

Dr. MATTHEW BRICK



PRECISION

MULTISPORT

**POLAR**®

# Precision Multisport

BY Dr MATTHEW BRICK

COPYRIGHT 1994 BY POLAR ELECTRO OY, FINLAND

ISBN 951-96925-7-6

6TH EDITION, JULY 2003

PRINTED IN FINLAND

POLAR ELECTRO INC.  
370 CROSSWAYS PARK DRIVE  
WOODBURY, NEW YORK 11797

POLAR ELECTRO OY  
PROFESSORINTIE 5  
90440 KEMPELE, FINLAND

LAYOUT / GRAPHIC DESIGN OULUN TYYPIT OY / FINLAND



# Table of Contents

<b>INTRODUCTION</b> .....	7
WHAT IS MULTISPORT?	
WHY BE INVOLVED?	
WHY TRAIN WITH A HEART RATE MONITOR?	
<b>CALCULATING YOUR OWN HEART RATE NUMBERS</b> .....	11
RESTING HEART RATE	
MAXIMUM HEART RATE	
THE KARVONEN EQUATION	
<b>THE TRAINING INTENSITIES</b> .....	19
VERY EASY	
AEROBIC CONDITIONING	
STEADY STATE	
ANAEROBIC THRESHOLD	
MAXIMAL	
<b>BASIC PRINCIPLES OF TRAINING</b> .....	27
STRETCHING	
WARM UP AND COOL DOWN	
KEEPING A DIARY	
INCREASE GRADUALLY	
SELF-MOTIVATION	
MACRO CYCLES	
QUALITY AND QUANTITY	
RECOVERY	
TAPERING	
<b>TECHNIQUE: AVOIDING THE PITFALLS</b> .....	37
SWIMMING: COACHING, SWIM SQUADS	
CYCLING: FRAME FIT, SAFETY EQUIPMENT, CLOTHING	
RUNNING: SHOE SELECTION, TERRAIN, SURFACES, AVOIDING INJURY	
<b>WORKOUTS</b> .....	41
FOR BEGINNERS	
FOR RECREATIONAL ATHLETES	
FOR SERIOUS COMPETITORS	
FOR THE IRONMAN TRIATHLETE	
SUGGESTED BIKE INTERVAL SESSIONS	
SUGGESTED RUN INTERVAL SESSIONS	
BIKE RUN INTERVALS	
IMPORTANT NOTES ON WORKOUTS	
<b>JOE'S FIRST TRIATHLON</b> .....	59
<b>A FINAL WORD</b> .....	66
<b>ABOUT THE AUTHOR</b> .....	68
<b>ABOUT POLAR</b> .....	70



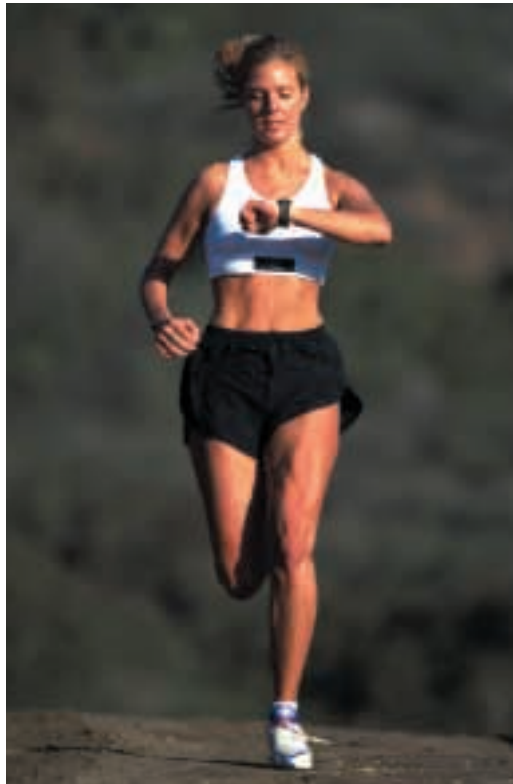
## Introduction

- What is Multisport?
- Why be involved?
- Why train with a Heart Rate Monitor?

# Introduction

## ■ What is Multisport?

Multisport commonly refers to an event comprising any combination of swimming, cycling, running and kayaking. The best known examples are the Triathlon (Swim: Bike: Run), currently on the verge of inclusion in the Olympic programme and Duathlon (Run: Bike: Run). Events range from entry level distances of 400m swim, 10k cycle, 2.5k run (approx. 40-60 min) up to the gruelling Ironman, measuring in at 3.8k swim, 180k cycle and 42k run!



## ■ Why Be Involved?

The reasons for being a triathlete or duathlete are as many and varied as the people who participate. Perhaps some of these answers could apply to you:

- *The Health Benefit:* Exercise strengthens the heart, lowers blood pressure and reduces and reverses heart and blood vessel disease.
- *Weight Reduction:* improves the way I look and feel about myself.
- *The Social Aspect:* I enjoy meeting people and making friends through our local club.
- *The Competition:* the Thrill of Winning.
- *The Challenge.*
- *The Technical aspects of equipment and the science of training.*
- *Active Body: Active Mind!*
- *The Release of Stress.*



## ■ Why Use a Heart Rate Monitor?

- The simple observation that the harder we exercise, the faster our heart beats can be put to good use. Our monitor is our rev counter, giving a precise measurement of our exercise intensity.
- *Individualise* your programme. You can train at your own ideal pace.
- *Progress* can be monitored and measured.
- Witnessing our own *improvement* is *motivating*.
- *Maximises* the benefits of exercise with the limited time of busy people.
- Introduce *objective* observation. Are we on the right track? Are we improving?





## Calculating Heart Rate Numbers

- Resting Heart Rate
- Maximum Heart Rate
- The Karvonen Equation

# Calculating Your Own Heart Rate Numbers!

You need know only three simple things:

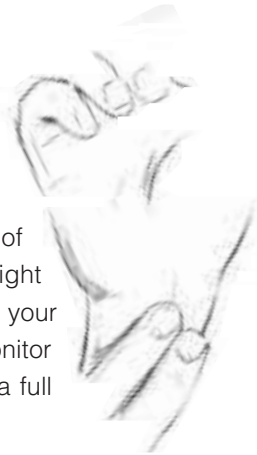
**Your Resting Heart Rate**

**Your Maximum Heart Rate**

**The Karvonen Equation**

## ■ Resting Heart Rate

Taking a consistent resting heart rate only comes with practice. The best time is as soon as you wake up in the morning, lying completely still. The easiest way is to reach over and place your index and middle finger of your left hand on the “palm side” of your right wrist, in the groove 2cm below the base of your thumb. You can now look at your watch/monitor on your left wrist and count your pulse over a full 60 seconds.



Take your heart rate every morning for a week and select the *lowest* result.

Your resting heart rate will go down as your fitness improves.

## The Scientific Way

If your heart rate monitor has a memory function you can get a very accurate measurement of your resting heart rate. Set your monitor to record every 60 seconds. This will give you around 33 hours of recording time! Wear your monitor as you sleep through the night and check your real minimum heart rate the next morning. Often the lowest readings will be one or two hours *before* you wake up.

## ■ Maximum Heart Rate

### The Easy Way

**MEN:  $220 - \text{Age} = \text{Maximum Heart Rate}$**  (approx.)

**WOMEN:  $226 - \text{Age} = \text{Maximum Heart Rate}$**  (approx.)



If you are new to sport, returning after a lengthy break or you have any history of heart disease, this simple formula will suffice initially. Because it is an “average”, it is not very accurate, especially for people who have been fit for many years or older people.

### The Hard Way

Your maximum heart rate will probably be different for each discipline in the following order:

Running max. > Cycling max. > Swimming max.

Running is highest, due to the greater percentage of muscles used during the activity.

Maximum heart rate changes very little in relation to our fitness. It does, on average, fall by one beat per year.

The most accurate method is a “Maximal Stress Test” performed on a running treadmill or stationary bicycle by a cardiologist or a trained technician.

If this is not an option for you, I have found the following methods effective:

### 1. Running

Choose a training partner of similar ability to do the test with you. Motivate one another, because we have to give it 100%! Perform the test after an easy training day or a day off. Warm up for 10 -15 min. near a long steep climb. Attack the climb as if you are racing to see who can run the farthest in 5 minutes. For the last 30 seconds, give it *everything* you have got. Glance at your monitor 2 or 3 times in this final sprint and select the highest number as your maximum.

### 2. Cycling

The principles are exactly the same. After a warm up, attack a *steep* five minute climb. Race your partner! Mounting your heart rate monitor on the handlebars will make it easier to watch your heart rate when the going gets tough.

### 3. Swimming

The entire Polar range, displayed at the end of this book, work well in water. After a good 15-20 minute warm-up, swim a 200m all-out effort. Look at your heart rate the moment you finish. If the result seems too low, take a thirty second rest and swim another 200m. Some people find that it takes two,

and possibly three repeats to reach a maximum. Another aid to reaching your maximum is to use flippers.

#### NOTE:

*Tighten your chest strap to ensure it does not slip as you swim. The read-out can be affected by very concentrated chlorine or salt water.*

#### NOTE:

*Some people find it difficult to motivate themselves to a maximal effort outside of a race. That nervousness and adrenaline does help! For example, if your tested maximum is 190, but at the end of a local 5k road race you reach 192, then that becomes your new maximum. **Before taking your maximal heart rate in the hard way you should consult your physician.***





## ■ The Karvonen Equation

At the very mention of the word “equation” many athletes will snap the book shut! Please bear with me, as this is a very simple, but effective idea:

Some heart rate calculations simply multiply the percentage effort by our maximum heart rate. This does not take into account the fact that everybody has a different minimum heart rate. The physiologist Karvonen realised this and said that our *Heart Rate Reserve* is our *Maximum Heart Rate minus our Minimum Heart Rate*. To get our target heart rate we simply multiply our Heart Rate Reserve by the percentage effort, and then add our minimum heart rate to this number.

*Working HR = [(Maximum HR - Minimum HR) x % effort] + Minimum HR*

### Joe Average's example:

Maximum Heart Rate: 200 beats per minute

Minimum (resting) Heart Rate: 50 beats per minute



**Application example 1:** Joe's 50% Effort Working Heart Rate:

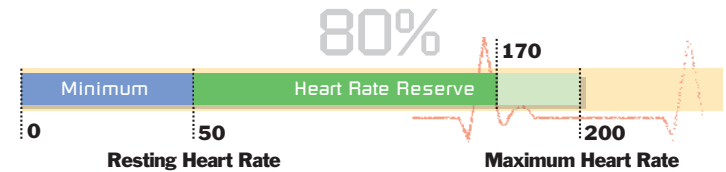
*Working Heart Rate*

$$\begin{aligned} &= (\text{Maximum} - \text{Minimum}) \times 50\% + \text{Minimum} \\ &= (200 - 50) \times 50\% + \text{Minimum} \\ &= 150 \times 50\% + \text{Minimum} \\ &= 75 + 50 \\ &= 125 \text{ beats per minute} \end{aligned}$$

Just multiply your cardiac reserve by the percentage, then add the minimum back on! Simple!

### Application example 2:

Joe's 80% Effort Working Heart Rate.



*Working Heart Rate*

$$\begin{aligned} &= (\text{Reserve} \times \text{Percentage effort}) + \text{Minimum} \\ &= (150 \times 80\%) + 50 \\ &= 120 + 50 \\ &= 170 \end{aligned}$$

You can use your own minimum and maximum numbers and quickly calculate your own working heart rates.



## The Training Intensities

- Very Easy
- Aerobic Conditioning
- Steady State
- Anaerobic Threshold
- Maximal

# The Training Intensities

## ■ Very Easy

### Training Heart Rate 50 - 60%

This is the easiest intensity we can work out at and still improve our fitness. At low training intensities, the body chooses fat as fuel for the working muscles.

This pace feels so easy most people feel guilty!

Conversation is easy and there is no sensation of being out of breath.

This pace is great for:

1. *Beginners*, or starting again after a lay-off.
2. *Recovery Sessions*.
3. People wanting to *lose weight*.

## ■ Aerobic Conditioning (Easy)

### Training Heart Rate 60 - 70%

It could be argued that this is the most important training intensity.

50-60%

60-70%  
EASY

Whether you are a beginner or a world-class professional, more than half of all training will be in this zone.

The benefits of the Aerobic Conditioning zone are:

1. Improves the ability of the *heart* to pump blood.
2. Increases the number of small *blood vessels* in our muscles.
3. Increases the *enzymes* in our muscles responsible for oxygen metabolism.
4. Increases the *strength* of our muscle tissues, tendons, ligaments and bones.
5. "*Familiarises*" our body with training.
6. Assists *weight control*.
7. Improves our *endurance*.



Fat remains the main source of energy at this intensity. It still feels easy and conversation is unimpeded.

## ■ Steady State (Medium)

### Training Heart Rate 70 - 80%

This is often the fastest pace we can maintain and still remain comfortable and "*pain-free*".

70-80%  
MEDIUM

Consequently, many people make the mistake of doing *all* their training at this pace! No wonder many beginners find exercise too hard!

I like the name “steady state” as it is the fastest pace we can maintain for a long time. (i.e. a competitive Ironman athlete will race near this intensity). Lactic acid does not build up.

There are many positive benefits:

1. “Familiarises” our body with a *faster pace*.
2. Improves *endurance*.
3. Begins to raise the speed we can maintain without building up lactic acid (*Anaerobic Threshold*).

When we are unfit, our muscles will choose carbohydrate for fuel, stored in the form of glycogen (long chains of sugar). As we become more fit, our body selects an increasing percentage of fat as fuel, allowing us to race for *longer* at this *faster* pace, while saving our limited stores of glycogen.

## ■ Anaerobic Threshold (AT) (Hard)

**Training Heart Rate 80 - 90%**

### **What does Anaerobic Threshold**

**Mean?** At lower training intensities our metabolism has no trouble supplying enough energy by burning glucose and/or fat in the presence of Oxygen. At high intensities our heart and lungs cannot supply enough oxygen to keep up with demand. Our body compensates by burning glucose in a short-term chemical reaction that does not require Oxygen (*Anaerobic means “without Oxygen”*).

The problem with Anaerobic Energy production is that it is only good for a few seconds before waste products like



*Lactic Acid* rapidly build up. Have you ever tried to sprint for longer than 60 seconds? You will know what I am talking about!

We refer to the intensity at which we begin to “go anaerobic” and build up lactic acid as our *Anaerobic Threshold*. It is useful to train for short periods (3 - 5 min) at a heart rate just below this point because....

■ *Our Anaerobic Threshold heart rate increases as we get fit.*

## **Estimate Your AT**

You can make a very good guess of your own AT by the following methods:

1. One hour time trial. We can maintain our AT heart rate for about one hour. Record your heart rate for best effort and average it for the hour.
2. Gradually speed up over at least 10 minutes while cycling or running. As you reach your AT heart rate your legs will begin to feel a little like rubber and *suddenly your rate of breathing will increase*. This is *not* because we need more oxygen but because the extra acid in our blood speeds up our breathing control centre in our brain. Glance at your monitor and take note of your heart rate. This can be a very accurate method.
3. If you have a Polar S610, S710 or S810 monitor and computer software you can perform the Conconi Test. The details are outside the scope of this book.

80-90%  
HARD

We reserve this hard intensity for -

1. When we have been training for some months and are confident of our *fitness*.
2. When we have *competitive aspirations*.
3. Short, sharp bursts of 3-5 minutes duration (*interval training*).
4. *Racing*: we can maintain this intensity for about one hour.

Originally, it was thought that AT was an exact heart rate beyond which lactic acid suddenly started to accumulate. Modern research tells us that it is not a sudden, easily-marked point, but a more gradual transition.

It remains a useful idea because when we are unfit, our AT might be at 70-80% effort or lower. As our training progresses, our AT shifts upward such that in a very fit competitive athlete it might be at 90% effort. Simply put, an unfit person may only be able to hold 70% effort for one hour, while a very fit athlete may be able to hold 90% effort!

This *hard training* is best reserved for one session each of biking and running per week, and only if we are reasonably fit.

Swimming is a little different. Because our body is suspended in water, two or three AT sessions per week does not seem to pose a problem.

## ■ Maximal (Very Hard)

### Training Heart Rate 90 - 100%

We reserve this extremely difficult level of training for *competitive athletes* who:

90% - 100%  
VERY HARD

1. Require a *sprint*, i.e. cyclists.
2. Race over *short distances* (track sprinters, short distance swimmers).

Multisport athletes are *endurance athletes*, and do not have to develop this shorter explosive type of exercise. We can *leave it alone* (phew!).







## Basic Principles of Training

- Stretching
- Warm up and Cool Down
- Keeping a Diary
- Increase Gradually
- Self-Motivation
- Macro Cycles
- Quality and Quantity
- Recovery
- Tapering

# Basic Principles of Training

## ■ Stretching

Whether to stretch our muscles before or after the warm up is a matter of contention. In fact some people advocate not stretching at all! Flexibility is in large part determined by our genetics. Perhaps people “born flexible” never need to stretch, but if you are like most of the athletes I know, five minutes of stretching *after* the warm up improves the workout and helps keep us injury-free.

Correct stretching technique is the subject of a book in itself. Ask a more experienced friend, a physiotherapist, or a coach.

### **But remember**

- don't *bounce* when you stretch
- stretch *slowly* and *steadily*
- hold the stretch for a slow count of *ten*
- it should not be *painful*



## ■ Warming Up & Cooling Down

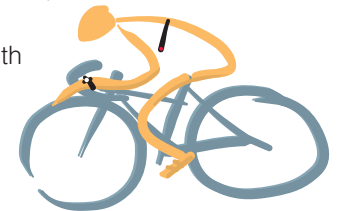
Our body makes a number of changes when we begin exercising. Blood is directed away from the abdominal organs and towards the exercising muscle. Blood is also directed to the skin to allow the extra heat created to escape, causing perspiration.

Much the same as a high performance car on a cold morning, we *begin with a slow period* before increasing the pace. The purpose of the *cool down* period is to allow the body to flush out our metabolic “waste” from exercise such as lactic acid. The heart rate and distribution of blood flow returns to normal *gently*.

### **Warm up examples**

#### **1. Beginner**

- Swim - 10 minutes easy, using different strokes. A good time for practicing stroke drills.
- Bike - 10 minutes spinning (pedalling with a high cadence: 90-100 revs per minute ) easily in a small gear.
- Run - 10 minutes beginning with a fast walk and easing into a slow easy jog.



#### **2. Competitive Athlete**

- Swim - 800 m - different strokes, stroke drills.
- Bike - 10-15 minute warm up for any exercise up to 80% effort. 30 minute warm up for haed intervals or time trials, finishing the warm up with a through stretching session.
- Run - 5-10 minutes warm up for exercise up to 80% effort. 15-20 minutes warm up (finishing with a thorough stretching session) for hard intervals or time trials.



## ■ Keeping a Diary

Ensuring training volume *increases slowly*, identifying *problems* with our training, maximising our *potential*, following our *progress* and making the most of our *time* are all impossible if we do not keep track of our training.



Write a quick note each day, with the session fresh in your memory. Try and include:

session fresh in your memory. Try and include:

1. Distances/Route
2. Approximate speed
3. Heart rates
4. How you felt/mood (low mood is usually the first indicator of overtraining)

You may also choose to include:

1. Resting heart rate
2. Hours of sleep / Quality of sleep
3. Weather conditions
4. Time for HR to return to “normal” (recovery time)
5. Any aches and pains/problems

## ■ Increase Gradually

Our body takes time to *adapt*. Any changes to our *training plan* or equipment must be introduced slowly.

### **Training Volume**

The “10% Rule” is a useful guideline. Do not increase training volumes by more than 10% per week. Experienced athletes may be confident in increasing volumes by 15 or 20% during periods of lesser volume.

## **Training Intensity**

Suddenly introducing hard 90% effort intervals is a good way to become injured or over-strained. *Slowly* introduce hard training - start with a small number of 80% effort repeats and build up slowly to a full set of 85-90% intervals. (See Workouts in later chapters.)

## **Equipment**



Suddenly changing your brand of running shoe, the type of surfaces or terrain you run on, the seat height or seat position of your bike or even the type of pedals you use can all cause an injury. Introduce changes gradually.

## ■ Self - Motivation

Unfortunately, motivation cannot be bought, rented, borrowed or given. It comes from within. Motivation stems from finding our own reasons for participating. To be fit and healthy? To win? For relaxation? To be involved?

You may find these hints useful:

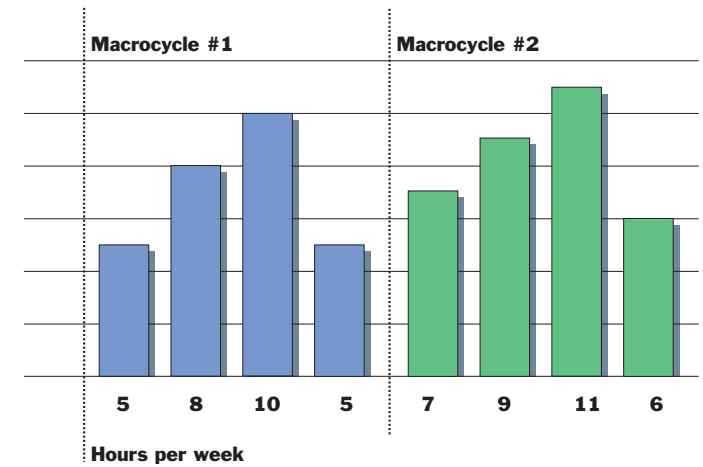
- Train with other people
- Join a club. Help out. Get involved.
- Make a specific time to train, much the same as any appointment we might keep.
- Monitor your progress.
- Match your commitment with your goals, your ability and your other life demands. Self Honesty is very important here...



## ■ Macro Cycles

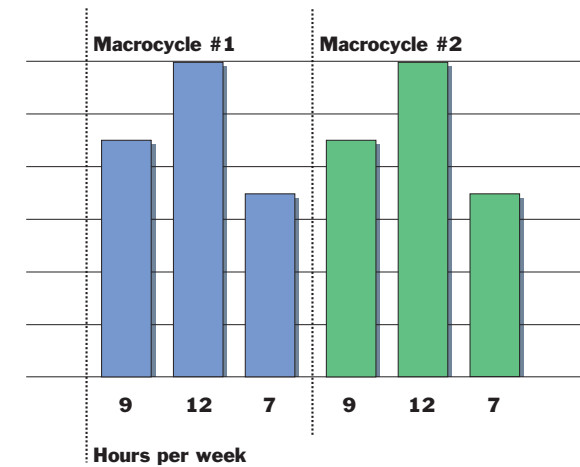
We must *slowly* increase our volume, week by week, *but* it is important to schedule an *easy week* every three or four weeks. One complete cycle, made up of 3, 4 or 5 weeks is called a *macro cycle*. It is important to schedule our training in macrocycles throughout the year.

## ■ Example #1



Four week cycles are excellent for our steady build-up phase.

## ■ Example #2



Three week cycles are suitable for final preparation for the big race.

## ■ Quality and Quantity

More is not necessarily better. A combination of shorter, faster sessions and longer, slower sessions produces the best training response.

Long races require longer, slower training: short races require shorter, faster training (Painfully obvious but frequently ignored!).

## ■ Recovery

Stress, Recovery.... Stress, Recovery.... Stress, Recovery. That's how training works. Our body adapts during the *Recovery* period.

Suggestions:

1. Take 1 or 2 days off per week.
2. Follow a hard day with an easy day.
3. Don't be afraid to take a day off or reduce training if you are tired.

Have you heard the saying....

"All Work and No Rest Makes Jack a Dull Boy" (and a tired, grumpy, frustrated, disillusioned and *slow* boy...).

## ■ Tapering

Tapering refers to a period of easy training immediately before a competition. Most triathletes, to the detriment of their performance, *hate* tapering. Just one more workout, just a short one....

Before an important race we might have a whole week of easy, low - volume training. (25% of our high volume week with one or two short, sharp, faster sessions early in the week.)

Before a regular weekend race, we might take 2-4 days easy.

Before a World Championship I would do as little as 2 1/2 hours training in the final week!

**Rest....to be at your best!**







## Technique Avoiding the Pitfalls

- Swimming: Coaching, Swim squads
- Cycling: Frame fit, Safety equipment, clothing
- Running: Shoe selection, terrain, surfaces, avoiding injury

# Technique

## Avoiding the Pitfalls

It is almost universal in human nature to concentrate on what we do best. Multisport requires the opposite. *Focus on your Weakest Discipline.* Huge gains with a modest workload can be made with improvements in technique. Train smart!



### ■ Swimming

- With swimming, technique is *paramount*.
- Swim with a local squad, with a coach supervising.
- Swimming appears to be almost “naturally acquired” when earned before the age of 18 years. If you are learning as an adult, don’t be disheartened. Gains are smaller, more difficult and slower but still satisfying.
- You can’t learn from a book. What we *think* we are doing and what we are *actually* doing are often entirely different. A coach can see our errors in technique, working on them one at a time.

### ■ Cycling

- Buying a frame that fits is critical. Get sized up accurately by a bike shop familiar with cycle racing and for triathlon.
- Establish a relationship with a reputable shop. Your bike will need ongoing care and attention.
- Safety equipment is essential: helmet, protective glasses, reflectors and/or lights.
- Bike shorts with a coating of chamois cream on the gusset will save you a painful rear end. Remember - you don’t wear underwear with cycling shorts!

### ■ Running

- Again, a reputable running shoe shop, familiar with competitive running is the best place to start.
- An experienced shoe salesperson can tell by the wear pattern on your old running shoes, or by watching us walk/run, what type of biomechanics we have. Do we over-pronate (roll inwards)? Do we supinate (roll outwards)?
- Select a shoe that is comfortable, fits well, suits your biomechanics, your weight and your mileage. Ignore the colour scheme!
- Wherever possible, run on soft surfaces (i.e. grass, dirt, gravel, sand, not concrete or asphalt).
- Human evolution has not caught up with the advent of concrete and asphalt surfaces. Perhaps in a million years we will all be able to run for miles on concrete without getting injured.
- Variation: mix it up between flat areas, gentle rolling hills and more challenging hills.





## Workouts!

- For the Beginner
- For the Recreational Athlete
- For the Serious Competitor
- For the Ironman Triathlete
- Suggested Bike Interval Sessions
- Suggested Run Interval Sessions
- Bike Run Intervals
- Important Notes on Workouts

# Workouts!

## Workouts for the Beginner

The following is a programme suggested to get ready for short triathlon (either 500m swim/20k bike/ 5k run or even Olympic Distance 1500m swim/40k bike/10k run, if you select the longer workout options).







People with jobs and family often find it difficult to adhere to a rigid training session, with a particular workout on a particular day. I have labelled the days Day 1 to Day 7. It is O.K. to mix up the days as your lifestyle permits, provided the basic hard day/easy day routine is followed

Day 6 is a “simulated triathlon” where the 3 disciplines are done back to back. This familiarises us with swimming, biking and running in succession, and allows us to practice transitions.



## TRIATHLON

for beginner

Date and activity	Time	HR	Note
<b>Day 1</b> 	30 min	60-70%	
<b>Day 2</b> 	45 min		
<b>Day 3</b> 	60-90 min	15 min 60%, 45-60 min 80%, 15 min 60%	
<b>Day 4</b> <b>DAY OFF</b>			
<b>Day 5</b>  	30 min 60 min	60-70%	easy
<b>Day 6</b> <b>Simulated Triathlon</b>	Swim: 30 min followed by Cycle: 45 min followed by Run: 30 min. all at 70-80%		
<b>Day 7</b> 	60 min	50-70%	Long run over a variety of flat and rolling terrain. Not on concrete or asphalt






### Weekly Total:

Swim: 1 hr 45 min  
Cycle: 2 hrs 15 min  
Run: 2 hrs

**6 hrs**

# DUATHLON

for beginner

Date and activity	Time	HR	Note
<b>Day 1</b> 	30 min	10 min 60% 15 min 80% 5 min 60%	
<b>Day 2</b> 	60 min	60-70%	Easy spinning
<b>Day 3</b> 	60 min	50-70%	Long run over a variety of terrain
<b>Day 4</b> 	60 min	15 min 50% 30 min 80% 15 min 60%	
<b>Day 5</b> <b>DAY OFF</b>			
<b>Day 6 Simulated Duathlon</b>	Run: 20 min followed by Cycle: 45 min followed by Run: 30 min. all at 70-80%		
<b>Day 7</b> 	60-90 min	50-70%	Long cycle

## Weekly Total:

Cycle: 3 hrs 40 min - 4 hrs

Run: 2 hrs 20 min

**5 hrs 50 min - 6 hrs 20 min**

## Workouts for the Recreational Athlete









The time comes when we have completed an Olympic distance race, but we would like to go a little faster. We are getting competitive!





# TRIATHLON

for Recreational Athlete







Date and activity	Time	HR	Note
<b>Day 1</b> 	60 min		
	60 min	15 min 70% 30 min 80% 15 min 70%	30 min section can be hills
<b>Day 2</b> 	90 min		Interval sessions (see suggested work-outs later)
	45 min	60%	Easy
<b>Day 3</b> 	90 min	60-70%	rolling terrain
<b>Day 4</b> 	60 min		
	60 min		Interval sessions (see suggested work-outs later)
<b>Day 5</b> <b>DAY OFF</b>			
<b>Day 6 Simulated Triathlon</b>	Swim: 30 min in open water Cycle: 90 min, followed by Run: 45 min, all at 70-80% effort		
<b>Day 7</b> 	21/2-3 hrs	60-70%	Long cycle

## Weekly Total:

Swim: 2 hrs 30 min  
 Cycle: 6 hrs 30 min - 7 hrs  
 Run: 4 hrs  
**13 hrs - 13 hrs 30 min**

# DUATHLON

for Recreational Athlete

Date and activity	Time	HR	Note
<b>Day 1</b> 	60 min	15 min 70% 30 min 80% 15 min 70%	30 min seduction rolling hills
	30 min	60-70%	
<b>Day 2</b> 	90 min		Interval session (see work-outs)
<b>Day 3</b> 	90 min	60-70%	Long run
<b>Day 4</b> 	60 min		Interval session (see work-outs)
<b>Day 5</b> <b>DAY OFF</b>			
<b>Day 6 Simulated Duathlon</b>	Run: 20 min followed by Cycle: 60-90 min followed by Run: 20-30 min. all at 70-80%		
<b>Day 7</b> 	21/2-3 hrs	60-70%	Long cycle

## Weekly Total:

Cycle: 5 hrs - 7 hrs  
 Run: 3 hrs - 4 hrs  
**8 hrs - 11 hrs**














## Workouts for the Serious Competitive Athlete



If you do not have several years of serious training and competition behind you, please do not turn to this section, seeing it as a shortcut to fast times. Remember, training volume and intensity must be increased *gradually*. For the inexperienced, these work-outs will be a free ride to over-training, disillusionment and the doctor's office!

# TRIATHLON

for Serious  
Competitive Athlete









Date and activity	Time	HR	Note
<b>Day 1</b>   	60 min		
	60 min	60-70%	Easy spinning (lower priority)
	60-90 min		Interval (see work-outs)
<b>Day 2</b>  	60 min		
	2 hrs	30 min 70%, 60 min 80%, 30 min 60-70%	
<b>Day 3</b>  	60 min	60-70%	easy spinning (lower priority)
	90 min	60-70%	Long run, include hills at 80%
<b>Day 4</b>   	60 min		
	2 hrs		Intervals (see work-outs)
	30 min	60-70%	Easy (lower priority)
<b>Day 5</b> <b>DAY</b>			
<b>Day 6</b> <b>Simulated Triathlon</b>	Swim: 30-45 min in open water Cycle: 90 min, followed by Run: 45-60 min, all at 70-80% effort		
<b>Day 7</b> 	4 hrs	60-70%	Long ride, include hills at 80%

### Weekly Total:

Swim: 3 hrs-3 hrs 30 min  
 Cycle: 10 hrs-11 hrs 30 min  
 Run: 3 hrs-4 hrs 30 min  
**18 hrs 45 min - 19 hrs 45 min**

# DUATHLON

for Serious  
Competitive Athlete

Date and activity	Time	HR	Note
<b>Day 1</b>  	60 min	60-70%	easy spinning (lower priority)
	60-90 min		Intervals (see work-outs)
<b>Day 2</b> 	2 hrs	30 min 70%, 60 min 80%, 30 min 60-70%	
<b>Day 3</b>  	60 min 90 min	60-70% 60-70%	easy spinning (lower priority) including hills at 80%
<b>Day 4</b>  	2 hrs 30-45 min		Intervals (see work-outs) easy (lower priority)
<b>Day 5</b> <b>DAY</b>			
<b>Day 6</b> <b>Simulated Duathlon</b>	Run: 30 min followed by Cycle: 90-120 min followed by Run: 30-45 min. All at 70-80%		
<b>Day 7</b> 	4 hrs	60-70%	including hills at 80%

## Weekly Total:

Cycle: 10 hrs - 12 hrs  
Run: 4 hrs - 5 hrs

**14 hrs - 17 hrs**












## Workouts for the Ironman Triathlete

Simulated Triathlon is especially important for the Ironman as your body will get used to exercising for a long period of time. You can practise with race food and fluids and improve your navigation in the swim.



# TRIATHLON

for the Ironman  
Triathlete

Date and activity	Time	HR	Note
<b>Day 1</b>   	60 min		
	90 min	60-70%	Easy spinning (lower priority)
	90-120min		Intervals (see work-outs)
<b>Day 2</b>  	60 min		lower priority
	2-3 hrs	30-60 min 70%, 60 min 80%, 30-60 min 60-70%	
<b>Day 3</b>  	60 min	60-70%	easy (lower priority)
	2-3 hrs	60%	Long run
<b>Day 4</b>   	60 min		
	2-3 hrs		Intervals (see work-outs)
	30 min	60-70%	Easy (lower priority)
<b>Day 5</b> <b>DAY OFF</b>			
<b>Day 6 Simulated Triathlon</b>	Swim: 45-60 min in open water Cycle: 3-4 hrs, followed by Run: 60-90 min, All at 60-70% effort		
<b>Day 7</b> 	5 hrs	60-70%	Long ride

## Weekly Total:

Swim: 3 - 4 hrs  
Cycle: 12 - 17 hrs  
Run: 4 - 6 hrs

**19 hrs - 27 hrs**

## Suggested Bike Interval Sessions

### 1. Five Minute Intervals

- 15 min warm up (small gear, easy spin, 60% effort).
- You may like to stop and stretch now.
- 5 min hard (80-90%), repeat 3 times.
- 2 min easy (60-70%).

These are the mainstay of the endurance athletes interval sessions. If I could do no other type of hard training, I would choose these. As the competitive season approaches and your fitness is good, follow this block of three five-minute intervals with 10 minutes easy spinning (60-70%) and add another block of three five-minute intervals.

Professional athletes and very competitive Ironman athletes might do as many as 10 or 12 of these in a session, broken up into 3 or 4 blocks. Finally, don't forget a 15 minute cool down.



### 2. 90 Second Intervals

This type of intense session is popular with professionals immediately before, or during the competitive season. Regular racing takes the place of the 5 minute intervals. Very short periods above AT improves the body's tolerance of lactic acid. Often during a short race a hill will temporarily take our heart rate over AT.

- 15 min warm up spinning easily (60-70%).
- 90 seconds hard (80-90%), depending on your fitness level.
- 2 min medium (80%).
- Repeat 5-10 times, depending on fitness. If repeating more than 5 times, break the session into 2 parts with 10 minutes easy (60-70%) in between.

### 3. Time Trial

- 15 min warm up (60%).
- 20-30 min hard (80-90%) concentrate on aerodynamics & technique.
- 15 min cool down (60%).

Perhaps your local cycling club holds a weekly 16km time trial. This is an ideal time to do your hard training with other people around. You may be able to test equipment and position over the same measured course.

## ■ Suggested Run Interval Sessions

### 1. Five Minute Intervals

- 15 min warm up.
- Stop and stretch.
- 5 min hard (80-90%), repeat 2-4 times.
- 5 min easy (60-70%).
- 10-15 min cool down (60-70%).
- Start with 2 intervals. As your fitness improves, add another interval.

Again, 5 minute intervals are the main set for the endurance athlete. You may have a local 400m running track that you can use.

### 2. Hill Repeats

The same as above, but running up a moderately steep, steady incline. Remember not to run back down too fast. Descending can be hard on your legs!

## ■ Bike Run Intervals

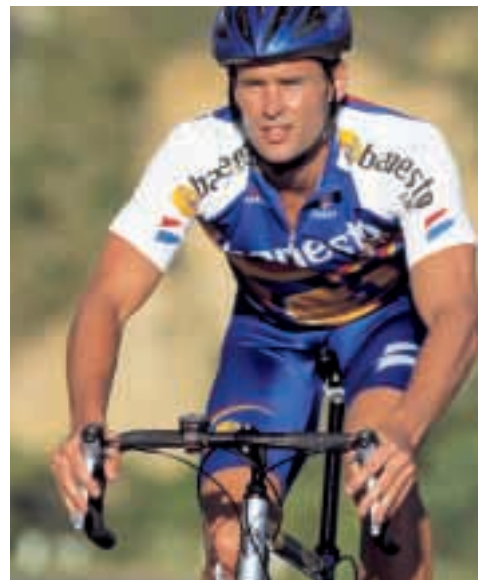
### 1. 400m repeats / stationary cycle trainer

Many top competitors like to run 400m repeats on the track. The biggest mistake is to run them too fast! There is little point going above our AT as we will be training our anaerobic (sprint) systems. If your best time for a 5k road race is 16 minutes, there is no use trying to run 400m repeats in less than 75 sec (run at around 2 seconds per 400m above your 5k time).

I have had good results from the following bike/run session:

Take your stationary cycle trainer to the local track and set up somewhere near the start/finish line.

- Warm up (run or bike) 15 min (60%).
- Run 400m (90%).
- Jog slowly in a circle until your HR comes down to 75-80%.
- Repeat 3 more times.
- Change into your cycle shoes.
- Cycle 15-20min (70-80%).





- *Begin with one (4 x 400m + cycle). Build up to two or three. The very serious athlete might try four.*
- *Cool down 15 min (60%).*

## 2. Hill Repeats

These are a specialty of my friend and coach, Dr John Hellemans. John is a world-class athlete himself and a medical doctor.

- *Warm Up: Ride at 60% to the nearest long, moderately steep/steep hill near you (bad luck if you live in Kansas!).*
- *Climb at 80-90% effort for 5-10 minutes.*
- *Dismount, put your running shoes on and run at 80-90% for 3-5 minutes.*
- *Turn around and run/bike back to the bottom of the hill.*
- *You can start with 1 or 2 repeats and work up to 3 or 4.*

Note that whenever I suggest 80-90% effort, I am talking about the heart rate just below your AT.

If you are out of shape, skip the intervals until you have 2-3 months of slower, steady exercise behind you. If you are new to exercise, I would suggest 6-9 months.

When beginning intervals, it is likely that your AT will be around 80%. As your fitness improves, your AT heart rate will go up, perhaps as high as 90%. Elite athletes who are in good shape have an AT heart rate around 90-93%.

## ■ Important Notes on Workouts

1. I have not included suggested heart rates for the swim sessions. Frequently, we will be swimming with a squad, guided by a coach. For longer (5 min) intervals, the same

principles apply - use a heart rate just below your AT. Swimming is different, in that 3 or 4 interval sessions per week can be safe and beneficial.

2. None of these workouts are designed to be done week after week. They are hard intensity weeks suitable for a pre-season build-up.
3. Remember, *Macrocycles*. Build up for two or three weeks and then have an easy week.
4. The workouts marked “*lower priority*” are less important and can be dropped if you need to reduce your volume.
5. Don't do a hard session if you are *tired*. (Change to an easy session or have a day off. The hard session can be rescheduled if possible or cancelled, if not.)
6. Use a similar plan for early season training, but reduce the volume, and change the interval sessions to easier sessions.
7. The Day 6 “*Simulated Triathlon/Duathlon*” is an ideal chance to practice transitions and race-day equipment, food and fluids, all at a slower pace.
8. Where there is a range of times for a workout (for example, 60-90 minutes), choose the longer work-out if your race is longer. Design your programme to fit the distance you want to race. Also you may choose the shorter workload during an easy week, and the longer workout during a hard week.



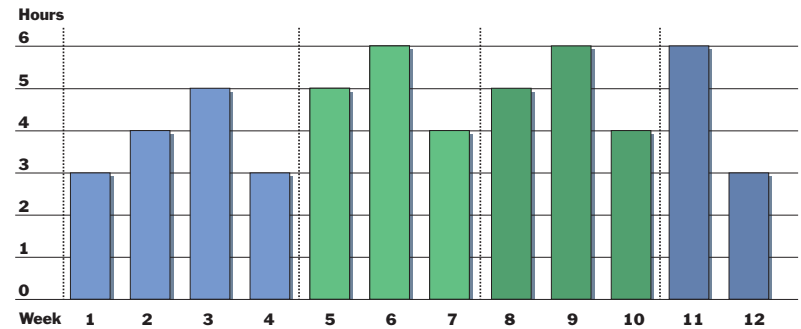


## Joe's First Triathlon

- 12 week programme to get Joe to the starting line

# Joe's First Triathlon

## Joe's Macrocycles



I mentioned Mr J. Average when I introduced calculating heart rate numbers. For those of you who would like to complete an Olympic distance triathlon but have no experience, I have prepared this final chapter. I have organised a 12 week programme to get Joe to the starting line.

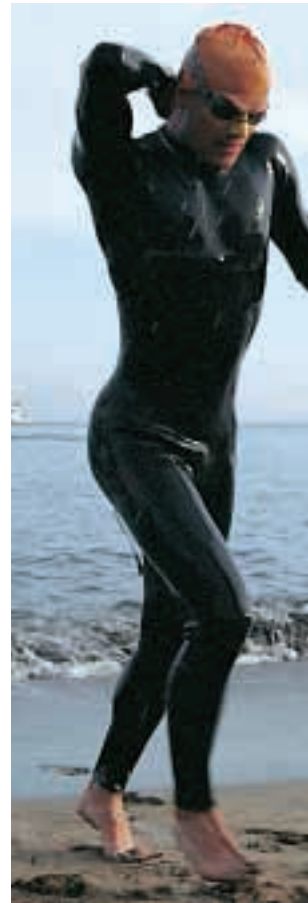
Joe is 35 years old, in good health and tries to watch his weight! He completed a 5k run once but otherwise he jogs a couple of times per week and plays a bit of tennis.

Joe has bought himself a Polar heart rate monitor and now it is time to begin...

*Joe's Resting Heart rate*                    50  
*Joe's Maximum Heart rate*                200 (high for a 35 year old, but an easy number!)  
*Joe's Cardiac Reserve*                    200 - 50 = 150

*Joe's Intensities*

60%	$(150 \times 60\%) + 50 = 140$
70%	$(150 \times 70\%) + 50 = 155$
80%	$(150 \times 80\%) + 50 = 170$
90%	$(150 \times 90\%) + 50 = 185$








Joe has 1 four- week macrocycle to get used to training. He starts slowly to avoid injury.

The next step is 2 three- week macrocycles to prepare for the event. The last week of each macrocycle is a 4 hour recovery week. The last 2 weeks include a hard 6 hour week followed by an easy tapering week.

Joe has approached his local swimming pool and has joined a swim program for learners where he gets good stroke tuition and avoids developing bad technique.

## Joe's Programme Three Hour Week

Date and activity	Time	HR	Note
Day 1 	15 min	60-70%	HR 140-155
Day 2 	30 min		
Day 3 	45 min	15 min 60%, 15 min 80%, 15 min 60%	
Day 4 <b>DAY OFF</b>			
Day 5 	30 min	60-70%	easy, HR 140-155
Day 6 <b>Simulated Triathlon</b>	Swim: 10 min in open water, followed by Cycle: 20 min, followed by Run: 15 min, all at 70-80% (HR 155-170)		
Day 7 	30 min	50-70%	over a variety of flat and rolling terrain, not on asphalt, HR 130-155

### Weekly Total:






Swim: 40 min  
Cycle: 1 hr 35 min  
Run: 1 hr

**3 hrs 15 min**

### Note:

- Day 7; Joe can go a little further if he has been jogging regularly.
- Joe does not have to be a slave to this programme. It is merely to give him an idea of what to do.
- If Joe had some experience in one of the three disciplines then he could rely on his experience and allocate the extra time to the two weaker disciplines. Joe could spend less time on his running and take an extra swimming session if he was concerned about coping with the swim.
- Swim sessions will include a wide variety of intervals (50m, 100m, 200m, 400m, and a longer 1500m aerobic swim closer to race time.)
- Joe's swim coach will keep a close eye on his technique.

## Joe's Programme Four Hour Week






Date and activity	Time	HR	Note
Day 1 	20 min	60-70%	HR 140-155
Day 2 	30 min		
Day 3 	60 min	15 min 60%, 30 min 80%, 15 min 60%	
Day 4 <b>DAY OFF</b>			
Day 5 	45 min	60-70%	easy, HR 140-155
Day 6 <b>Simulated Triathlon</b>	Swim: 15 min in open water, followed by Cycle: 25 min, followed by Run: 20 min, all at 70-80% (HR 155-170)		
Day 7 	45 min	50-70%	over a variety of flat and rolling terrain, not on asphalt, HR 130-155

### Weekly Total:

Swim: 45 min  
Cycle: 2 hrs 10 min  
Run: 1 hr 25 min

**4 hrs 20 min**

## Joe's Programme Five Hour Week






Date and activity	Time	HR	Note
Day 1 	25 min	60-70%	HR 140-155
Day 2 	35 min		
Day 3 	60 min	15 min 60%, 30 min 80%, 15 min 60%	
Day 4 <b>DAY OFF</b>			
Day 5 	75 min	60-70%	easy, HR 140-155
Day 6 <b>Simulated Triathlon</b>	Swim: 20 min in open water, followed by Cycle: 35 min, followed by Run: 25 min, all at 70-80% (HR 155-170)		
Day 7 	50 min	50-70%	over a variety of flat and rolling terrain, not on asphalt, HR 130-155

### Weekly Total:

Swim: 55 min  
Cycle: 2 hrs 50 min  
Run: 1 hr 40 min

**5 hrs 25 min**

## Six Hour Week








Date and activity	Time	HR	Note
Day 1 	30 min	60-70%	HR 140-155
Day 2 	45 min		
Day 3 	90 min	20 min 70%, 45 min 80%, 25 min 60-70%	
Day 4 <b>DAY OFF</b>			
Day 5 	60 min	60-70%	easy, HR 140-155
<b>Day 6 Simulated Triathlon</b>	Swim: 30 min in open water, followed by Cycle: 45 min, followed by Run: 30 min, all at 70-80% (HR 155-170)		
Day 7 	60 min	50-70%	over a variety of flat and rolling terrain, not on asphalt, HR 130-155

### Weekly Total:

Swim: 1 hr 15 min  
Cycle: 3 hrs 15 min  
Run: 2 hrs

**6 hrs 30 min**

## Taper Week

Date and activity	Time	HR	Note
Day 1 	45 min		
Day 2 	60 min	15 min 70%, 30 min 80%, 15 min 60%	
Day 3 	30 min	10 min 70%, 10 min 80%, 10 min 70%	
Day 4 	30 min 15-20min	60-70%	easy swim
Day 5 <b>DAY OFF</b>			
Day 6 Run, Cycle or Swim	15 min	60%	
Day 7   	<b>SHOWTIME</b>		

- I have included a short swim on day 4 because many athletes complain that they lose their "feel for the water" if they do not swim for several days before the race.
- An easy session the day before the race is good for our nerves but does nothing for our fitness.





# A Final Word

Returning to medical practise, I see a very different cross-section of people compared to the friends I met as an athlete over the past three years. Every day I am asked to see patients whose health has suffered solely through poor diet, obesity, cigarettes, alcohol and especially, lack of exercise.

Many of the degenerative changes we associate with getting older are actually caused by a lack of use. For example: getting weaker, getting fatter, getting slower, developing high blood pressure and heart disease, and maybe even losing our mental capacities.

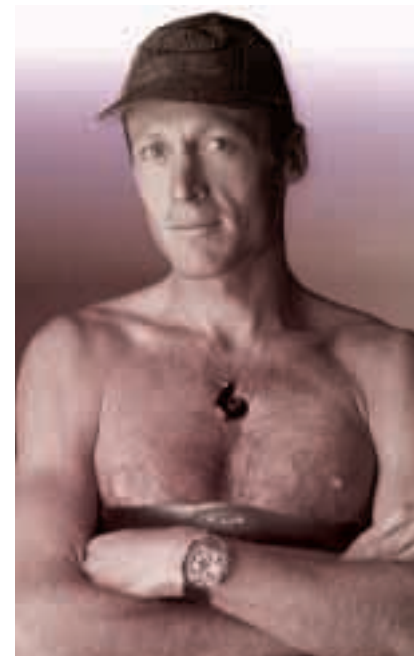
As we get older, the expectation of society is that we will slow down until we stop altogether. Even famous athletes a few years ago would not run a step further once they had retired from competitive sport. Paavo Nurmi was an exception earlier this century, continuing to run 10 miles per day. His contemporaries were convinced that he had taken leave of his senses!

Our middle-aged uncle may be an "armchair sportman" who knows plenty and does little! Perhaps our grandmother simply sits in a chair and knits. Often these images are consistent with our own expectations.

It doesn't have to be this way! Recent scientific evidence from Boston has shown that even a frail 90 year old can make massive gains in strength and fitness within weeks of beginning an appropriate fitness programme. Another study demonstrated that a 70-year-old masters swimmer will have the strength and vitality of a "normal" 45-year-old!

Physicians speak of "chronological age" and "biological age". We cannot turn back the hands of time and reduce our chronological age, but the latter is very much in our own hands. It is our biological age which corresponds to morbidity and disease. By creating an exercise programme, tailor-made for you through utilising your heart rate, you may keep one more hospital bed empty in the future.

It is my hope that somebody may pick this book up and discover that exercising at their correct intensity is neither painful nor arduous. *Turn your back on old age!*



**Use it or lose  
it.....**

Good Luck, Good  
Health and have fun  
always

**Mat Brick**

# About the Author

As two-time World Duathlon Champion, and a Doctor of Medicine, Dr Matthew Brick has been the ideal person to integrate the Science of Endurance Training with the day to day practicalities of being an athlete.

Dr Brick, a New Zealander, was a competitor from his early childhood years in anything but sport. However, despite rarely receiving less than an A in the classroom, sport did not come easily. Being overweight and uncoordinated, he was one of the few children at his school to fail physical education! Graduating top of his Medical School class at the age of 24, Brick stumbled into the sport of Triathlon quite by accident - accepting the invitation of a friend to compete on a bike complete with pannier racks.

Seeing an advertisement for one of the early Polar heart rate monitors, Brick quickly saw the opportunity to introduce some objective scientific discipline to his training. Using himself as a subject, he soon developed successful heart rate monitored training methods, and finished second in the New Zealand Ironman less than two years after his first training session.

Realising swimming was his weakness, Brick early on decided that his skills were more suited to the Duathlon than

Triathlon. He and his wife, Tracey (also a doctor) left their medical practises in 1991 to embark on the international professional Duathlon circuit. Brick remains the only Duathlete to have twice won the World Duathlon Championship. Other titles have included the Canadian Championship, the US Championship and the Japan Championship.

Brick was a natural spokesman for Polar Electro Oy, with his heart rate monitor permanently attached to his wrist while both training and racing. He continues to give seminars on the practise use of the heart rate monitor throughout the world.
























A serious achilles tendon injury half way through the 1993 season, failed to respond to treatment, forcing Brick into early retirement from his career in Duathlon, and he has returned to the Medical profession in Tauranga, New Zealand. He hopes to pursue post graduate studies in Sports Medicine, maintaining his link with international sport.

# About Polar

Whatever your motivation for exercise is, you'll reach your target best if you measure your heart rate. It's the fastest and most accurate way to get feedback from your body while exercising. A Polar heart rate monitor guides you to do your exercise and training right, in the most effective way.

If you have a reason for exercising or training, you have a reason for Polar.

## LIST OF FEATURES

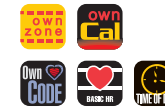
- |   |   |  |
|---|---|--|
|  Heart rate, average heart rate, exercise duration   |  Settings for two users  |  Allows to set exercise sets for interval training with HR target zones and recovery calculation. Exercise files are recorded for further details |
|  Heart rate as bpm and % of HR <sub>max</sub> , average heart rate, exercise duration  |  Automatic determination of your age-based heart rate target zone limits   |  Relaxation rate indicates the state of your physical recovery, online connection with PC   |
|  Automatic determination of your individual target heart rate zone with high and low options                                       |  The world-famous walking test by UKK institute and Polar  |  Infrared communication allows two-way exchange of exercise sets and exercise data with PC  |
|  Automatic determination of your individual heart rate target zone limits  |  Body Mass Index. The world-famous weight indicator  |  Allows to upload exercise settings from computer with UpLink™ and to download exercise data to a computer with SonicLink™                        |
|  Counts and displays calorie expenditure (M71ti, A5) and the fat % of calories expended (M91ti, M62, M61, M32, M31)                |  Time of day, weekday and alarm function   |  Speed, optional cadence and power output sensors (S720i, S710i). Speed and optional cadence sensors (S520, S510). Speed and distance (S150)      |
|  Avoids cross-talk with other heart rate monitors  |  Ability to record 99 lap times and files (S810i, S720i, S710i, S610i, S410, S210) Ability to record 50 lap times and files (S150) and 60 lap times and files (S120) |  Visit <a href="http://www.polar.fi">www.polar.fi</a> to upload exercise settings and monitor icons   |
|  Measures your fitness level with Polar Fitness Test™ (M-series) Polar Fitness Test™ defines your maximal oxygen uptake (S-series) |  Allows to set 7 exercise profiles for multi-phase exercise sessions with HR target zones and recovery calculation. Records complete files of the exercises          |  Shows and records altitude and temperature information   |

## A-SERIES



## M-SERIES

m71ti™



m91ti™



m61™



m62™



m31™



m32™



Specifications may change without notice due to manufacturer's continuous programme of development. No claims are made or implied in the use, or results by the use of equipment herein. Polar logo type is a registered trademark of Polar Electro Oy. All Polar product names are trademarks or registered trademarks of Polar Electro Oy. All other trademarks recognised. E & OE © 2001, 2002

## S-SERIES

### FOR RUNNERS

**S810i™**



**S610i™**



**S410™**



**S210™**



**S120™**



## S-SERIES

### FOR CYCLISTS

**S720i™**



**S710i™**



**S520™**



**S510™**



**S150™**

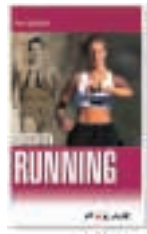




# Polar Library



**Precision Heart Rate Training**  
by Edmund R. Burke, PhD



**Precision Running**  
by Dr. Matthew Brick



**Precision Walking**  
by Mark Fenton, Dave McGovern



**Target Your Fitness and Weight Management Goals**  
by Dr. James Rippe



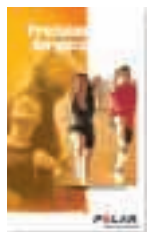
**Precision Football/Precision Soccer**  
by Paul D. Balsom



**Let's beat them in Ice Hockey**  
by Erkkka Westerlund, Raimo Summanen



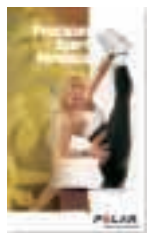
**Precision Weight Management**  
by Dr. Katriina Kukkonen-Harjula, Dr. Raija Laukkanen



**Precision Aerobics**  
by Ute Haas, M.Sc. Tarja Suomi, M.Sc. Raija Laukkanen, Ph.D.



**Precision Cycling**  
by Edmund R. Burke



**Precision Sport Aerobics**  
by Yvonne Lin

## Programme

Activity	Time	HR	Note
Day 1			
Day 2			
Day 3			
Day 4			
Day 5			
Day 6			
Day 7			

### Weekly Total:

---

## Notes

---



---



---



---



---



---



---



---



---



---



*Multisport commonly refers to an event comprising any combination of swimming, cycling, running and even kayaking. The best known examples are triathlon and duathlon. Events range from entry level distances taking less than one hour up to the gruelling Ironman.*



These sports offer an excellent way of exercising whether to keep fit or to compete. The combination of disciplines ensures balanced muscle development, maximising cardiovascular fitness while minimising the risk of overuse injury. People throughout the world are discovering that multisport is an exciting and effective way to keep fit. Interest in triathlon and duathlon is growing rapidly.

By following these practical training methods, including the use of heart rate information, even a complete novice can become a triathlete or duathlete.

As two-time World Duathlon Champion and Doctor of Medicine, Mr Matthew Brick is the ideal person to integrate the Science of Endurance Training with the day to day practicalities of being an athlete.

POLAR ELECTRO OY  
Professorintie 5  
90440 Kempele  
Finland  
tel. +358-8-5202100  
fax +358-8-5202300  
www.polar.fi

POLAR ELECTRO INC.  
370 Crossways Park Drive  
Woodbury, NY 11797, USA  
tel. +1-516-364-0400  
fax +1-516-364-5454  
www.polarusa.com

LEISURE SYSTEMS INTERNATIONAL LTD  
Northfield Road  
Southam  
Warwickshire, CV47 0RD  
England  
Tel: 01926-811611  
E-mail: [lsisales@lsi.co.uk](mailto:lsisales@lsi.co.uk)

ISBN 951-96925-7-6



7 258829 901807