessing whether you're ready for the first week of the schedule. For example, if you've been running 30 miles (48 km) per week and your longest run in the last several weeks is 8 miles (13 km), now isn't the time to jump suddenly to a 54-mile (86 km) week containing a 15-mile (24 km) run and a 4-mile (6 km) tempo run, as the first week of the 18-week schedule calls for. The idea behind the schedules isn't to make you as tired as possible as soon as possible but to apply repeated training stress that you absorb and from which you benefit.

As a rule, you should be running at least 45 miles (72 km) a week before starting these schedules, and in the last month you should have comfortably completed a run close in length to the long run called for in the first week of the schedule.

READING THE SCHEDULES

The schedules are presented in a day-by-day format. The main limitation with this approach is that it's impossible to guess the myriad of outside factors that may influence your day-to-day nonrunning life. Work schedules, family life, relationships, school commitments, and Mother Nature all play a part in determining when you get to do your long runs and other aspects of marathon preparation. You'll no doubt require some flexibility in your training and will need to juggle days around from time to time. That's expected, and as long as you don't try to make up for lost time by doing several hard days in a row, you should be able to avoid injury and overtraining. By following the principles covered in the earlier chapters, you'll be able to safely fine-tune the training schedules to suit your circumstances.

The schedules express each day's training in miles and kilometers; use whichever you're accustomed to. The mile and kilometer figures for each day (and the weekly total) are rough equivalents of each other, not a conversion from one to the other accurate to the third decimal point.

FOLLOWING THE SCHEDULES

Each column of the schedules represents a week's training. For example, in the 12-week schedule, the column for 11 weeks to goal indicates that at the end of that week you have 11 weeks until your marathon. The schedules continue week by week until race week.

We have included a specific workout for each day as well as a category of training for that day. For example, in the 18-week schedule, on the Tuesday of the 7-weeks-to-go column, the specific workouts are a 6-mile (10 km) run and a 4-mile (6 km) run, and the category of training for that day is recovery. This aspect of the schedules allows you to quickly see the balance of training during each week and the progression of workouts from week to week. Look again at the 18-week schedule—it's easy to see that with 7 weeks to go until the marathon, there are four recovery days that week, along with an LT session, a long run, and a medium-long run. Looking at the row for Sunday, it's easy to see how the long runs progress and then taper in the last few weeks before the marathon.

The workouts are divided into the following eight categories: long runs, medium-long runs, marathon-pace runs, general aerobic runs, LT runs, recovery runs, $\dot{V}O_2max$ intervals, and speed training. Each of these categories is explained in depth in chapter 8, and the physiology behind the training is explained in chapter 1.

As discussed in chapter 8, sometimes marathoners benefit from running twice a day. This is obviously the case for elites cranking out 130-mile (209 km) weeks, but it isn't necessary on a regular basis if you're running 50 to 70 miles (80 to 113 km) per week. In these schedules, doubles are called for only on the occasional recovery day, with a total of 10 miles (16 km) for the day. On these days, your recovery will be enhanced by doing a 6-miler (10 km) and a 4-miler (6 km) rather than putting in one 10-mile (16 km) run. Instead of making you more tired, splitting your mileage like this on easy days will speed your recovery because each run will increase blood flow to your muscles yet take little out of you.

RACING STRATEGIES

We discussed marathon race strategy at length in chapter 7. Part of that discussion centered on running with a group when possible. If you follow one of the schedules in this chapter, you might well be finishing within the top quarter or third of the field in your marathon. That means you're likely to have runners around you throughout the marathon, especially in a big-city race, but there won't be so many people in front of you at the start that you'll spend the first few miles navigating around crowds. Make use of this probable position within the field; once you feel as if you're running comfortably at your goal pace, look around for other runners who appear able to sustain the pace until the end. Talk to them, ask what their goals are, and try to find others to run with.

Training with others can help with running in a pack on race day.
Katherine Frey/The Washington Post via Getty Images

In chapter 7, we also discussed the importance of a conservative early pace. Although you'll be well trained if you follow one of these schedules, you won't have as large a margin of error as those who have regularly put in 85 miles (137 km) a week or more. If you run intelligently in the early part of the race, you'll have runners to pick off regularly in the last 10 miles (16 km) or so because others who are either less prepared or more foolhardy will come back to you.

AFTER THE MARATHON

The final schedule in this chapter is a 5-week recovery schedule for after the marathon; it completes the training program and leaves you ready to prepare for future challenges.

The recovery schedule is purposely conservative. You have little to gain by rushing back into training, and your risk of injury is elevated at this point, owing to the reduced resiliency of your muscles and connective tissue after the marathon.

The schedule starts with 2 days off from running, which is the bare minimum of time away from running you should allow yourself. If you still have acute soreness or tightness so severe that it will alter your form, or if you just don't feel like running, certainly feel free to take more than 2 days off. If ever there was a time to lose your marathoner's mind-set, the week after your goal race is it. Even most of the top runners in the world take days off after a marathon. They know that the nearly negligible benefits of a short run at this time are far outweighed by the risks. Not running now will also increase your chances of being inspired to resume hard training when your body allows it.

Of course, some people don't consider themselves real runners unless they run pretty much every day of their lives. Plod through a few miles if you must, but be aware that you're likely prolonging your recovery.

What better aids recovery during this time is light cross-training, such as swimming or cycling. These activities increase blood flow through your muscles without subjecting them to pounding. Walking will also achieve this in the week after the marathon.

One way to ensure that you don't run too hard too soon after your marathon is to use a heart rate monitor. As discussed in chapter 3, a heart rate monitor can help prevent you from going too fast on recovery days. During the first few weeks after the marathon, keep your heart rate below 76 percent of your maximal heart rate or 68 percent of your heart rate reserve. Running at this intensity will help your body overcome the stress of the marathon as quickly as possible.

During this 5-week recovery schedule, the number of days of running per week increases from 3 to 5. At the end of the 5 weeks, you should be fully recovered from the marathon and, with a little luck, injury free and mentally fresh.

55 to 70 Miles per Week 18-Week Schedule

Training Block 1—Endurance

	WEEKS TO GOAL					
	17	16	15	14	13	(Recovery)12
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	LT 9 miles (14 km) with 4 miles (6 km) at LT pace	Gen-aerobic + speed 8 miles (13 km) with 6 × 10 sec hill sprints + 8 × 100 m strides	Med-long run 11 miles (18 km)	Gen-aerobic + speed 9 miles (14 km) with 6 × 10 sec hill sprints + 8 × 100 m strides	LT 9 miles (14 km) with 5 miles (8 km) at LT pace	Gen-aerobic + speed 8 miles (13 km) with 10 × 100 m strides
Wednesday	Med-long run 11 miles (18 km)	Med-long run 12 miles (19 km)	Med-long run 13 miles (21 km)	Med-long run 14 miles (23 km)	Med-long run 14 miles (23 km)	Med-long run 12 miles (19 km)
Thursday	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)
Friday	Gen-aerobic 9 miles (14 km)	Gen-aerobic 9 miles (14 km)	LT 9 miles (14 km) with 4 miles (6 km) at LT pace	Med-long run 11 miles (18 km)	Med-long run 12 miles (19 km)	Gen-aerobic 10 miles (16 km)
Saturday	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)
Sunday	Med-long run 15 miles (24 km)	Marathon-pace run 16 miles (26 km) with 8 miles (13 km) at marathon pace	Med-long run 15 miles (24 km)	Long run 18 miles (29 km)	Marathon-pace run 18 miles (29 km) with 10 miles (16 km) at marathon pace	Med-long run 15 miles (24 km)
Weekly volume	54 miles (87 km)	55 miles (89 km)	58 miles (93 km)	62 miles (100 km)	63 miles (101 km)	55 miles (89 km)

Training Block 2—LT + Endurance

	WEEKS TO GOAL				
	11	10	9	(Recovery) 8	7
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	LT 10 miles (16 km) with 5 miles (8 km) at LT pace	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Gen-aerobic 9 miles (14 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)
Wednesday	Med-long run 14 miles (23 km)	Med-long run 14 miles (23 km)	Med-long run 15 miles (24 km)	$\dot{V}O_2$max 9 miles (14 km) with 6 × 800 m at 5K race pace; jog 50-90% interval time	Med-long run 15 miles (24 km)
Thursday	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)
Friday	Med-long run 11 miles (18 km)	LT 11 miles (18 km) with 6 miles (10 km) at LT pace	Med-long run 13 miles (21 km)	Med-long run 11 miles (18 km)	LT 12 miles (19 km) with 7 miles (11 km) at LT pace
Saturday	Gen-aerobic + speed 7 miles (11 km) with 10 × 100 m strides	Recovery 6 miles (10 km)	Recovery + speed 7 miles (11 km) with 6 × 100 m strides	Gen-aerobic + speed 8 miles (13 km) with 8 × 10 sec hill sprints + 8 × 100 m strides	Recovery 5 miles (8 km)
Sunday	Long run 21 miles (34 km)	Long run 20 miles (32 km)	Marathon-pace run 16 miles (26 km) with 12 miles (19 km) at marathon pace	Med-long run 15 miles (24 km)	Long run 22 miles (35 km)
Weekly volume	68 miles (109 km)	66 miles (106 km)	67 miles (108 km)	58 miles (93 km)	70 miles (113 km)

Training Block 3—Race Preparation

	WEEKS TO GOAL			
	6	**5**	**4**	**3**
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	$\dot{V}O_2max$ 9 miles (14 km) with 5 × 600 m at 5K race pace; jog 50-90% interval time	$\dot{V}O_2max$ 10 miles (16 km) with 6 × 1,000 m at 5K race pace; jog 50-90% interval time	$\dot{V}O_2max$ 9 miles (14 km) with 5 × 600 m at 5K race pace; jog 50-90% interval time	Recovery AM 6 miles (10 km) PM 4 miles (6 km)
Wednesday	Med-long run 14 miles (23 km)	Med-long run 15 miles (24 km)	Med-long run 14 miles (23 km)	$\dot{V}O_2max$ 11 miles (18 km) with 5 × 1,200 m at 5K race pace; jog 50-90% interval time
Thursday	Recovery + speed AM 6 miles (10 km) with 6 × 100 m strides PM 4 miles (6 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery + speed 6 miles (10 km) with 6 × 100 m strides	Med-long run 14 miles (23 km)
Friday	Recovery 5 miles (8 km)	Med-long run 12 miles (19 km)	Recovery 5 miles (8 km)	Gen-aerobic + speed 8 miles (13 km) with 8 × 100 m strides
Saturday	8K-15K tune-up race (total 9-13 miles [14-21 km])	Recovery 5 miles (8 km)	8K-15K tune-up race (total 9-13 miles [14-21 km])	Recovery 5 miles (8 km)
Sunday	Long run 18 miles (29 km)	Marathon-pace run 18 miles (29 km) with 14 miles (23 km) at marathon pace	Long run 17 miles (27 km)	Long run 20 miles (32 km)
Weekly	65-69 miles	70 miles (113	60-64 miles	68 miles (109

volume	(105-111 km)	km)	(96-103 km)	km)

Training Block 4—Taper and Race

	WEEKS TO GOAL		
	2	**1**	**Race week**
Monday	Rest or cross-train	Rest	Rest
Tuesday	Recovery + speed 7 miles (11 km) with 8 × 100 m strides	Recovery + speed 7 miles (11 km) with 8 × 100 m strides	Recovery 7 miles (11 km)
Wednesday	Med-long run 12 miles (19 km)	Recovery 4 miles (6 km)	Dress rehearsal 7 miles (11 km) with 2 miles (3 km) at marathon pace
Thursday	Recovery + speed 5 miles (8 km) with 6 × 100 m strides	$\dot{V}O_2max$ 8 miles (13 km) with 4 × 1,200 m at 5K race pace; jog 50-90% interval time	Recovery 5 miles (8 km)
Friday	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery + speed 5 miles (8 km) with 6 × 100 m strides
Saturday	8K-10K tune-up race (total 9-11 miles [14-18 km])	Recovery + speed 6 miles (10 km) with 8 × 100 m strides	Recovery 4 miles (6 km)
Sunday	Long run 17 miles (27 km)	Med-long run 13 miles (21 km)	Goal marathon
Weekly volume	55-57 miles (89-92 km)	43 miles (69 km)	28 miles (45 km) (6 days prerace)

55 to 70 Miles per Week 12-Week Schedule

Training Block 1—Endurance

	WEEKS TO GOAL			
	11	**10**	**9**	**8**

Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	Gen-aerobic + speed 8 miles (13 km) with 6 × 10 sec hill sprints + 8 × 100 m strides	Med-long run 12 miles (19 km)	Gen-aerobic + speed 9 miles (14 km) with 6 × 10 sec hill sprints + 8 × 100 m strides	Med-long run 13 miles (21 km)
Wednesday	Med-long run 11 miles (18 km)	Med-long run 11 miles (18 km)	Med-long run 14 miles (22 km)	Med-long run 15 miles (24 km)
Thursday	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)
Friday	Med-long run 11 miles (18 km)	LT 9 miles (14 km) with 4 miles (6 km) at LT pace	Med-long run 12 miles (19 km)	LT 10 miles (16 km) with 5 miles (8 km) at LT pace
Saturday	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)
Sunday	Marathon-pace run 15 miles (24 km) with 8 miles (13 km) at marathon pace	Long run 17 miles (27 km)	Marathon-pace run 17 miles (27 km) with 10 miles (16 km) at marathon pace	Long run 18 miles (29 km)
Weekly volume	55 miles (89 km)	59 miles (95 km)	62 miles (100 km)	66 miles (106 km)

Training Block 2—LT + Endurance

	WEEKS TO GOAL		
	(Recovery) 7	**6**	**5**
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	Gen-aerobic + speed 8 miles (13 km) with 10 × 100 m strides	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Gen-aerobic + speed 9 miles (14 km) with 10 × 100 m strides
Wednesday	Med-long run 15 miles (24 km)	$\dot{V}O_2max$ 11 miles (18 km) with 5 × 1,200 m at 5K race pace;	Med-long run 15 miles (24 km)

		jog 50-90% interval time	
Thursday	Recovery 5 miles (8 km)	Med-long run 15 miles (24 km)	Recovery 7 miles (11 km)
Friday	LT 10 miles (16 km) with 4 miles (6 km) at LT pace	Gen-aerobic 10 miles (16 km)	LT 12 miles (19 km) with 7 miles (11 km) at LT pace
Saturday	Recovery 7 miles (11 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)
Sunday	Long run 17 miles (27 km)	Marathon-pace run 18 miles (29 km) with 12 miles (19 km) at marathon pace	Long run 21 miles (34 km)
Weekly volume	59 miles (95 km)	70 miles (113 km)	70 miles (113 km)

Training Block 3—Race Preparation

	WEEKS TO GOAL		
	4	**3**	**2**
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	$\dot{V}O_2max$ 9 miles (14 km) with 5 × 600 m at 5K race pace; jog 50-90% interval time	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	$\dot{V}O_2max$ 8 miles (13 km) with 5 × 600 m at 5K race pace; jog 50-90% interval time
Wednesday	Med-long run 15 miles (24 km)	$\dot{V}O_2max$ 11 miles (18 km) with 6 × 1,000 m at 5K race pace; jog 50-90% interval time	Med-long run 12 miles (19 km)
Thursday	Recovery + speed 7 miles (11 km) with 6 × 100 m strides	Med-long run 15 miles (24 km)	Recovery 6 miles (10 km) with 6 × 100 m strides
Friday	Recovery 6 miles (10 km)	Gen-aerobic 8 miles (13 km)	Recovery 5 miles (8 km)
Saturday	8K-15K tune-up race (total 9-13 miles [14-21 km])	Recovery 6 miles (10 km)	8K-10K tune-up race (total 9-11 miles [14-18 km])
Sunday	Long run 18 miles (29 km)	Long run 20 miles (32 km)	Long run 17 miles (27 km)

Weekly volume	64-68 miles (103-109 km)	70 miles (113 km)	57-59 miles (92-95 km)

Training Block 4—Taper and Race

	WEEKS TO GOAL	
	1	**Race week**
Monday	Rest or cross-train	Rest
Tuesday	Gen-aerobic + speed 8 miles (13 km) with 10 × 100 m strides	Recovery 7 miles (11 km)
Wednesday	Recovery 4 miles (6 km)	Dress rehearsal 7 miles (11 km) with 2 miles (3 km) at marathon pace
Thursday	$\dot{V}O_2max$ 8 miles (13 km) with 4 × 1,200 m at 5K race pace; jog 50-90% interval time	Recovery 5 miles (8 km)
Friday	Recovery 5 miles (8 km)	Recovery + speed 5 miles (8 km) with 6 × 100 m strides
Saturday	Recovery + speed 6 miles (10 km) with 10 × 100 m strides	Recovery 4 miles (6 km)
Sunday	Med-long run 13 miles (21 km)	Goal marathon
Weekly volume	44 miles (71 km)	28 miles (45 km) (6 days prerace)

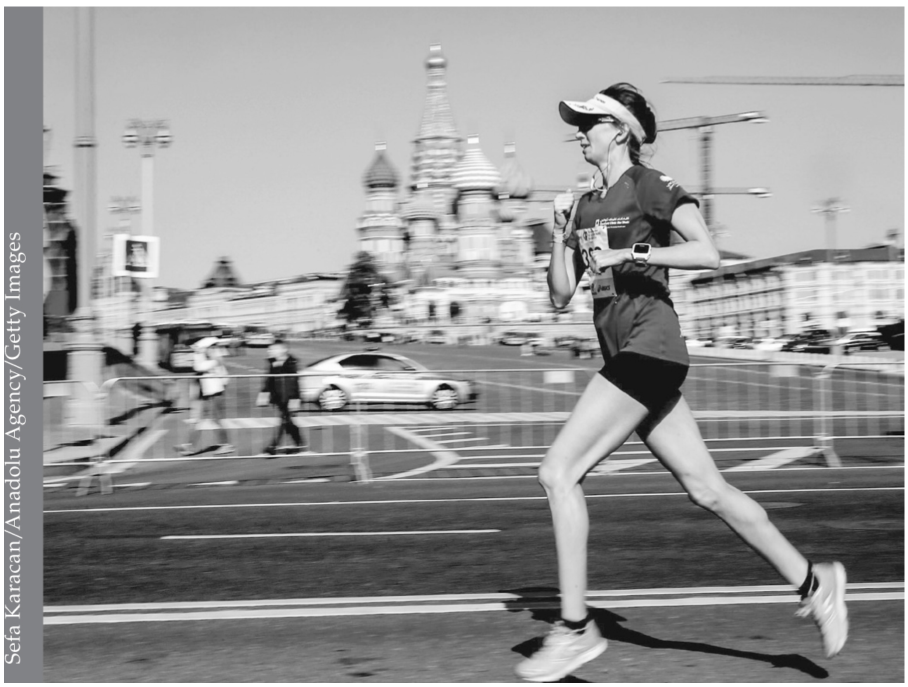
55 to 70 Miles per Week Recovery

Training Block 5—Recovery

	WEEKS POSTMARATHON				
	1	2	3	4	5
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	Rest or cross-train	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 6 miles (10 km)
Wednesday	Recovery 4 miles (6 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Gen-aerobic 7 miles (11 km)	Gen-aerobic 8 miles (13 km)
Thursday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Friday	Recovery 5 miles (8 km)	Recovery 6 miles (10 km)	Gen-aerobic + speed 7 miles (11 km) with 8 × 100 m strides	Gen-aerobic + speed 8 miles (13 km) with 8 × 100 m strides	Gen-aerobic + speed 9 miles (14 km) with 8 × 100 m strides
Saturday	Rest or cross-train	Rest or cross-train	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 6 miles (10 km)
Sunday	Recovery 6 miles (10 km)	Recovery 8 miles (13 km)	Gen-aerobic 9 miles (14 km)	Med-long run 11 miles (18 km)	Med-long run 12 miles (19 km)
Weekly volume	15 miles (24 km)	24 miles (39 km)	31 miles (50 km)	36 miles (58 km)	41 miles (66 km)

Chapter 11

Marathon Training on 70 to 85 Miles (113 to 137 km) per Week



Sefa Karacan/Anadolu Agency/Getty Images

This chapter is for high-mileage marathoners. It includes two schedules: an 18-week schedule that starts at 65 miles (105 km) per week and a 12-week schedule that starts at 66 miles (106 km) per week. Each of these schedules increases weekly mileage progressively and builds to a peak of 87 miles (140 km).

As discussed in chapter 1, it's useful to divide your overall training schedule into training blocks of several weeks each. The training schedules consist of four blocks, which focus on endurance, lactate threshold (LT) and endurance, race preparation, and tapering, respectively. A final schedule,

which contains a 5-week postmarathon recovery program, can follow either of the training schedules.

Of the two training schedules presented in this chapter, we recommend the 18-week schedule for most situations. Eighteen weeks is plenty of time to stimulate the necessary adaptations to improve your marathon performance. At the same time, 18 weeks is short enough that you can focus your efforts without becoming bored with the process.

At times, however, you simply don't have 18 weeks to prepare for your marathon. The 12-week schedule includes the same training blocks as the 18-week schedule, but because of the short time for preparation, each block is abbreviated. If you go into a marathon in a rush, you must realize that your preparation won't be as thorough as if you had longer to prepare. The 12-week schedule takes into account that sometimes circumstances don't allow you the optimal length of time for preparation and strives to provide a compact yet effective training program.

BEFORE STARTING THE SCHEDULES

These schedules are challenging right from the start and get harder as your marathon approaches. So that you can progress as the training increases in quantity and quality and to minimize your chances of injury, you should be able to complete the first week of the schedule without too much effort.

Be realistic in assessing whether you're ready for the first week of the schedule. For example, if you've been running 40 miles (64 km) per week and your longest run in the last several weeks is 12 miles (19 km), now isn't the time to suddenly jump to a 65-mile (105 km) week containing a 17-mile (27 km) run, as the first week of the 18-week schedule calls for. The idea behind the schedules isn't to make you as tired as possible as soon as possible but to apply repeated training stress that you absorb and from which you benefit.

As a rule, you should be running at least 55 miles (89 km) a week before starting these schedules, and in the last month, you should have comfortably completed a run close in length to the long run called for in the first week of the schedule.

READING THE SCHEDULES

The schedules are presented in a day-by-day format. The main limitation with this approach is that it's impossible to guess the myriad of outside factors that may influence your day-to-day nonrunning life (assuming you still have one at this level of volume). Work schedules, family life, relationships, school commitments, and Mother Nature all play a part in determining when you get to do your long runs and other aspects of marathon preparation. You'll no doubt require some flexibility in your training and will need to juggle days around from time to time. That's expected, and as long as you don't try to make up for lost time by doing several hard days in a row, you should be able to avoid injury and overtraining. By following the principles covered in the earlier chapters, you will be able to safely fine-tune the training schedules to suit your circumstances.

The schedules express each day's training in miles and kilometers; use whichever you're accustomed to. The mile and kilometer figures for each day (and the weekly total) are rough equivalents of each other, not a conversion from one to the other accurate to the third decimal point.

FOLLOWING THE SCHEDULES

Each column of the schedules represents a week's training. For example, in the 12-week schedule, the column for 11 weeks to goal indicates that at the end of that week you have 11 weeks until your marathon. The schedules continue week by week until race week.

Strong training and a good taper should make the early miles feel easy.

ERIC FEFERBERG/AFP/Getty Images

We have included a specific workout for each day as well as a category of training for that day. For example, in the 18-week schedule, on the Monday of the 7-weeks-to-go column, the specific workouts are a 6-mile (10 km) run and a 4-mile (6 km) run, and the category of training for that day is recovery. This aspect of the schedules allows you to quickly see the balance of training during each week and the progression of workouts from week to week. Look again at the 18-week schedule—it's easy to see that with 7 weeks to go until the marathon, there are two recovery days that week, plus two general aerobic runs, an LT session, a long run, and a medium-long run. Looking at the row for Sunday, it's easy to see how the long runs progress and then taper in the last few weeks before the marathon.

The workouts are divided into the following eight categories: long runs, medium-long runs, marathon-pace runs, general aerobic runs, LT runs, recovery runs, $\dot{V}O_2$max intervals, and speed training. Each of these categories is explained in depth in chapter 8, and the physiology behind the training is explained in chapter 1.

DOING DOUBLES

As discussed in chapter 8, sometimes marathoners benefit from running twice a day. This is obviously the case for elites cranking out 130-mile (209 km) weeks, but it can also be true for anyone running more than 70 miles (113 km) a week. In these schedules, for example, recovery days of 10 miles (16 km) are often broken into two short runs. Rather than making you more tired, splitting your mileage like this on easy days will speed your recovery because each run will increase blood flow to your muscles yet take little out of you.

As we mention at the beginning of this chapter, we know that not everyone will be able to follow these schedules exactly as they appear. That applies on the days that call for an LT workout in the morning and an easy recovery run in the evening. If your schedule makes it more likely that you'll do a high-quality tempo run in the evening rather than the morning, simply flip the workouts prescribed for these days. Just be sure to make the short morning run a true recovery run.

When a second run is called for on the day of a medium-long run, however, try to stick to the schedule as written. As explained in chapter 4, a short evening run on these days provides an additional endurance boost, whereas doing a short morning run and a medium-long run in the evening will likely detract from the quality of the medium-long run. Again, though, use your best judgment. If your schedule means that you'll have to do a midweek medium-long run at 4:30 a.m., you're probably better off making time for it in the evening.

RACING STRATEGIES

We discussed marathon race strategy at length in chapter 7. If you follow one of the schedules in this chapter, you'll probably find yourself near the front part of the field once everyone settles into their paces. Still, you might be running with people who aren't as well prepared as you (e.g., a fit-looking man in his late 20s whose goal is to break 3:00, more because it's a nice round number than because that's what his training has prepared him for). If you wind up in a group early on, talk to the others to get a sense of whom you can count on still being there with 10 miles (16 km) to go.

Because of your strong preparation followed by an effective taper, you'll probably find your goal pace in the early miles quite easy. After all, you were doing long runs with lengthy sections at goal pace in the midst of your heaviest training. Now that you're rested and filled with race-day excitement, goal pace should feel eminently doable. You'll need to be disciplined and resist the temptation to go too fast so that you can use your fitness in the second half of the race and run even splits. Although your outstanding preparation makes you less likely than most to blow up late in the race from a too-hasty start, there's still no point in squandering months of hard work with an overly ambitious early pace.

AFTER THE MARATHON

The final schedule in this chapter is a 5-week recovery schedule for after the marathon; it completes the training program and leaves you ready to prepare for future challenges.

The recovery schedule is purposely conservative. You have little to gain by rushing back into training, and your risk of injury is elevated at this point, owing to the reduced resiliency of your muscles and connective tissue after the marathon.

The schedule starts with 2 days off from running, which is the bare minimum of time away from running you should allow yourself. If you still have acute soreness or tightness so severe that it will alter your form, or if you just don't feel like running, certainly feel free to take more than 2 days off. If ever there was a time to lose your marathoner's mind-set, the week after your goal race is it. Even most of the top runners in the world take days off after a marathon. They know that the nearly negligible benefits of a short run at this time are far outweighed by the risks. Not running now will also increase your chances of being inspired to resume hard training when your body allows it.

Of course, some people don't consider themselves real runners unless they run pretty much every day of their lives. Plod through a few miles if you must, but be aware that you're likely prolonging your recovery.

What better aids recovery during this time is light cross-training, such as swimming or cycling. These activities increase blood flow through your muscles without subjecting them to pounding. Walking will also achieve this in the week after the marathon.

One way to ensure that you don't run too hard too soon after your marathon is to use a heart rate monitor. As discussed in chapter 3, a heart rate monitor can help prevent you from going too fast on recovery days. During the first few weeks after the marathon, keep your heart rate below 76 percent of your maximal heart rate or 68 percent of your heart rate reserve. Running at this intensity will help your body overcome the stress of the marathon as quickly as possible.

During this 5-week recovery schedule, the number of days of running per week increases from 3 to 6. At the end of the 5 weeks, you should be fully recovered from the marathon and, with a little luck, injury free and mentally fresh.

70 to 85 Miles per Week 18-Week Schedule

Training Block 1—Endurance

	WEEKS TO GOAL					
	17	16	15	14	13	(Recovery) 12
Monday	Recovery 5 miles (8 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery 7 miles (11 km)
Tuesday	LT 9 miles (14 km) with 4 miles (6 km) at LT pace	Gen-aerobic + speed 8 miles (13 km) with 6 × 12 sec hill sprints + 8 × 100 m strides	Med-long run 12 miles (19 km)	Gen-aerobic + speed 10 miles (16 km) with 8 × 12 sec hill sprints + 8 × 100 m strides	LT 10 miles (16 km) with 4 miles (6 km) at LT pace	Gen-aerobic + speed 10 miles (16 km) with 10 × 100 m strides
Wednesday	Med-long run 12 miles (19 km)	Med-long run 13 miles (21 km)	Med-long run 14 miles (23 km)	Med-long run 14 miles (23 km)	Med-long run 15 miles (24 km)	Med-long run 13 miles (21 km)
Thursday	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)
Friday	Gen-aerobic 10 miles (16 km)	Med-long run 11 miles (18 km)	LT 10 miles (16 km) with 5 miles (8 km) at LT pace	Med-long run 12 miles (19 km)	Med-long run 13 miles (21 km)	Gen-aerobic 10 miles (16 km)
Saturday	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)
Sunday	Long run 17 miles (27 km)	Marathon-pace run 17 miles (27 km) with 8 miles (13 km) at marathon pace	Med-long run 16 miles (26 km)	Long run 20 miles (32 km)	Marathon-pace run 18 miles (29 km) with 10 miles (16 km) at marathon pace	Long run 16 miles (26 km)
Weekly volume	65 miles (105 km)	67 miles (108 km)	70 miles (113 km)	74 miles (119 km)	78 miles (126 km)	68 miles (109 km)

Training Block 2—LT + Endurance

	WEEKS TO GOAL				
	11	10	9	8	(Recovery) 7
Monday	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)
Tuesday	LT 11 miles (18 km) with 5 miles (8 km) at LT pace	Gen-aerobic 9 miles (14 km)	Gen-aerobic 9 miles (14 km)	Gen-aerobic 9 miles (14 km)	Gen-aerobic 8 miles (13 km)
Wednesday	Med-long run 15 miles (24 km)	Med-long run 15 miles (24 km)	Med-long run 15 miles (24 km)	$\dot{V}O_2$max 9 miles (14 km) with 6 × 800 m at 5K race pace; jog 50-90% interval time	Med-long run 15 miles (24 km)
Thursday	Recovery 7 miles (11 km)	Recovery 7 miles (11 km)	Recovery 8 miles (13 km)	Recovery 7 miles (11 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)
Friday	Med-long run 13 miles (21 km)	LT 12 miles (19 km) with 6 miles (10 km) at LT pace	Med-long run 13 miles (21 km)	Med-long run AM 11 miles (18 km) Recovery PM 4 miles (6 km)	LT 12 miles (19km) with 7 miles (11 km) at LT pace
Saturday	Gen-aerobic + speed 8 miles (13 km) with 10 × 100 m strides	Recovery 7 miles (11 km)	Recovery + speed 7 miles (11 km) with 6 × 100 m strides	Gen-aerobic + speed 8 miles (13 km) with 8 × 12 sec hill sprints + 8 × 100 m strides	Gen-aerobic 8 miles (13 km)
Sunday	Long run 20 miles (32 km)	Long run 22 miles (35 km)	Marathon-pace run 18 miles (29 km) with 12 miles (19 km) at marathon pace	Long run 16 miles (26 km)	Long run 24 miles (39 km)
Weekly volume	84 miles (135 km)	82 miles (130 km)	80 miles (129 km)	74 miles (119 km)	87 miles (140 km)

Training Block 3—Race Preparation

	WEEKS TO GOAL			
	6	**5**	**4**	**3**
Monday	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)
Tuesday	$\dot{V}O_2$max 9 miles (14 km) with 5 × 600 m at 5K race pace; jog 50-90% interval time	$\dot{V}O_2$max 12 miles (19 km) with 6 × 1,000 m at 5K race pace; jog 50-90% interval time	$\dot{V}O_2$max 9 miles (14 km) with 5 × 600 m at 5K race pace; jog 50-90% interval time	Gen-aerobic 8 miles (13 km)
Wednesday	Med-long run 15 miles (24 km)	Med-long run 15 miles (24 km)	Med-long run 14 miles (22 km)	$\dot{V}O_2$max 12 miles (19 km) with 6 × 1,200 m at 5K race pace; jog

				50-90% interval time
Thursday	Recovery + speed 7 miles (11 km) with 6 × 100 m strides	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery + speed 7 miles (11 km) with 6 × 100 m strides	Med-long run AM 15 miles (24 km) Recovery PM 4 miles (6 km)
Friday	Recovery 6 miles (10 km)	Med-long run 12 miles (19 km)	Recovery 6 miles (10 km)	Gen-aerobic + speed 8 miles (13 km) with 8 × 100 m strides
Saturday	8K-15K tune-up race (total 9-13 miles [14-21 km])	Recovery 7 miles (11 km)	8K-15K tune-up race (total 9-13 miles [14-21 km])	Recovery 6 miles (10 km)
Sunday	Long run 18 miles (29 km)	Marathon-pace run 20 miles (32 km) with 14 miles (23 km) at marathon pace	Long run 18 miles (29 km)	Long run 22 miles (35 km)
Weekly volume	74-78 miles (119-126 km)	86 miles (138 km)	73-77 miles (117-124 km)	85 miles (137 km)

Training Block 4—Taper and Race

	WEEKS TO GOAL		
	2	**1**	**Race week**
Monday	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)
Tuesday	$\dot{V}O_2max$ 9 miles (14 km) with 5 × 600 m at 5K race pace; jog 50-90% interval time	Gen-aerobic + speed 8 miles (13 km) with 8 × 100 m strides	Gen-aerobic 7 miles (11 km)
Wednesday	Med-long run 14 miles (23 km)	Recovery 6 miles (10 km)	Dress rehearsal 8 miles (13 km) with 2 miles (3 km) at marathon pace
Thursday	Recovery + speed	$\dot{V}O_2max$	Recovery 6 miles (10 km)

	7 miles (11 km) with 6 × 100 m strides	9 miles (14 km) with 4 × 1,200 m at 5K race pace; jog 50-90% interval time	
Friday	Recovery 6 miles (10 km)	Recovery 5 miles (8 km)	Recovery + speed 5 miles (8 km) with 6 × 100 m strides
Saturday	8K-10K tune-up race (total 9-11 miles [14-18 km])	Gen-aerobic + speed 7 miles (11 km) with 8 × 100 m strides	Recovery 4 miles (6 km)
Sunday	Long run 17 miles (27 km)	Med-long run 13 miles (21 km)	Goal marathon
Weekly volume	68-70 miles (109-113 km)	54 miles (87 km)	36 miles (58 km) (6 days prerace)

70 to 85 Miles per Week 12-Week Schedule

Training Block 1—Endurance

	WEEKS TO GOAL			
	11	**10**	**9**	**8**
Monday	Recovery 6 miles (10 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)
Tuesday	Gen-aerobic + speed 8 miles (13 km) with 8 × 12 sec hill sprints + 8 × 100 m strides	Med-long run 12 miles (19 km)	Gen-aerobic + speed 8 miles (13 km) with 8 × 12 sec hill sprints + 8 × 100 m strides	Med-long run 13 miles (21 km)
Wednesday	Med-long run 12 miles (19 km)	Gen-aerobic 10 miles (16 km)	Med-long run 13 miles (21 km)	Med-long run 15 miles (24 km)
Thursday	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)
Friday	Med-long run 11 miles (18 km)	LT 10 miles (16 km) with 4	Med-long run 13 miles (21 km)	LT 10 miles (16 km) with 5

		miles (6 km) at LT pace		miles (8 km) at LT pace
Saturday	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)
Sunday	Marathon-pace run 17 miles (27 km) with 8 miles (13 km) at marathon pace	Long run 18 miles (29 km)	Marathon-pace run 19 miles (31 km) with 10 miles (16 km) at marathon pace	Long run 17 miles (27 km)
Weekly volume	66 miles (106 km)	72 miles (116 km)	75 miles (121 km)	77 miles (124 km)

Training Block 2—LT + Endurance

	WEEKS TO GOAL		
	(Recovery) 7	**6**	**5**
Monday	Recovery 6 miles (10 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)
Tuesday	Gen-aerobic + speed 8 miles (13 km) with 10 × 100 m strides	Gen-aerobic 9 miles (14 km)	Gen-aerobic + speed 10 miles (16 km) with 10 × 100 m strides
Wednesday	Med-long run 15 miles (24 km)	$\dot{V}O_2$max 12 miles (19 km) with 5 × 1,200 m at 5K race pace; jog 50-90% interval time	Med-long run 15 miles (24 km)
Thursday	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Med-long run AM 15 miles (24 km) Recovery PM 4 miles (6 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)
Friday	LT 10 miles (16 km) with 4 miles (6 km) at LT pace	Gen-aerobic 10 miles (16 km)	LT 12 miles (19 km) with 7 miles (11 km) at LT pace
Saturday	Gen-aerobic + speed 7 miles (11 km) with 6 × 100 m strides	Recovery + speed 7 miles (11 km) with 6 × 100 m strides	Gen-aerobic + speed 8 miles (13 km) with 6 × 100 m strides

Sunday	Long run 18 miles (29 km)	Marathon-pace run 17 miles (27 km) with 12 miles (19 km) at marathon pace	Long run 22 miles (35 km)
Weekly volume	70 miles (113 km)	84 miles (135 km)	87 miles (140 km)

Training Block 3—Race Preparation

	WEEKS TO GOAL		
	4	**3**	**2**
Monday	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)
Tuesday	$\dot{V}O_2max$ 9 miles (14 km) with 5 × 600 m at 5K race pace; jog 50-90% interval time	Gen-aerobic 9 miles (14 km)	$\dot{V}O_2max$ 9 miles (14 km) with 5 × 600 m at 5K race pace; jog 50-90% interval time
Wednesday	Med-long run AM 15 miles (24 km) Recovery PM 4 miles (6 km)	$\dot{V}O_2max$ 11 miles (18 km) with 6 × 1,000 m at 5K race pace; jog 50-90% interval time	Med-long run 12 miles (19 km)
Thursday	Recovery + speed 7 miles (11 km) with 6 × 100 m strides	Med-long run 15 miles (24 km)	Recovery + speed 6 miles (10 km) with 6 × 100 m strides
Friday	Recovery 6 miles (10 km)	Gen-aerobic 10 miles (16 km)	Recovery 6 miles (10 km)
Saturday	8K-15K tune-up race (total 9-13 miles [14-21 km])	Gen-aerobic + speed 8 miles (13 km) with 6 ×100 m strides	8K-10K tune-up race (total 9-11 miles [14-18 km])
Sunday	Long run 18 miles (29 km)	Long run 20 miles (32 km)	Long run 17 miles (27 km)
Weekly volume	78-82 miles (124-131 km)	83 miles (134 km)	69-71 miles (111-114 km)

Training Block 4—Taper and Race

	WEEKS TO GOAL	
	1	**Race week**

Monday	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)
Tuesday	Gen-aerobic + speed 8 miles (13 km) with 8 × 100 m strides	Gen-aerobic 7 miles (11 km)
Wednesday	Recovery 6 miles (10 km)	Dress rehearsal 8 miles (13 km) with 2 miles (3 km) at marathon pace
Thursday	$\dot{V}O_2max$ 9 miles (14 km) with 4 × 1,200 m at 5K race pace; jog 50-90% interval time	Recovery 6 miles (10 km)
Friday	Recovery 5 miles (8 km)	Recovery + speed 5 miles (8 km) with 6 × 100 m strides
Saturday	Gen-aerobic + speed 7 miles (11 km) with 10 × 100 m strides	Recovery 4 miles (6 km)
Sunday	Med-long run 13 miles (21 km)	Goal marathon
Weekly volume	54 miles (87 km)	36 miles (58 km) (6 days prerace)

70 to 85 Miles per Week Recovery

Training Block 5—Recovery

	WEEKS POSTMARATHON				
	1	2	3	4	5
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	Rest or cross-train	Recovery 5 miles (8 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)
Wednesday	Recovery 4 miles (6 km)	Recovery 5 miles (8 km)	Recovery 6 miles (10 km)	Gen-aerobic 9 miles (14 km)	Gen-aerobic 9 miles (14 km)
Thursday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Recovery 6 miles (10 km)
Friday	Recovery 5 miles (8 km)	Recovery 6 miles (10 km)	Gen-aerobic + speed 8 miles (13 km) with 8 × 100 m strides	Gen-aerobic + speed 9 miles (14 km) with 8 × 100 m strides	Gen-aerobic + speed 10 miles (16 km) with 8 × 100 m strides
Saturday	Rest or cross-train	Recovery 5 miles (8 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)
Sunday	Recovery 7 miles (11 km)	Gen-aerobic 10 miles (16 km)	Gen-aerobic 10 miles (16 km)	Med-long run 12 miles (19 km)	Med-long run 13 miles (21 km)
Weekly volume	16 miles (26 km)	31 miles (50 km)	36 miles (58 km)	42 miles (68 km)	50 miles (80 km)

Chapter 12

Marathon Training on More Than 85 Miles (137 km) per Week

This chapter is for true high-volume marathoners who can devote their full energy to training. It includes two schedules: an 18-week schedule that starts at 80 miles (129 km) per week and a 12-week schedule that starts at 82 miles (132 km) per week. Each of these schedules increases weekly volume progressively, building to a peak of at least 105 miles (169 km).

As discussed in chapter 1, it's useful to divide your overall training schedule into training blocks of several weeks each. The training schedules consist of four blocks, which focus on endurance, lactate threshold (LT) and endurance, race preparation, and tapering, respectively. A final schedule, which contains a 5-week postmarathon recovery program, can follow either of the training schedules.

Of the two training schedules presented in this chapter, we recommend the 18-week schedule for most situations. Eighteen weeks is plenty of time to stimulate the necessary adaptations to improve your marathon performance. At the same time, 18 weeks is short enough that you can focus your efforts without becoming bored with the process.

At times, however, you simply don't have 18 weeks to prepare for your marathon. The 12-week schedule includes the same training blocks as the 18-week schedules, but because of the short time for preparation, each block is abbreviated. If you go into a marathon in a rush, you must realize that your preparation won't be as thorough as if you had longer to prepare. The 12-week schedule takes into account that sometimes circumstances don't allow you the optimal length of time for preparation and strives to provide a compact yet effective training program.

BEFORE STARTING THE SCHEDULES

These schedules are challenging right from the start and get harder as your marathon approaches. So that you can progress as the training increases in quantity and quality and to minimize your chances of injury, you should be able to complete the first week of the schedule without too much effort.

Be realistic in assessing whether you're ready for the first week of the schedule. For example, if you've been running 60 miles (97 km) per week and your longest run in the last several weeks is 12 miles (19 km), now isn't the time to suddenly jump to an 82-mile (132 km) week containing a 17-mile (27 km) run, as the first week of the 12-week schedule calls for. The idea behind the schedules isn't to make you as tired as possible as soon as possible but to apply repeated training stress that you absorb and from which you benefit.

As a rule, you should be running at least 70 to 75 miles (113 to 121 km) a week before starting these schedules, and in the last month, you should have comfortably completed a run of at least 15 miles (24 km).

READING THE SCHEDULES

The schedules are presented in a day-by-day format. The main limitation with this approach is that it's impossible to guess the myriad of outside factors that may influence your day-to-day nonrunning life (assuming you still have one at this level of volume). Work schedules, family life, relationships, school commitments, and Mother Nature all play a part in determining when you get to do your long runs and other aspects of marathon preparation. You'll no doubt require some flexibility in your training and will need to juggle days around from time to time. That's expected, and as long as you don't try to make up for lost time by doing several hard days in a row, you should be able to avoid injury and overtraining. By following the principles covered in the earlier chapters, you will be able to safely fine-tune the training schedules to suit your circumstances.

The schedules express each day's training in miles and kilometers; use whichever you're accustomed to. The mile and kilometer figures for each day (and the weekly total) are rough equivalents of each other, not a conversion from one to the other accurate to the third decimal point.

FOLLOWING THE SCHEDULES

Each column of the schedules represents a week's training. For example, in the 12-week schedule, the column for 11 weeks to goal indicates that at the end of that week you have 11 weeks until your marathon. The schedules continue week by week until race week.

We have included a specific workout for each day as well as a category of training for that day. For example, in the 18-week schedule, on the Monday of the 5-weeks-to-go column, the specific workouts are two 6-mile (10 km) runs and the category of training for that day is recovery. This aspect of the schedules allows you to quickly see the balance of training during each week and the progression of workouts from week to week. Look again at the 18-week schedule—it's easy to see that with 5 weeks to go until the marathon, there are four recovery days that week with an LT session, a general aerobic and speed session, and a long run. Looking at the row for Sunday, it’s easy to see how the long runs progress and then taper in the last few weeks before the marathon.

The workouts are divided into the following eight categories: long runs, medium-long runs, marathon-pace runs, general aerobic runs, LT runs, recovery runs, $\dot{V}O_2$max intervals, and speed training. Each of these categories is explained in depth in chapter 8, and the physiology behind the training is explained in chapter 1.

DOING DOUBLES

As discussed in chapter 8, sometimes marathoners benefit from running twice a day. This is obviously the case for anyone cranking out 100-mile (161 km) weeks. In these schedules, for example, recovery days of 10 to 12 miles (16 to 19 km) are often broken into two short runs. Rather than making you more tired, splitting your volume like this on easy days will speed your recovery because each run will increase blood flow to your muscles yet take so little out of you.

As we mention at the beginning of this chapter, we know that not everyone will be able to follow these schedules exactly as they appear. That applies on the days that call for a recovery run in the morning and an LT workout in the evening. If your schedule makes it more likely that you’ll do a high-quality tempo run in the morning rather than the evening, simply flip the workouts prescribed for these days.

WHEN 105 MILES (169 KM) PER WEEK JUST ISN’T ENOUGH

The hardy few among you might want to do more volume than what’s prescribed in the schedules. If you’re in this group, be sure to follow the spirit of the schedules when adding miles—that is, your volume should build gradually during training block 1, peak at the end of training block 2, come down slightly during training block 3, and fall dramatically during training block 4.

Draw confidence from your training that you can sustain an ambitious pace.
Michael Steele/Getty Images for QTA

Where should you add miles to the schedules? Try adding a bit of volume to the general aerobic runs and medium-long runs if you sense that doing so doesn't detract from your week's most important sessions. (Remember, volume is a means to a goal, not a primary goal in itself. At your volume level, the risk of injury increases rapidly if additional distance is added haphazardly.) You could also add miles to your warm-ups and cool-downs on $\dot{V}O_2$max and LT workout days. If you're going to do more doubles than the schedules stipulate, refer to the section on two-a-day runs in chapter 8.

RACING STRATEGIES

We discussed marathon race strategy at length in chapter 7. If you follow one of the schedules in this chapter, you will be more thoroughly prepared for your marathon than most of the other runners in the race. Few others in the field will have done the combination of volume and targeted quality that you have.

Despite your commitment and eagerness, though, you'll need to not get carried away in the early miles, even if your goal pace in the first half feels quite easy. The temptation to try to capitalize on that good feeling will be strong. Perhaps more than any other readers of this book, you will need to be disciplined in the early miles to stick to your goal pace so that you can use your fitness in the second half of the race and run even splits. Although your outstanding preparation makes you less likely than most to blow up late in the race from a too-hasty start, there's still no point in squandering months of hard work with an overly ambitious early pace.

At the same time, it's likely that among readers of this book you'll be attempting to race the marathon at the greatest differential from your normal training pace. For that reason, in the days before your marathon, your goal pace might seem especially daunting. Draw confidence from your long runs, tempo runs, and marathon-pace runs that you can sustain your ambitious goal pace for 26.2 miles (42.2 km). Also, focus on your goal-pace splits to increase your chances of running the first half of the race intelligently and thereby vastly increasing your chances of being able to hold goal pace past 20 miles (32 km) all the way to the finish line.

AFTER THE MARATHON

The final schedule in this chapter is a 5-week recovery schedule for after the marathon; it completes the training program and leaves you ready to prepare for future challenges.

The recovery schedule is purposely conservative. You have little to gain by rushing back into training, and your risk of injury is elevated at this point, owing to the reduced resiliency of your muscles and connective tissue after the marathon.

The schedule starts with 2 days off from running, which is the bare minimum of time away from running you should allow yourself. If you still have acute soreness or tightness so severe that it will alter your form, or if you just don't feel like running, certainly feel free to take more than 2 days off. If ever there was a time to lose your marathoner's mind-set, the week after your goal race is it. Even most of the top runners in the world take days off after a marathon. They know that the nearly negligible benefits of a short run at this time are far outweighed by the risks. Not running now will also increase your chances of being inspired to resume hard training when your body allows it.

Of course, some people don't consider themselves real runners unless they run pretty much every day of their lives. Plod through a few miles if you must, but be aware that you're likely prolonging your recovery.

What better aids recovery during this time is light cross-training, such as swimming or cycling. These activities increase blood flow through your muscles without subjecting them to pounding. Walking will also achieve this in the week after the marathon.

One way to ensure that you don't run too hard too soon after your marathon is to use a heart rate monitor. As discussed in chapter 3, a heart rate monitor can help prevent you from going too fast on recovery days. During the first few weeks after the marathon, keep your heart rate below 76 percent of your maximal heart rate or 68 percent of your heart rate reserve. Running at this intensity will help your body overcome the stress of the marathon as quickly as possible.

During this 5-week recovery schedule, the number of days of running per week increases from 3 to 6. At the end of the 5 weeks, you should be fully recovered from the marathon and, with a little luck, injury free and mentally fresh.

More Than 85 Miles per Week 18-Week Schedule

Training Block 1—Endurance

	WEEKS TO GOAL					
	17	16	15	14	13	(Recovery) 12
Monday	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 5 miles (8 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 6 miles (10 km)	Recovery AM 6 miles (10 km) PM 6 miles (10 km)	Recovery AM 6 miles (10 km) PM 6 miles (10 km)
Tuesday	Recovery AM 4 miles (6 km) LT PM 10 miles (16 km) with 4 miles (6 km) at LT pace	Recovery AM 4 miles (6 km) Gen-aerobic + speed PM 10 miles (16 km) with 8 × 12 sec hill sprints + 8 × 100 m strides	Med-long run 12 miles (19 km)	Recovery AM 4 miles (6 km) Gen-aerobic + speed PM 10 miles (16 km) with 8 × 12 sec hill sprints + 8 × 100 m strides	Recovery AM 5 miles (8 km) LT PM 10 miles (16 km) with 5 miles (8 km) at LT pace	Gen-aerobic + speed 10 miles (16 km) with 10 × 100 m strides
Wednesday	Med-long run 12 miles (19 km)	Med-long run 13 miles (21 km)	Recovery AM 4 miles (6 km) LT PM 10 miles (16 km) with 5 miles (8 km) at LT pace	Med-long run 15 miles (24 km)	Med-long run 15 miles (24 km)	Med-long run 13 miles (21 km)
Thursday	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)
Friday	Gen-aerobic + speed 10 miles (16 km) with 10 × 100 m strides	Med-long run 12 miles (19 km)	Med-long run 14 miles (22 km)	Med-long run 13 miles (21 km)	Med-long run 14 miles (22 km)	Med-long run 12 miles (19 km)
Saturday	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Gen-aerobic 9 miles (14 km)	Recovery 7 miles (11 km)	Gen-aerobic 8 miles (13 km)	Gen-aerobic 8 miles (13 km)
Sunday	Long run 16 miles (26 km)	Marathon-pace run 17 miles (27 km) with 8 miles (13 km) at marathon pace	Long run 18 miles (29 km)	Long run 20 miles (32 km)	Marathon-pace run 20 miles (32 km) with 10 miles (16 km) at marathon pace	Long run 16 miles (26 km)
Weekly volume	80 miles (129 km)	84 miles (135 km)	88 miles (141 km)	92 miles (148 km)	95 miles (153 km)	82 miles (133 km)

Training Block 2—LT + Endurance

	WEEKS TO GOAL				
	11	10	9	(Recovery) 8	7
Monday	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 6 miles (10 km)
Tuesday	Recovery AM 5 miles (8 km) LT PM 10 miles (16 km) with 5 miles (8 km) at LT pace	Recovery AM 6 miles (10 km) Gen-aerobic + speed PM 10 miles (16 km) with 10 × 100 m strides	Gen-aerobic 10 miles (16 km)	Gen-aerobic + speed 10 miles (16 km) with 10 × 100 m strides	Recovery AM 6 miles (10 km) Gen-aerobic + speed PM 10 miles (16 km) with 10 × 100 m strides
Wednesday	Recovery AM 5 miles (8 km) Med-long run PM 15 miles (24 km)	Med-long run 15 miles (24 km)	Recovery AM 6 miles (10 km) Med-long run PM 15 miles (24 km)	$\dot{V}O_2$max 10 miles (16 km) with 5 × 800 m at 5K race pace; jog 50-90% interval time	Med-long run 15 miles (24 km)
Thursday	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 6 miles (10 km)
Friday	Med-long run 13 miles (21 km)	Recovery AM 6 miles (10 km) LT PM 11 miles (18 km) with 6 miles (10 km) at LT pace	Recovery AM 6 miles (10 km) Med-long run PM 14 miles (22 km)	Recovery AM 5 miles (8 km) Med-long run PM 13 miles (21 km)	Recovery AM 6 miles (10 km) LT PM 12 miles (19 km) with 7 miles (11 km) at LT pace
Saturday	Gen-aerobic + speed 10 miles (16 km) with 8 × 12 sec hill sprints + 8 × 100 m strides	Gen-aerobic 10 miles (16 km)	Gen-aerobic + speed 10 miles (16 km) with 10 × 100 m strides	Gen-aerobic 10 miles (16 km)	Gen-aerobic 10 miles (16 km)
Sunday	Long run 20 miles (32 km)	Long run 22 miles (35 km)	Marathon-pace run 20 miles (32 km) with 12 miles (19 km) at marathon pace	Long run 16 miles (26 km)	Long run 24 miles (39 km)
Weekly volume	100 miles (161 km)	102 miles (165 km)	103 miles (167 km)	86 miles (139 km)	107 miles (174 km)

Training Block 3—Race Preparation

	WEEKS TO GOAL			
	6	**5**	**4**	**3**
Monday	Recovery AM 6 miles (10 km) PM 6 miles (10 km)	Recovery AM 6 miles (10 km) PM 6 miles (10 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)
Tuesday	Recovery AM 5 miles (8 km) $\dot{V}O_2max$ PM 10 miles (16 km) with 5 × 800 m at 5K race pace; jog 50-90% interval time	Recovery AM 5 miles (8 km) Gen-aerobic + speed PM 10 miles (16 km) with 8 × 100 m strides	Recovery AM 5 miles (8 km) $\dot{V}O_2max$ PM 10 miles (16 km) with 5 × 800 m at 5K race pace; jog 50-90% interval time	Gen-aerobic 10 miles (16 km)
Wednesday	Recovery AM 5 miles (8 km) Med-long run PM 15 miles (24 km)	Recovery AM 5 miles (8 km) Med-long run PM 15 miles (24 km)	Recovery AM 5 miles (8 km) Med-long run PM 15 miles (24 km)	Recovery AM 4 miles (6 km) $\dot{V}O_2max$ PM 10 miles (16 km) with 6 × 1,200 m at 5K race pace; jog 50-90% interval time
Thursday	Recovery AM 5 miles (8 km) Recovery + speed PM 6 miles (10 km) with 8 × 100 m strides	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 5 miles (8 km) Recovery + speed PM 8 miles (13 km) with 8 × 100 m strides	Recovery AM 5 miles (8 km) Med-long run PM 15 miles (24 km)
Friday	Recovery 6 miles (10 km)	LT 12 miles (19 km) with 5 miles (8 km) at LT pace	Recovery 6 miles (10 km)	Recovery AM 4 miles (6 km) Gen-aerobic PM 10 miles (16 km)
Saturday	15K to half marathon tune-	Gen-aerobic + speed	8K-15K tune-up race (total 9-13	Recovery

	up race (total 13-17 miles [21-27 km])	10 miles (16 km) with 8 × 100 m strides	miles [14-21 km])	AM 4 miles (5 km) Gen-aerobic + speed PM 8 miles (13 km) with 8 × 100 m strides
Sunday	Gen-aerobic 8 miles (13 km)	Long run 22 miles (35 km)	Long run 18 miles (29 km)	Long run 21 miles (34 km)
Weekly volume	85-89 miles (138-144 km)	102 miles (164 km)	92-96 miles (148-155 km)	102 miles (162 km)

Training Block 4—Taper and Race

	WEEKS TO GOAL		
	2	**1**	**Race week**
Monday	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)
Tuesday	$\dot{V}O_2max$ 10 miles (16 km) with 5 × 800 m at 5K race pace; jog 50-90% interval time	Gen-aerobic + speed 10 miles (16 km) with 10 × 100 m strides	Recovery AM 6 miles (10 km) PM 4 miles (6 km)
Wednesday	Med-long run 13 miles (21 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Dress rehearsal 9 miles (14 km) with 2.5 miles (4 km) at marathon pace
Thursday	Recovery AM 4 miles (6 km) Gen-aerobic + speed PM 8 miles (13 km) with 8 × 100 m strides	$\dot{V}O_2max$ 9 miles (14 km) with 4 × 1,200 m at 5K race pace; jog 50-90% interval time	Recovery 6 miles (10 km)
Friday	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery + speed 5 miles (8 km) with 6 × 100 m strides
Saturday	8K-10K tune-up race (total 9-11 miles [14-18 km])	Gen-aerobic + speed 8 miles (13 km) with 8 × 100 m strides	Recovery 4 miles (6 km)
Sunday	Long run	Med-long run	Goal marathon

	17 miles (27 km)	13 miles (21 km)	
Weekly volume	78-80 miles (125-129 km)	62 miles (100 km)	40 miles (64 km) (6 days prerace)

More Than 85 Miles per Week 12-Week Schedule

Training Block 1—Endurance

	WEEKS TO GOAL			
	11	**10**	**9**	**8**
Monday	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)
Tuesday	Gen-aerobic + speed 10 miles (16 km) with 8 × 12 sec hill sprints + 8 × 100 m strides	Med-long run 12 miles (19 km)	Recovery AM 4 miles (6 km) Gen-aerobic + speed PM 10 miles (16 km) with 8 × 12 sec hill sprints + 8 × 100 m strides	Recovery AM 4 miles (6 km) LT PM 11 miles (18 km) with 5 miles (8 km) at LT pace
Wednesday	Med-long run 14 miles (23 km)	Recovery AM 4 miles (6 km) LT PM 10 miles (16 km) with 5 miles (8 km) at LT pace	Med-long run 15 miles (24 km)	Recovery AM 5 miles (8 km) Med-long run PM 15 miles (24 km)
Thursday	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Recovery AM 6 miles (10 km) PM 6 miles (10 km)
Friday	Med-long run 12 miles (19 km)	Med-long run 15 miles (24 km)	Med-long run 14 miles (23 km)	Med-long run 14 miles (23 km)

Saturday	Gen-aerobic + speed 8 miles (13 km) with 8 × 100 m strides	Gen-aerobic + speed 8 miles (13 km) with 8 × 100 m strides	Gen-aerobic + speed 10 miles (16 km) with 8 × 100 m strides	Gen-aerobic + speed 10 miles (16 km) with 8 × 100 m strides
Sunday	Marathon-pace run 17 miles (27 km) with 8 miles (13 km) at marathon pace	Long run 18 miles (29 km)	Long run 20 miles (32 km)	Marathon-pace run 18 miles (29 km) with 10 miles (16 km) at marathon pace
Weekly volume	82 miles (132 km)	88 miles (141 km)	94 miles (151 km)	100 miles (162 km)

Training Block 2—LT + Endurance

	WEEKS TO GOAL		
	7	**6**	**5**
Monday	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 6 miles (10 km)	Recovery AM 6 miles (10 km) PM 6 miles (10 km)
Tuesday	Recovery AM 6 miles (10 km) Gen-aerobic + speed PM 10 miles (16 km) with 10 × 100 m strides	Recovery AM 6 miles (10 km) Gen-aerobic PM 10 miles (16 km)	Recovery AM 6 miles (10 km) Gen-aerobic + speed PM 10 miles (16 km) with 8 × 100 m strides
Wednesday	Med-long run 15 miles (24 km)	$\dot{V}O_2max$ 10 miles (16 km) with 6 × 1,200 m at 5K race pace; jog 50-90% interval time	Recovery AM 6 miles (10 km) Med-long run PM 15 miles (24 km)
Thursday	Recovery AM 6 miles (10 km) PM 6 miles (10 km)	Recovery AM 6 miles (10 km) Med-long run PM 15 miles (24 km)	Recovery AM 6 miles (10 km) PM 6 miles (10 km)
Friday	LT 10 miles (16 km) with 4 miles (6 km) at LT pace	Recovery AM 6 miles (10 km Gen-aerobic PM 10 miles (16 km)	LT 12 miles (19 km) with 7 miles (11 km) at LT pace
Saturday	Gen-aerobic + speed	Gen-aerobic + speed	Gen-aerobic + speed

	10 miles (16 km) with 8 × 100 m strides	10 miles (16 km) with 8 × 100 m strides	10 miles (16 km) with 8 × 100 m strides
Sunday	Long run 18 miles (29 km)	Marathon-pace run 18 miles (29 km) with 12 miles (19 km) at marathon pace	Long run 22 miles (35 km)
Weekly volume	86 miles (139 km)	103 miles (167 km)	105 miles (170 km)

Training Block 3—Race Preparation

	WEEKS TO GOAL		
	4	**3**	**2**
Monday	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)	Recovery AM 6 miles (10 km) PM 5 miles (8 km)
Tuesday	Recovery AM 5 miles (8 km) $\dot{V}O_2max$ PM 10 miles (16 km) with 5 × 800 m at 5K race pace; jog 50-90% interval time	Gen-aerobic 10 miles (16 km)	$\dot{V}O_2max$ 10 miles (16 km) with 5 × 800 m at 5K race pace; jog 50-90% interval time
Wednesday	Recovery AM 5 miles (8 km) Med-long run PM 15 miles (24 km)	Recovery AM 5 miles (8 km) $\dot{V}O_2max$ PM 10 miles (16 km) with 6 × 1,200 m at 5K race pace; jog 50-90% interval time	Med-long run 13 miles (21 km)
Thursday	Recovery AM 5 miles (8 km) Gen-aerobic + speed PM 8 miles (13 km) with 8 × 100 m strides	Recovery AM 4 miles (6 km) Med-long run PM 15 miles (24 km)	Recovery AM 4 miles (6 km) Gen-aerobic + speed PM 8 miles (13 km) with 8 × 100 m strides
Friday	Recovery 6 miles (10 km)	Recovery AM 4 miles (6 km) Gen-aerobic PM 10 miles (16 km)	Recovery 6 miles (10 km)
Saturday	8K-15K tune-up race (total 9-13 miles [13-21 km])	Recovery AM 4 miles (6 km) Gen-aerobic + speed	8K-10K tune-up race (total 9-11 miles [14-18 km])

		PM 8 miles (13 km) with 8 × 100 m strides	
Sunday	Long run 18 miles (29 km)	Long run 21 miles (34 km)	Long run 17 miles (27 km)
Weekly volume	92-96 miles (147-154 km)	102 miles (163 km)	78-80 miles (125-129 km)

Training Block 4—Taper and Race

	WEEKS TO GOAL	
	1	**Race week**
Monday	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)
Tuesday	Gen-aerobic + speed 10 miles (16 km) with 10 × 100 m strides	Recovery AM 6 miles (10 km) PM 4 miles (6 km)
Wednesday	Recovery AM 6 miles (10 km) PM 4 miles (6 km)	Dress rehearsal 9 miles (14 km) with 2.5 miles (4 km) at marathon pace
Thursday	$\dot{V}O_2max$ 9 miles (14 km) with 4 × 1,200 m at 5K race pace; jog 50-90% interval time	Recovery 6 miles (10 km)
Friday	Recovery 6 miles (10 km)	Recovery + speed 5 miles (8 km) with 6 ×100 m strides
Saturday	Gen-aerobic + speed 8 miles (13 km) with 8 × 100 m strides	Recovery 4 miles (6 km)
Sunday	Med-long run 13 miles (21 km)	Goal marathon
Weekly volume	62 miles (100 km)	40 miles (64 km) (6 days prerace)

More Than 85 Miles per Week Recovery

Training Block 5—Recovery

	WEEKS POSTMARATHON				
	1	2	3	4	5
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Recovery 6 miles (10 km)
Tuesday	Rest or cross-train	Recovery 5 miles (8 km)	Recovery 6 miles (10 km)	Gen-aerobic 8 miles (13 km)	Gen-aerobic 8 miles (13 km)
Wednesday	Recovery 4 miles (6 km)	Recovery 6 miles (10 km)	Recovery 7 miles (11 km)	Gen-aerobic 10 miles (16 km)	Gen-aerobic + speed 10 miles (16 km) with 10 × 100 m strides
Thursday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Friday	Recovery 6 miles (10 km)	Recovery 7 miles (11 km)	Gen-aerobic + speed 8 miles (13 km) with 8 × 100 m strides	Gen-aerobic + speed 9 miles (14 km) with 8 × 100 m strides	LT 10 miles (16 km) with 4 miles (6 km) at LT pace
Saturday	Rest or cross-train	Recovery 5 miles (8 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)
Sunday	Recovery 8 miles (13 km)	Gen-aerobic 10 miles (16 km)	Med-long run 11 miles (18 km)	Med-long run 12 miles (19 km)	Med-long run 14 miles (23 km)
Weekly volume	18 miles (29 km)	33 miles (53 km)	38 miles (62 km)	45 miles (72 km)	54 miles (88 km)

Chapter 13
Multiple Marathoning

David Madison/Getty Images

This chapter is for those occasions when, for whatever perverse reason, you've decided to do two marathons with 12 weeks or less between. Though doing two (or more) marathons in rapid succession generally isn't the best way to go after a personal best time, this chapter focuses on structuring your training to maximize your likelihood of success. It includes five schedules covering 12, 10, 8, 6, and 4 weeks between marathons.

These schedules are substantially different from the schedules in chapters 9 through 12; the schedules in this chapter must start with helping you recover from marathon number 1 and then help you train and taper for marathon number 2. The number of weeks between marathons dictates how much time you devote to recovery, training, and tapering. For example, the 12-week schedule allows a relatively luxurious 4 weeks for recovery, whereas the 6-week schedule allocates only 2 weeks to recovery.

The schedules in this chapter are written for marathoners who typically build to 60 to 70 miles (97-113 km) per week during marathon preparation. The 10- and 12-week schedules build to a peak weekly mileage of 67 (108 km), whereas the 8-, 6-, and 4-week schedules peak at 66 (106 km), 60 (97 km), and 48 miles (77 km), respectively. If your mileage during marathon preparation is typically more than 70 miles (113 km) per week, scale up the volume in these schedules moderately. Similarly, if your mileage typically peaks at less than 60 miles (97 km) per week, scale the training back proportionately.

The schedules assume that you want to do your best in your second marathon. Though this might not mean running a personal best or even running as fast as in the first race in your double (or triple, or whatever), it does mean toeing the line with the intention of running as fast as you can that day. If your multiple-marathoning goal is to cruise comfortably through a second or third marathon soon after a peak effort, ignore these schedules. Simply focus on recovering from your first race while interspersing enough long runs to maintain your endurance until your next one.

WHY MULTIPLE MARATHONING?

It's been said that you can't run another marathon until you've forgotten your last one. If that's so, a lot of runners out there have short memories.

Although statistics in this area are hard to come by, anecdotal evidence suggests that many runners choose to circumvent the conventional wisdom —which is to do, at most, a spring and a fall marathon—and are running three, four, or more marathons a year. Some run a marathon a month. And we're not just talking about middle-of-the-packers here. When Yuki Kawauchi won the 2018 Boston Marathon, the mid-April race was already his fourth marathon (and fourth marathon victory) of the year. In 2017 he ran 12 marathons, all faster than 2:16, and won five of them. As detailed in the profile on the next page, Kawauchi simply loves to race. His competitive record, his 80-plus sub-2:20 times, and his 2:08:14 show it's possible even at the elite level to race the marathon distance well often if doing so appeals to you.

Should you be a multiple marathoner? We can't answer that question for you other than to describe why some people are drawn to multiple marathoning.

Unmet Goals

It’s rare to finish a marathon and—after the obligatory utterance of “Never again”—not think you could have run at least a little faster if only X, Y, and Z hadn’t occurred. If you’ve run a less-than-satisfying marathon but it didn’t seem to take too much out of you, and if another likely site for a good race looms several weeks ahead, you might want to consider drawing on your horse-remounting skills.

Building Blocks

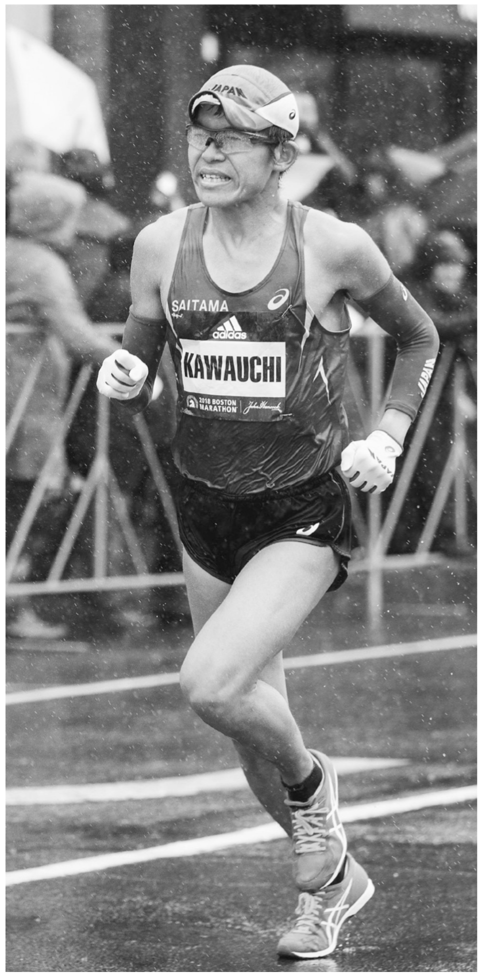
A marathon run at a controlled but honest pace a few months before a peak effort can provide a significant training boost and a good measure of your fitness. If you run a race too hard or too close to your real goal race, of course, this is akin to pulling up roots to see how your carrots are growing. Certainly these are excellent opportunities to test your marathon drink, shoes, and the like in battle conditions.

Yuki Kawauchi

Fastest marathon: 2:08:14 (Seoul, 2013) Marathon highlights: 1st place, 2018 Boston Marathon; most sub-2:20 marathons in history

There are elite marathoners who hole up most of the year for one big race. And then there’s Yuki Kawauchi.

The surprise 2018 Boston Marathon champion is the fastest of a small number of elites who race marathons with the frequency more often seen in 10K specialists. In 2018 Kawauchi ran 11 marathons, with five other victories besides the one in Boston. The previous year he ran 12 marathons, all faster than 2:16, including four wins. Every year he also contests several half marathons—he did so each of the weekends before and after winning Boston—and at least one ultramarathon. (He won the longest race of his life, a 71K, one month after winning Boston.) Kawauchi holds the world record for the most sub-2:20 marathons (80-plus).



Scott Eisen/Getty Images

Kawauchi obviously has an extraordinary talent for quick recovery. Even many elites have difficulty walking normally, much less running, in the immediate aftermath of a marathon. His apparent immunity to typical soft-tissue soreness is a genetic gift in the same way that others' muscle-fiber composition or running economy is. That said, there is much to learn from Kawauchi, even if you have no interest in becoming a serial marathoner.

For starters, why does Kawauchi race so much? Mostly because he enjoys it. In chapter 1 we talked about the importance of personally meaningful goals. What's most important to you should affect how often you race. The broader way to state that is that you should do with your running whatever best speaks to you. That might be racing one marathon a year with the goal of setting a personal best. That might be making as many attempts at a Boston qualifier as it takes. Or, like Kawauchi, it might be regularly experiencing the unique thrill of competition. Know what aspects of running you most enjoy, and train and race accordingly.

Kawauchi's frequent racing also gives him more chances at success. Of course, there's a limit to the try-and-try-again approach to the marathon, depending on your physical and mental recovery. And it's natural to think that Kawauchi's personal best of 2:08:14 could be even faster if he were more selective. A compelling counterargument is that doing something like running two marathons every three years might also not be the way to reach your potential, given how many things can go wrong in any one marathon. At a less extreme level than Kawauchi, Meb Keflezighi has said that regular racing—his marathon career spanned 15 years—increased his odds of race day aligning with his firing on all cylinders.

On a practical level, Kawauchi's racing schedule meshes well with his nonrunning schedule for most of his career. Before becoming a full-time runner in 2019, Kawauchi was a Japanese government clerk, working from noon until 9:00 p.m. Monday through Friday. He generally had the time for one run a day, in the morning, during the work week. (Most of his competitors run twice a day most days of the week.) In a typical week, Kawauchi ran an easy 70 to 100 minutes on work mornings except for an interval session on Wednesdays. Regular weekend races gave him a chance to combine volume and quality. They also helped him build to his key races. His 71K ultramarathon, for example, was a (very) long training run for his next marathon. For someone with a 2:08 marathon best, half marathons in 65 or 66 minutes are more marathon-pace medium-long runs than all-out efforts. If you often struggle to do typical marathon training during the work week, weekend races can provide an opportunity to still get the necessary work done.

Finally, all runners can learn from how Kawauchi handles the inevitable subpar days—he moves on to the next challenge rather than beating himself up. There's something to be said for showing up and persevering even when you know it won't be a perfect day. It's not surprising that, in cold rain and heavy winds, Kawauchi prevailed in Boston while many of the world's best marathoners crumbled.

Travel

As the growing popularity of destination marathons shows, a special knowledge of an area comes from covering it at length on foot. Many runners plan vacations around a scenic marathon for a chance to view the scenery in a way you can't experience from a tour bus. When you combine such trips with a standard marathon schedule, you're likely to run into instances of short turnaround times.

Variety

Some runners simply like to run marathons and to experience them in all their permutations, from intimate affairs such as the Marshfield New Year's Day Marathon in Massachusetts (two finishers in 2018, one, of course, being Yuki Kawauchi); to medium-size marathons such as Napa Valley (1,300 runners traversing California wine country) and Twin Cities (7,000 runners along the Mississippi River at peak fall foliage); on up to the mega-events such as Chicago, Berlin, and New York City, the last of which now has more than 50,000 finishers each year. Even though marathons are held throughout the year, the traditional spring and fall clustering can mean that sampling the marathon world requires becoming a multiple marathoner.

A Foolish Consistency

How can we put this gently? Some runners are drawn to challenges for no better reason than because they sound good. This would include such undertakings as running a marathon a month for a year, running a marathon in all 50 U.S. states plus the District of Columbia, running one in every province and territory in Canada, and completing a marathon on every continent. The marathon-a-month goal obviously requires scant time between efforts, but so can the geographically based ones, given that you'll be at the mercy of marathon planners.

Even some elite runners do several marathons in a year.

Herbert Kratky/SEPA.Media /Getty Images

Why Not?

"Normal" marathoners should check the amount of glass in their houses before throwing stones at multiple marathoners. After all, the bulk of this book has been devoted to detailing how to maximize your chances of success at an activity that the human body isn't really suited for. So if some runners want to give the standard reason for undertaking such a challenge—"Because it's there"—several times a year, well, it's not as if they're clubbing seals.

READING THE SCHEDULES

The schedules are presented in a day-by-day format. The main limitation with this approach is that it's impossible to guess the myriad of outside factors that may influence your day-to-day nonrunning life. Work schedules, family life, relationships, school commitments, and Mother Nature all play their part in determining when you get to do your long runs and other aspects of marathon preparation. You'll no doubt require some flexibility in your training and will need to juggle days around from time to time. That's expected, and as long as you don't try to make up for lost time by doing several hard days in a row, you should be able to avoid injury and overtraining.

The schedules express each day's training in miles and kilometers; use whichever you're accustomed to. The mile and kilometer figures for each day (and the weekly total) are rough equivalents of each other, not a conversion from one to the other accurate to the third decimal point.

Because of the large variation in the time required for marathon recovery for individual runners, you should approach these schedules with a high degree of flexibility. Also, if in your first marathon the weather was hot, you became severely dehydrated, or you became unusually hobbled, your recovery is likely to take longer than usual. When a conflict arises between what the schedule says to do and what your body indicates it's willing to do, listen to your body. With these tight time frames between marathons, your best strategy is first to focus on recovery and then to worry about the other aspects of training. If you're not able to follow the schedules closely for one reason or another, follow the priorities discussed later in this chapter in choosing which workouts to do and which to miss.

For all the schedules in this chapter, remember that in the first few weeks after marathon number 1, recovery is your primary objective, and that during the last 3 weeks, tapering to consolidate your energy reserves is paramount. If you're worn out or injured going into marathon number 2, any extra workouts you've squeezed in won't have been worth the effort.

PETE'S MULTIPLE MARATHONING TRIFECTA

In 1983 I ran three high-quality marathons in 17 weeks. Nine weeks after winning the San Francisco Marathon in 2:14:44, I finished second in the Montreal Marathon in 2:12:33. Eight weeks after that, I won the Auckland Marathon in 2:12:19. At the time, the last two races were personal bests.

I did a few things wrong between San Francisco and Montreal but was able to hold my body together through a combination of luck, enthusiasm, and youth. (I was 26.) After San Francisco, I was remarkably stiff for several days. I hobbled a 2-miler (3 km) 2 days after the race and racked up 46 miles (74 km) for the week. Regular massage helped bring my legs around.

Fortunately, my body bounced back really well after that first week, and I was up to 100 miles (161 km) in the third week after, including a session of eight 800-meter repeats on the track. My mileage climbed to 116 (187 km) and 122 (196 km) for the fourth and fifth weeks, which was about as high as I used to get back then. (I hadn’t made an Olympic team yet, so I was working full time.) There was just enough time to fit in two tune-up races, a 5-miler (8 km) in 23:35 and a third-place finish in the New Haven 20K, and then it was time to taper again. Eight days before Montreal, I went to the track and did two repeats of 1,600 meters in 4:24 and 4:23, which was really fast for me and a good omen. The last 2 weeks before the race I tried to get caught up on sleep, and I felt really ready going into Montreal.

The night after Montreal, I stayed out late, took an early flight back to Boston, and caught a cab directly to work. This didn’t help my recovery. After that, though, I settled down, and in the first 3 weeks after Montreal covered 48, 72, and 97 miles (77, 116, and 156 km). Lots of sleep and weekly massage kept me injury free, and, except for the occasional “Felt like hell” notation in my diary, training went pretty well.

Three weeks before the Auckland Marathon, I started my leave of absence from work at New Balance to prepare for the Olympic trials and flew to New Zealand with my training partner, Tom Ratcliffe, who was also running Auckland. We got a bit carried away with the excitement and probably overtrained the first week there. The second week in New Zealand, I ran a 10K tune-up race in 29:12, with which I was very pleased. During the last week before the marathon, however, I could tell that my body was on a fine edge, and I decided to back right off. Three days before the race, I was still feeling pretty tired. Fortunately, on race day, I felt strong and broke away after 17 miles (27 km). The positive experience in multiple marathoning was excellent practice for the following year's Olympic trials and marathon.

—Pete Pfitzinger

One way to ensure that you don't run too hard during the first few weeks after your previous marathon is to use a heart rate monitor. As discussed in chapters 1 and 3, a heart rate monitor can help prevent you from going too fast on your easy days. During the first few weeks after the marathon, keep your heart rate below 76 percent of your maximal heart rate or 68 percent of your heart rate reserve to help speed your recovery.

FOLLOWING THE SCHEDULES

Each column of the schedules represents a week's training. For example, in the 10-week schedule, the column for 9 weeks to goal indicates that at the end of that week you have 9 weeks until your second marathon. The schedules continue week by week until race week.

We have included a specific workout for each day as well as a category of training for that day. For example, in the 10-week schedule, on the Friday of the 5-weeks-to-go column, the specific workout is a 9-mile (14 km) run, and the category of training for that day is general aerobic conditioning. This aspect of the schedules allows you to quickly see the balance of training during each week and the progression of workouts from week to week. Look again at the 10-week schedule—it's easy to see that with 5 weeks to go until the marathon, there are three recovery days that week along with a $\dot{V}O_2max$ session, a long run, a medium-long run, and a general aerobic conditioning run. Looking at the row for Sunday, it's easy to see how the long runs progress and then taper in the last few weeks before the marathon.

The workouts are divided into the following eight categories: long runs, medium-long runs, marathon-pace runs, general aerobic runs, lactate threshold (LT) runs, recovery runs, $\dot{V}O_2max$ intervals, and speed training. Each category is explained in depth in chapter 8, and the physiology behind the training is explained in chapter 1.

MULTIPLE-MARATHONING PRIORITIES

The following sections explain the priorities for the training schedules in this chapter. But what if you don't have 12, 10, 8, 6, or 4 weeks between marathons?

If you have less than 4 weeks between marathons, you're on your own. Your main concern should be recovery, recovery, and more recovery, not only from your first marathon but also from the lobotomy that led you to come up with this plan.

For other amounts of time between marathons, follow these guidelines.

- For 11 weeks between, do the 12-week schedule but skip the week "6 weeks to goal."
- For 9 weeks between, do the 10-week schedule but skip the week "5 weeks to goal," and with 35 days to go, increase the distance of the run to 18 miles (29 km).
- For 7 weeks between, do the 8-week schedule but skip the week "3 weeks to goal," and with 21 days to go, increase the distance of the run to 18 miles (29 km).
- For 5 weeks between, do the 6-week schedule but skip the week "2 weeks to goal," and with 14 days to go, increase the medium-long run to 16 miles (26 km).

12-WEEK SCHEDULE

A period of 12 weeks between marathons isn't too bad. There's a real risk, however, of either taking it too easy and gradually losing marathon-specific fitness or overdoing it and finding yourself at the starting line of marathon number 2 feeling tired and wondering why you're there. You need to find the perfect balance for your individual situation. The best strategy is to really take it easy for the first 3 or 4 weeks after your previous marathon to ensure that your body is fully recovered. That leaves 8 or 9 weeks until the next marathon, including 5 or 6 weeks of solid training and a 3-week taper.

The key training time is the 6-week period lasting from 7 weeks to go through 2 weeks until the second marathon. The most important workouts during those weeks are the tune-up races with 29 and 15 days to go; the marathon-pace run with 42 days to go; the long runs with 49, 35, 28, and 21 days to go; the $\dot{V}O_2max$ sessions with 39, 33, and 25 days to go; and the medium-long runs with 52, 44, 38, 32, and 24 days until marathon number 2.

10-WEEK SCHEDULE

Allowing 10 weeks between marathons is almost reasonable, and the schedule reflects this by providing 3 weeks of solid recovery, 4 weeks of solid training, and a 3-week taper.

The key training weeks are those that end with 6, 5, 4, 3, and 2 weeks until your second marathon. The most important workouts during those weeks are the tune-up races with 29 and 15 days to go; the long runs with 35, 28, 21, and 14 days to go; the LT session with 44 days to go; the $\dot{V}O_2max$ sessions with 39 and 25 days to go; and the medium-long runs with 38, 32, and 24 days until marathon number 2. The only word of caution concerning a 10-week time frame between marathons is to allow yourself to recover fully from your previous marathon before training too intensely for the next one.

8-WEEK SCHEDULE

The 8-week schedule allows you to recover thoroughly from your previous marathon, train well for about 3 weeks, and then taper for marathon number 2. A period of 8 weeks between marathons is far less risky than 4 or 6 weeks. Even if your first marathon was in hot weather, or if you came out of it with a minor injury, with a bit of luck you should still be OK for marathon number 2.

The key training weeks are those that end with 4, 3, and 2 weeks until the second marathon. The most important workouts during those weeks are the tune-up race with 15 days to go; the long runs with 28, 21, and 14 days to go; the LT session with 30 days to go; and the medium-long runs with 24 and 18 days until the marathon. Try to avoid doing more than the schedules call for because 8 weeks between marathons is still brief enough that you don't have much room for error.

PETE'S OLYMPIC-YEAR DYNAMIC DOUBLE

On May 26, 1984, I ran 2:11:43 to win the Olympic marathon trials, and then on August 12, I placed 11th in 2:13:53 in the Olympics. Here's how I approached the 11 weeks in between.

I was on a bit of a high after winning the trials, to say the least. I took the next day off and went for a relaxed swim and a pathetic 3-mile (5 km) shuffle 2 days after the race. The next day, I had my weekly massage, and my muscles weren't too bad. Building toward the Olympics, massage each week helped keep me injury free despite the short recovery. I ran 45 miles (72 km) the week after the trials. Using the philosophy that I needed to get the training in as quickly as possible to be able to taper again and be in top form for the Olympics, I initially ran as I felt and got in 112 miles (180 km) the second week and 151 miles (243 km) the third week. During the second week after the trials, I started doing a few strides every couple days to try to get my legs turning over. This seemed to help quite a bit.

In retrospect, I should have run 80 to 90 miles (129-145 km) the second week and 110 to 120 miles (177-193 km) the third week. Doing the amount I did showed a lack of confidence because I wouldn't have lost fitness by doing fewer miles. In fact, if I had run a bit less mileage right after the trials, I probably would have performed better at the Olympics. But I didn't understand that at the time.

The problem I faced was that in 11 weeks I couldn't very well do a 4-week recovery and a 3-week taper because that would have left only 4 weeks to train to compete against the best runners in the world. I got around that by cutting back the recovery and getting back into fairly high-quality long intervals by the fourth or fifth week after the trials. The beauty of the short recovery after the trials was that I was fit enough to do my long intervals at a good clip right away, so I didn't need as long to build into them. For example, in the fifth week after the trials, I did a 3-mile time trial on the track in 14:02.

I did continue, however, to train according to how I felt, with flexibility both ways. For example, one day I headed out for a 15-miler (24 km), felt good, and wound up going 26 miles (42 km). On other days, I would postpone a track workout for a day or two until my legs felt as if they could give a good effort without getting injured.

I tapered more for the Olympics than for the trials. This was somewhat necessitated by tightness that I developed in my back during the last 3 weeks before the race. It was also out of a realization that I had trained too hard in the weeks after the trials and that my energy level needed time to come up a notch. This is a very subjective matter, but I could tell during my training runs that a bit of zip was missing and that it was better to cut back and regain my strength. I did this by making my easy days—in terms of speed and distance—easier. I also trimmed the volume of my long runs and my speed workouts. This taper became the model that I followed for the rest of my racing career.

—Pete Pfitzinger

6-WEEK SCHEDULE

The 6-week schedule was difficult to put together because 6 weeks is just enough time to start to lose fitness if you don't train enough, but it is also just barely enough time to recover from marathon number 1 before you need to taper for marathon number 2. The most important training weeks are those that end 3 weeks and 2 weeks before marathon number 2. Those weeks provide a small window during which you can train fairly hard without wearing yourself out for the second marathon.

The key workouts during those weeks are the tune-up race with 15 days to go, the long run with 14 days to go, the $\dot{V}O_2max$ sessions with 23 and 19 days to go, and the medium-long runs with 21 and 18 days until the marathon. This brief training stimulus will keep you in peak marathon fitness so that after tapering, you should be close to your best.

4-WEEK SCHEDULE

The 4-week schedule is about as compact as you can get. This program consists of 2 weeks of recovery merging into 2 weeks of taper. The objective is to get you to the starting line injury free, fully recovered from your previous marathon, and still in top shape. The mileage for this program starts at 24 miles (39 km) and builds to 48 miles (77 km) during the third week. Unfortunately, that's also the penultimate week before the marathon, so mileage and intensity building abruptly halt and merge into a taper.

The most important workouts in this schedule are the medium-long runs with 14 and 10 days until marathon number 2 and the $\dot{V}O_2max$ session with 12 days to go. If you need to do two marathons just 4 weeks apart (and *need* is a relative term), this schedule should maximize your chances of success.

RACING STRATEGIES

Don't do it!

Just kidding. You should definitely set a clear goal for the second (or third, or fourth, …) marathon you're running within a brief time frame. Otherwise, you might very well find yourself a few miles into it already wondering, *What am I doing here?* Being able to state what you want to accomplish in your multiple marathoning will provide en route direction and motivation. The longer you've allowed between marathons, the more precisely you should be able to state your goals for marathon number 2 (beyond "to get through it").

Once you've picked your goal, map out the splits you'll need to hit. Throughout this book, we've stressed the merits of showing restraint early in the marathon to maximize your chances of being able to run a strong second half. That advice is especially pertinent if you've already finished one marathon in the last 12 weeks or sooner. Your multiple-marathoning experience will almost certainly become a self-fulfilling death march if you run too fast early in the race in the hope of building a cushion against an inevitably slower second half.

Wait until the week before your second marathon to decide on a time goal. Be realistic, taking into account how your recovery from your first race went; the quality of your long runs, tempo runs, and interval sessions in the interim; and whether you've felt your energy level rise during your taper for marathon number 2.

Also consider the circumstances of your previous marathon. For example, if you ran a huge personal best off of negative splits, there's probably room for improvement this time around. Or say you wilted over the last 10K the last time around and realize in retrospect that this was because of a too-aggressive first 10 miles (16 km); you should be able to make another attempt at your goal time for the first marathon. If, however, you prepared with monk-like devotion for 24 weeks for your previous marathon and shaved 3 seconds off your lifetime best, and your second marathon is 4 weeks later, well, sorry, but this probably isn't the time to try for a 10-minute PR.

If you've never consciously tried to run a marathon with negative splits, this might be the occasion to do so. Give yourself the first several miles to get an accurate feel for how your body is responding to the challenge you've set for it, and pick up the pace only when you're fairly confident that you can sustain it to the end.

AFTER THE MARATHON

If you've just run two or more marathons within a brief time span, your best strategy for future success is to take a well-deserved break. A few weeks of no running or easy training will help your body to recover and your mind to develop new challenges. You have little to gain by rushing back into training, and your risk of injury is exceptionally high at this point, owing to the reduced resiliency of your muscles and connective tissue after running multiple marathons.

Multiple Marathoning 12-Week Schedule

	WEEKS TO NEXT MARATHON			
	11	**10**	**9**	**8**
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	Rest or 5 miles (8 km)	Recovery 6 miles (10 km)	Recovery 6 miles (10 km)	Gen-aerobic + speed 8 miles (13 km) with 10 × 100 m strides
Wednesday	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Gen-aerobic 9 miles (14 km)	Med-long run 12 miles (19 km)
Thursday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Recovery 4 miles (6 km)
Friday	Recovery 5 miles (8 km)	Gen-aerobic + speed 7 mile (11 km) with 8 × 100 m strides	Gen-aerobic + speed 9 miles (14 km) with 8 × 100 m strides	LT 9 miles (14 km) with 5 miles (8 km) at LT pace
Saturday	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery + speed 5 miles (8 km) with 6 × 100 m strides
Sunday	Recovery 7 miles (11 km)	Gen-aerobic 10 miles (16 km)	Med-long run 13 miles (21 km)	Long run 16 miles (26 km)
Weekly volume	22-27 miles (35-43 km)	32 miles (53 km)	42 miles (67 km)	54 miles (86 km)

Multiple Marathoning 12-Week Schedule

	WEEKS TO NEXT MARATHON			
	7	**6**	**5**	**4**
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	$\dot{V}O_2max$ 9 miles (14 km) with 6 × 800 m at 5K race pace; jog 50-90% interval time	Gen-aerobic + speed 8 miles (13 km) with 10 × 100 m strides	Recovery 6 miles (10 km)	$\dot{V}O_2max$ 9 miles (14 km) with 6 × 600 m at 5K race pace; jog 50-90% interval time
Wednesday	Recovery 6 miles (10 km)	Med-long run 15 miles (24 km)	$\dot{V}O_2max$ 10 miles (16 km) with 4 × 1,200 m at 5K race pace; jog 50-90% interval time	Med-long run 11 miles (18 km)
Thursday	Med-long run 13 miles (21 km)	Recovery 6 miles (10 km)	Med-long run 15 miles (24 km)	Recovery + speed 6 miles (10 km) with 6 × 100 m strides
Friday	Gen-aerobic + speed 8 miles (13 km) with 6 × 10 sec hill sprints + 8 × 100 m strides	Med-long run 13 miles (21 km)	Gen-aerobic 9 miles (14 km)	Recovery 5 miles (8 km)
Saturday	Recovery 6 miles (10 km)	Recovery + speed 7 miles (11 km) with 6 × 100 m strides	Recovery 6 miles (10 km)	8K-15K tune-up race (total 9-13 miles [14-21 km])
Sunday	Long run 18 miles (29 km)	Marathon-pace run 15 miles (24 km) with 10 miles (16 km) at marathon pace	Long run 20 miles (32 km)	Long run 17 miles (27 km)
Weekly volume	60 miles (97 km)	64 miles (103 km)	66 miles (106 km)	57-61 miles (92-98 km)

Multiple Marathoning 12-Week Schedule

	WEEKS TO NEXT MARATHON			
	3	**2**	**1**	**Race week**
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest
Tuesday	Recovery 6 miles (10 km)	$\dot{V}O_2max$ 9 miles (14 km) with 6 × 600 m at 5K race pace; jog 50-90% interval time	Gen-aerobic + speed 8 miles (13 km) with 8 × 100 m strides	Recovery 6 miles (10 km)
Wednesday	$\dot{V}O_2max$ 11 miles (18 km) with 6 × 1,000 m at 5K race pace; jog 50-90% interval time	Med-long run 11 miles (18 km)	Recovery 5 miles (8 km)	Dress rehearsal 7 miles (11 km) with 2 miles (3 km) at marathon pace
Thursday	Med-long run 15 miles (24 km)	Recovery + speed 6 miles (10 km) with 6 × 100 m strides	$\dot{V}O_2max$ 9 miles (14 km) with 4 × 1,200 m at 5K race pace; jog 50-90% interval time	Recovery 6 miles (10 km)
Friday	Gen-aerobic 9 miles (14 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery + speed 5 miles (8 km) with 6 × 100 m strides
Saturday	Recovery 6 miles (10 km)	8K-10K tune-up race (total 9-11 miles [14-18 km])	Gen-aerobic + speed 7 miles (11 km) with 10 × 100 m strides	Recovery 4 miles (6 km)
Sunday	Long run 20 miles (32 km)	Long run 17 miles (27 km)	Med-long run 13 miles (21 km)	Second marathon
Weekly volume	67 miles (108 km)	57-59 miles (92-95 km)	47 miles (76 km)	28 miles (45 km) (6 days prerace)

Multiple Marathoning 10-Week Schedule

	WEEKS TO NEXT MARATHON				
	9	**8**	**7**	**6**	**5**
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	Rest or cross-train	Recovery 5 miles (8 km)	Recovery 6 miles (10 km)	Gen-aerobic + speed 8 miles (13 km) with 6 × 10 sec hill sprints + 8 × 100 m strides	Recovery 6 miles (10 km)
Wednesday	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Gen-aerobic 9 miles (14 km)	Med-long run 12 miles (19 km)	$\dot{V}O_2$max 10 miles (16 km) with 4 × 1,200 m at 5K race pace; jog 50-90% interval time
Thursday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Recovery 4 miles (6 km)	Med-long run 15 miles (24 km)
Friday	Recovery 5 miles (8 km)	Gen-aerobic + speed 7 miles (11 km) with 8 × 100 m strides	Gen-aerobic + speed 9 miles (14 km) with 8 × 100 m strides	LT 9 miles (14 km) with 5 miles (8 km) at LT pace	Gen-aerobic 9 miles (14 km)
Saturday	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery + speed 5 miles (8 km) with 6 × 100 m strides	Recovery 6 miles (10 km)
Sunday	Recovery 7 miles (11 km)	Gen-aerobic 10 miles (16 km)	Med-long run 13 miles (21 km)	Long run 17 miles (27 km)	Long run 19 miles (31 km)
Weekly volume	22 miles (35 km)	32 miles (51 km)	42 miles (68 km)	55 miles (89 km)	65 miles (105 km)

Multiple Marathoning 10-Week Schedule

	WEEKS TO NEXT MARATHON				
	4	**3**	**2**	**1**	**Race week**
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest
Tuesday	$\dot{V}O_2$max 9 miles (14 km) with 6 × 600 m at 5K race pace; jog 50-90% interval time	Recovery 6 miles (10 km)	$\dot{V}O_2$max 9 miles (14 km) with 6 × 600 m at 5K race pace; jog 50-90% interval time	Gen-aerobic + speed 8 miles (13 km) with 8 × 100 m strides	Recovery 6 miles (10 km)
Wednesday	Med-long run 11 miles (18 km)	$\dot{V}O_2$max 11 miles (18 km) with 6 × 1,000 m at 5K race pace; jog 50-90% interval time	Med-long run 11 miles (18 km)	Recovery 5 miles (8 km)	Dress rehearsal 7 miles (11 km) with 2 miles (3 km) at marathon pace
Thursday	Recovery + speed 6 miles (10 km) with 6 × 100 m strides	Med-long run 15 miles (24 km)	Recovery + speed 6 miles (10 km) with 6 × 100 m strides	$\dot{V}O_2$max 9 miles (14 km) with 4 × 1,200 m at 5K race pace; jog 50-90% interval time	Recovery 6 miles (10 km)
Friday	Recovery 5 miles (8 km)	Gen-aerobic 9 miles (14 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery + speed 5 miles (8 km) with 6 × 100 m strides
Saturday	8K-15K tune-up race (total 9-13 miles [14-21 km])	Recovery 6 miles (10 km)	8K-10K tune-up race (total 9-11 miles [14-18 km])	Gen-aerobic + speed 7 miles (11 km) with 10 × 100 m strides	Recovery 4 miles (6 km)
Sunday	Long run 17 miles (27 km)	Long run 20 miles (32 km)	Long run 17 miles (27 km)	Med-long run 13 miles (21 km)	Second marathon
Weekly volume	57-61 miles (92-97 km)	67 miles (108 km)	57-59 miles (92-95 km)	47 miles (76 km)	28 miles (45 km) (6 days prerace)

Multiple Marathoning 8-Week Schedule

WEEKS TO NEXT MARATHON

	7	6	5	4
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	Rest or cross-train	Recovery 5 miles (8 km)	Recovery 6 miles (10 km)	Gen-aerobic + speed 8 miles (13 km) with 6 × 10 sec hill sprints + 8 × 100 m strides
Wednesday	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Gen-aerobic 9 miles (14 km)	Med-long run 12 miles (19 km)
Thursday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Recovery 4 miles (6 km)
Friday	Recovery 5 miles (8 km)	Gen-aerobic + speed 7 miles (11 km) with 8 × 100 m strides	Gen-aerobic + speed 9 miles (14 km) with 8 × 100 m strides	LT 9 miles (14 km) with 5 miles (8 km) at LT pace
Saturday	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery + speed 5 miles (8 km) with 6 × 100 m strides
Sunday	Recovery 7 miles (11 km)	Gen-aerobic 10 miles (16 km)	Med-long run 13 miles (21 km)	Long run 17 miles (27 km)
Weekly volume	22 miles (35 km)	32 miles (52 km)	42 miles (68 km)	55 miles (87 km)

Multiple Marathoning 8-Week Schedule

	WEEKS TO NEXT MARATHON			
	3	**2**	**1**	**Race week**
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest
Tuesday	Recovery 6 miles (10 km)	$\dot{V}O_2max$ 9 miles (14 km) with 6 × 600 m at 5K race pace; jog 50-90% interval time	Gen-aerobic + speed 8 miles (13 km) with 8 × 100 m strides	Recovery 6 miles (10 km)
Wednesday	$\dot{V}O_2max$ 10 miles (16 km) with 5 × 1,000 m	Med-long run 11 miles (18 km)	Recovery 5 miles (8 km)	Dress rehearsal 7 miles (11 km) with 2

	at 5K race pace; jog 50-90% interval time			miles (3 km) at marathon pace
Thursday	Med-long run 15 miles (24 km)	Recovery + speed 6 miles (10 km) with 6 × 100 m strides	$\dot{V}O_2$max 9 miles (14 km) with 4 × 1,200 m at 5K race pace; jog 50-90% interval time	Recovery 6 miles (10 km)
Friday	Gen-aerobic 9 miles (14 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery + speed 5 miles (8 km) with 6 × 100 m strides
Saturday	Recovery 6 miles (10 km)	8K-10K tune-up race (total 9-11 miles [14-18 km])	Recovery + speed 6 miles (10 km) with 8 × 100 m strides	Recovery 4 miles (6 km)
Sunday	Long run 20 miles (32 km)	Long run 17 miles (27 km)	Med-long run 13 miles (21 km)	Second marathon
Weekly volume	66 miles (106 km)	57-59 miles (92-95 km)	46 miles (74 km)	28 miles (45 km) (6 days prerace)

Multiple Marathoning 6-Week Schedule

	WEEKS TO NEXT MARATHON		
	5	**4**	**3**
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train
Tuesday	Rest or cross-train	Recovery 6 miles (10 km)	Gen-aerobic + speed 7 miles (11 km) with 8 × 100 m strides
Wednesday	Recovery 5 miles (8 km)	Gen-aerobic 8 miles (13 km)	Med-long run 12 miles (19 km)
Thursday	Rest or cross-train	Rest or cross-train	Recovery 4 miles (6 km)
Friday	Recovery 6 miles (10 km)	Gen-aerobic + speed	$\dot{V}O_2$max 9 miles (14 km) with 6 × 800 m at 5K race pace; jog 50-90% interval

		8 miles (13 km) with 8 × 100 m strides	time
Saturday	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)
Sunday	Gen-aerobic 8 miles (13 km)	Gen-aerobic 10 miles (16 km)	Med-long run 15 miles (24 km)
Weekly volume	24 miles (39 km)	37 miles (60 km)	52 miles (84 km)

Multiple Marathoning 6-Week Schedule

	WEEKS TO NEXT MARATHON		
	2	**1**	**Race week**
Monday	Rest or cross-train	Rest or cross-train	Rest
Tuesday	$\dot{V}O_2max$ 9 miles (14 km) with 6 × 600 m at 5K race pace; jog 50-90% interval time	Gen-aerobic + speed 8 miles (13 km) with 8 × 100 m strides	Recovery 6 miles (10 km)
Wednesday	Med-long run 11 miles (18 km)	Recovery 5 miles (8 km)	Dress rehearsal 7 miles (11 km) with 2 miles (3 km) at marathon pace
Thursday	Recovery + speed 6 miles (10 km) with 6 × 100 m strides	$\dot{V}O_2max$ 9 miles (14 km) with 4 × 1,200 m at 5K race pace; jog 50-90% interval time	Recovery 6 miles (10 km)
Friday	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery + speed 5 miles (8 km) with 6 × 100 m strides
Saturday	8K-10K tune-up race (total 9-11 miles [14-18 km])	Recovery + speed 6 miles (10 km) with 8 × 100 m strides	Recovery 4 miles (6 km)
Sunday	Long run 18 miles (29 km)	Med-long run 13 miles (21 km)	Second marathon
Weekly volume	58-60 miles (93-97 km)	46 miles (74 km)	28 miles (45 km) (6 days prerace)

Multiple Marathoning 4-Week Schedule

	WEEKS TO NEXT MARATHON			
	3	**2**	**1**	**Race week**
Monday	Rest or cross-train	Rest or cross-train	Rest or cross-train	Rest
Tuesday	Rest or cross-train	Recovery 6 miles (10 km)	$\dot{V}O_2max$ 8 miles (13 km) with 5 × 800 m at 5K race pace; jog 50-90% interval time	Recovery 6 miles (10 km)
Wednesday	Recovery 5 miles (8 km)	Gen-aerobic 8 miles (13 km)	Recovery 5 miles (8 km)	Dress rehearsal 7 miles (11 km) with 2 miles (3 km) at marathon pace
Thursday	Rest or cross-train	Rest or cross-train	Med-long run 15 miles (24 km)	Recovery 6 miles (10 km)
Friday	Recovery 6 miles (10 km)	Gen-aerobic + speed 8 miles (13 km) with 8 × 100 m strides	Recovery 4 miles (6 km)	Recovery + speed 5 miles (8 km) with 6 × 100 m strides
Saturday	Recovery 5 miles (8 km)	Recovery 5 miles (8 km)	Recovery + speed 5 miles (8 km) with 8 × 100 m strides	Recovery 4 miles (6 km)
Sunday	Gen-aerobic 8 miles (13 km)	Med-long run 11 miles (18 km)	Med-long run 11 miles (18 km)	Second marathon
Weekly volume	24 miles (39 km)	38 miles (61 km)	48 miles (77 km)	28 miles (45 km) (6 days prerace)

Appendix A

Marathon Race-Pace Chart

Goal	Pace per mile	5 miles	10K	10 miles	20K	Halfway
2:10:00	4:57.5	24:47	30:48	49:35	1:01:36	1:05:00
2:15:00	5:09.0	25:45	32:00	51:30	1:04:00	1:07:30
2:20:00	5:20.4	26:42	33:11	53:24	1:06:22	1:10:00
2:25:00	5:31.8	27:39	34:22	55:18	1:08:44	1:12:30
2:30:00	5:43.2	28:36	35:33	57:12	1:11:06	1:15:00
2:35:00	5:54.7	29:33	36:44	59:07	1:13:28	1:17:30
2:40:00	6:06.1	30:30	37:55	1:01:01	1:15:50	1:20:00
2:45:00	6:17.6	31:28	39:06	1:02:56	1:18:12	1:22:30
2:50:00	6:29.0	32:25	40:17	1:04:50	1:20:34	1:25:00
2:55:00	6:40.5	33:22	41:28	1:06:45	1:22:56	1:27:30
3:00:00	6:51.9	34:19	42:39	1:08:39	1:25:18	1:30:00
3:05:00	7:03.3	35:16	43:50	1:10:33	1:27:40	1:32:30
3:10:00	7:14.8	36:14	45:02	1:12:28	1:30:04	1:35:00
3:15:00	7:26.2	37:11	46:13	1:14:22	1:32:26	1:37:30
3:20:00	7:37.7	38:08	47:24	1:16:17	1:34:48	1:40:00
3:25:00	7:49.1	39:05	48:35	1:18:11	1:37:10	1:42:30
3:30:00	8:00.5	40:02	49:46	1:20:05	1:39:32	1:45:00
3:35:00	8:12.0	41:00	50:57	1:22:00	1:41:54	1:47:30
3:40:00	8:23.4	41:57	52:08	1:23:54	1:44:16	1:50:00
3:45:00	8:34.9	42:54	53:19	1:25:49	1:46:38	1:52:30
3:50:00	8:46.3	43:51	54:30	1:27:43	1:49:00	1:55:00
3:55:00	8:57.8	44:49	55:41	1:29:38	1:51:22	1:57:30
4:00:00	9:09.2	45:46	56:53	1:31:32	1:53:46	2:00:00

15 miles	30K	20 miles	40K	25 miles	Finish
1:14:22	1:32:24	1:39:10	2:03:12	2:03:57	2:10:00
1:17:15	1:36:00	1:43:00	2:08:00	2:08:45	2:15:00
1:20:06	1:39:33	1:46:48	2:12:44	2:13:30	2:20:00
1:22:57	1:43:06	1:50:36	2:17:28	2:18:15	2:25:00
1:25:48	1:46:39	1:54:24	2:22:12	2:23:00	2:30:00
1:28:40	1:50:12	1:58:14	2:26:56	2:27:47	2:35:00
1:31:31	1:53:45	2:02:02	2:31:40	2:32:32	2:40:00
1:34:24	1:57:18	2:05:52	2:36:24	2:37:20	2:45:00
1:37:15	2:00:51	2:09:40	2:41:08	2:42:05	2:50:00
1:40:07	2:04:24	2:13:30	2:45:52	2:46:52	2:55:00
1:42:58	2:07:57	2:17:18	2:50:36	2:51:37	3:00:00
1:45:49	2:11:30	2:21:06	2:55:20	2:56:22	3:05:00
1:48:42	2:15:06	2:24:56	3:00:08	3:01:10	3:10:00
1:51:33	2:18:39	2:28:44	3:04:52	3:05:55	3:15:00
1:54:25	2:22:12	2:32:34	3:09:36	3:10:42	3:20:00
1:57:16	2:25:45	2:36:22	3:14:20	3:15:27	3:25:00
2:00:07	2:29:18	2:40:10	3:19:04	3:20:12	3:30:00
2:03:00	2:32:51	2:44:00	3:23:48	3:25:00	3:35:00
2:05:51	2:36:24	2:47:48	3:28:32	3:29:45	3:40:00
2:08:43	2:39:57	2:51:38	3:33:16	3:34:32	3:45:00
2:11:34	2:43:30	2:55:26	3:38:00	3:39:17	3:50:00
2:14:27	2:47:03	2:59:16	3:42:44	3:44:05	3:55:00
2:17:18	2:50:39	3:03:04	3:47:32	3:48:50	4:00:00

Appendix B

Equivalent Race Times: 10K Through Marathon

The following table provides an estimate of equivalent race performances for the most popular distances between 10K and the marathon. The table is meant to provide at-a-glance help in setting time goals.

Note the word *estimate*. Your training history, race terrain and weather, experience at each distance, the level of competition, and your genetic predisposition will influence how these times fit for you. The estimated equivalences assume that you're equally well trained for the various distances. Also, the more recent the performances you're assessing, the more accurate the table will be.

10K	15K	10 miles	Half marathon	Marathon
27:00	41:50	45:21	60:24	2:07:22
28:00	43:23	47:02	62:39	2:12:05
29:00	44:56	48:43	64:53	2:16:48
30:00	46:29	50:24	67:07	2:21:31
31:00	48:02	52:06	69:21	2:26:14
32:00	49:35	53:45	71:36	2:30:57
33:00	51:08	55:26	73:50	2:35:40
34:00	52:41	57:07	76:04	2:40:23
35:00	54:14	58:48	78:18	2:45:07
36:00	55:47	60:28	80:33	2:49:50
37:00	57:20	62:09	82:47	2:54:33
38:00	58:53	63:50	85:01	2:59:16
39:00	60:26	65:31	87:15	3:04:18
40:00	61:59	67:12	89:30	3:38:42
41:00	63:32	68:52	91:44	3:13:25
42:00	65:05	70:33	93:58	3:18:08
43:00	66:38	72:14	96:12	3:22:51
44:00	68:11	73:55	98:27	3:27:34
45:00	69:44	75:35	1:40:41	3:32:17
46:00	71:17	77:16	1:42:55	3:37:00
47:00	72:50	78:57	1:45:09	3:41:43
48:00	74:23	80:38	1:47:24	3:46:26
49:00	75:56	82:19	1:49:47	3:51:09
50:00	77:28	83:59	1:51:52	3:55:52
51:00	79:01	85:40	1:54:06	4:00:35
52:00	80:34	87:21	1:56:20	4:05:18
53:00	82:07	89:02	1:58:35	4:10:01
54:00	83:40	90:42	2:00:49	4:14:44
55:00	85:13	92:23	2:03:03	4:19:27

Glossary

This glossary is purposefully short. It contains only the main physiological terms used in this book that are highly pertinent to marathon training and racing. It's provided here for easy reference if you're reading the book other than from cover to cover.

biomechanics—How the various parts of your body work together to create your running form. Although some features of your biomechanics, such as the structure of your bones, are primarily genetically determined, stretching and strengthening exercises may improve your running biomechanics and therefore improve your marathon performance.

capillaries—The smallest blood vessels; several typically border each muscle fiber. With the correct types of training, you'll increase the number of capillaries per muscle fiber. By providing oxygen directly to the individual muscle fibers, increased capillary density allows your rate of aerobic energy production to increase. Capillaries also deliver fuel to the muscle fibers and remove waste products such as carbon dioxide.

fast-twitch muscle fibers—Muscle fibers that contract and fatigue rapidly to power intense short-term exercise such as sprinting. They're classified into two primary categories, A and B; fast-twitch A fibers have more of the characteristics of slow-twitch fibers than do fast-twitch B. With endurance training your fast-twitch A fibers gain more of the characteristics of slow-twitch fibers. These adaptations are beneficial because your fast-twitch fibers then become better at producing energy aerobically.

glycogen—The storage form of carbohydrate in your muscles and the main source of energy during running. Endurance training reduces your body's need to burn glycogen at a given pace and teaches your body to store more glycogen.

heart rate reserve—Your maximal heart rate minus your resting heart rate. Heart rate reserve reflects how much your heart rate can increase to pump more oxygen-rich blood to your muscles.

hemoglobin—A red blood cell protein that carries oxygen in the blood. The higher your hemoglobin content, the more oxygen that can be carried (per unit of blood) to your muscles to produce energy aerobically.

lactate threshold—The exercise intensity above which your rate of lactate production is substantially greater than your rate of lactate clearance. At effort levels above your lactate threshold, the lactate concentration rises in your muscles and blood. The hydrogen ions associated with lactate production inactivate the enzymes for energy production and may interfere with the uptake of calcium, thereby reducing the muscles' ability to contract. You can't, therefore, maintain a pace faster than your lactate-threshold pace for more than a few miles.

maximal heart rate—The highest heart rate you can attain during all-out running. Your maximal heart rate is determined genetically. In other words, it doesn't increase with training. Successful marathoners don't have particularly high maximal heart rates, so it isn't a factor in determining success.

maximal oxygen uptake—Commonly referred to as $\dot{V}O_2$max; the maximal amount of oxygen your heart can pump to your muscles and your muscles can then use to produce energy. The combination of your training and your genetics determines how high a $\dot{V}O_2$max you have.

mitochondria—The only part of your muscle fibers in which energy can be produced aerobically. Think of them as the aerobic energy factories in your muscle fibers. The right types of training increase the size of your mitochondria (i.e., make bigger factories) and the number of mitochondria (i.e., make more factories) in your muscle fibers.

periodization—Systematically structuring your training over a period of time to reach your goal.

running economy—How fast you can run using a given amount of oxygen. If you can run faster than another athlete while using the same amount of oxygen, then you have better running economy. Running economy can also be looked at as how much oxygen is required to run at a given speed. If you use less oxygen while running at the same speed as another runner, then you're more economical.

slow-twitch muscle fibers—Muscle fibers that contract and tire slowly and that power sustained submaximal exercise such as endurance running. Slow-twitch muscle fibers naturally resist fatigue, and they have a high aerobic capacity, high capillary density, and other characteristics that make them ideal for marathon running.

$\dot{V}O_2$max—See maximal oxygen uptake.

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Index

Note: The italicized *f* and *t* following page numbers refer to figures and tables, respectively.

I

K

N

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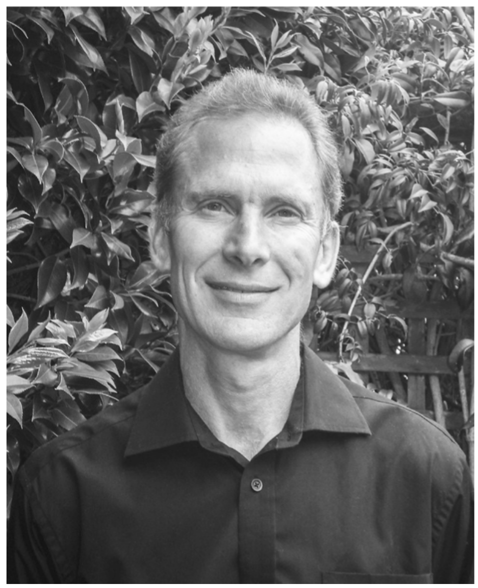
P

About the Authors



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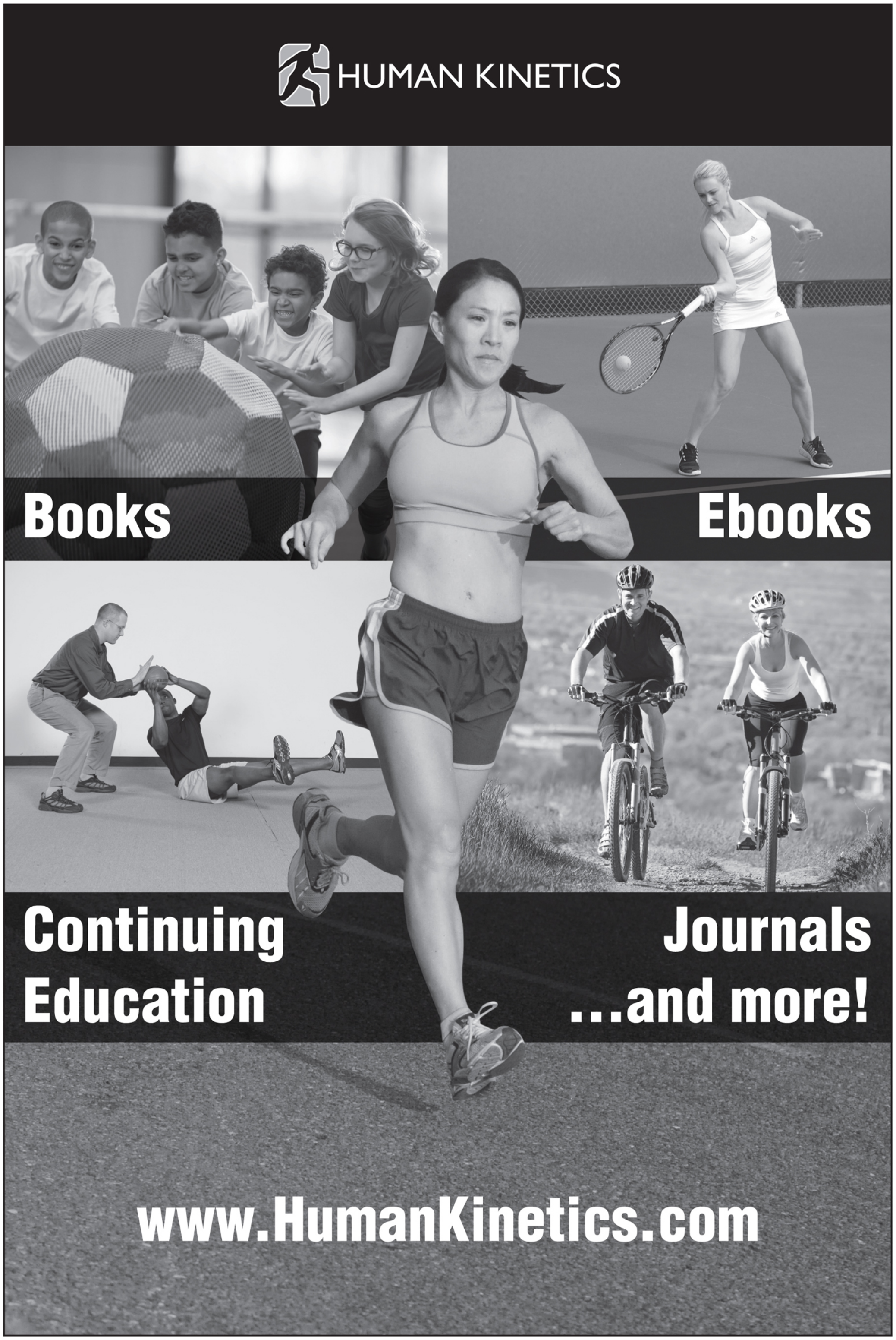
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