

Training for Increased Endurance The Team Mudge Way

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(Main Sources: *The Maffetone Method*, Dr. Phil Maffetone; *Triathlete's Training Bible*, Joe Friel)

This primer is intended for those who would like to start a physical training program, particularly with endurance sports such as cycling in mind. I hope to convince you that not only is being “in training” a fun thing to say whenever possible, but it is easy to do. I also hope to convince you that increasing your endurance with your initial training program is the first step in addressing many other fitness and health concerns, such as: hill-climbing ability, sustaining speed on the flats, inability to keep up with “the group”, or losing weight and keeping it off. We'll start with a few definitions, then talk about creating an individual training plan.

Health and Fitness

Health – A state in which all the body's parts, including the muscles, nerves, bones, hormones, organs, and glands are in balance. Health may decline with age, but proper care can counteract the effects of aging.

Fitness – The ability to be physically active, generally sport-specific.

Fitness does not necessarily reflect health. And being healthy may not make you a fitter athlete. It is possible, and common, for people to be fit but unhealthy, actually sacrificing health for increased fitness. Examples are injuries caused from overtraining or muscular imbalance, trying to lose weight too quickly, or abuse of supplements and drugs.

Your goal is to balance health and fitness, becoming as healthy and as fit as possible considering your potential, schedule, and desires.

Aerobic and Anaerobic

Aerobic – The body's ability to obtain more energy through increased fat burning.

Anaerobic – The increased use of sugar for energy, and diminished fat burning.

Think of your aerobic system as more than just lungs and oxygen. It encompasses the cardiovascular, nervous, and the muscular systems. In humans aerobic and anaerobic muscle fibers together make up each skeletal muscle with the majority being aerobic fibers. Thus, each muscle is capable of burning both fat and sugar, depending on what it is asked to do:

	Aerobic Muscle Fibers	Anaerobic Muscle Fibers
Predominant Energy From	fat	sugar (glycogen)
Amount of Available Energy	large	small
Blood Vessels	many	few
Physical Activity	long duration at low to moderate effort (endurance)	short duration at high effort (sprinting)

Aerobic vs. Anaerobic: A Useful Analogy

Picture your available fat energy as a large vat with a small tap (your aerobic capacity), and your available sugar energy as a small vat with a large tap (your anaerobic capacity). Assume both vats are refilled with energy at a fairly low but constant rate (your diet). Lastly, note that when your body needs energy, it sensibly taps the large fat vat first, and takes energy from the sugar vat only when it needs energy more quickly than the large vat can supply it.

But suppose that the tap on the fat vat releases only a trickle of energy, not enough to cover daily activities, much less exercise. This is a realistic assumption for most people. So the body is tapping the sugar vat for energy even at low activity levels. When energy demands rise, the body starts drawing energy from the small sugar vat faster than it can be refilled. Since the sugar tap is large and the vat is small, it is easy to drain the vat dry, at which point the body complains and stops working (low blood sugar or **Bonking** in cycling lingo) until the sugar vat has a chance to refill. Even if the sugar vat does not go dry, it is subject to wild swings in level throughout the day as it is drawn down and replenished. Meanwhile, the fat tap is wide open, but may be trickling so slowly that its refill rate exceeds its tap rate and so excess fat spills out of the vat and accumulates elsewhere (in your hips, thighs, belly and blood vessels).

Fortunately, with proper exercise you have the ability to increase the size of both taps. But now we see that the benefits are **not** equal. It makes sense to spend far more time developing the fat tap than the sugar. Yet most people spend more exercise time on the sugar tap than the fat, by default or design, through not specifically training their aerobic system.

Looking at the different capabilities of the aerobic and anaerobic systems, it is clearly most efficient for the human body to develop its aerobic system. It would burn mostly fat for day-to-day activities and moderate exercise, and reserve its limited anaerobic energy stores for when they are really needed. Weight control would be easier since fat is burned not stored, and daily energy levels would be high, since the body can tap the relatively inexhaustible supply of energy stored as fat. Sounds great.

But here's the rub: *the aerobic system needs regular doses of moderate activity to develop and maintain itself*. In the absence of a strong aerobic capacity, the body relies on its anaerobic system even for day-to-day, low to moderate energy needs. Fat will be stored instead of burned. Insulin may become important in regulating large swings in blood and liver sugars. Fatigue and lack of energy are always possible, since even everyday tasks can exhaust the limited sugar supplies.

But it's more insidious than that. Most people who exercise regularly are still not building their aerobic capacity because exercise at higher intensities reinforces the anaerobic system. Muscles get further developed for their anaerobic properties, and get better at burning sugars. The body may be very fit for certain sports, and be strong, fast and powerful. But weight control problems, recurring injuries, and fatigue may still be present. This condition is particularly evident when the body is asked to "go long". The body responds by exhausting its small supply of sugars, upon which performance declines markedly.

It is not unreasonable to assume that people with undeveloped aerobic capacity may get 90% of their energy from sugars and only 10% from fat during moderate exercise. But proper training (described later) over as little as three months may improve the functioning of the aerobic system such that it now gets 50% of its energy from fat burning and only 50% from sugars at the same exercise intensity.

Yet more reasons to train aerobically:

- Aerobic fibers resist injury.
- Aerobically efficient athletes stay hydrated longer.
- Aerobic muscle fibers burn fat.
- Increased aerobic function improves circulation and the entire cardiovascular system.
- Antioxidant activity occurs in aerobic muscles.
- High aerobic function prevents overtraining.
- People with developed aerobic systems say that training is more fun and sustainable over the long term.

Thus, for a given investment in a regular exercise program, most people will derive the greatest benefit in health **and** fitness by first improving their aerobic systems, or **building an aerobic base**, as the pro's say. And absent the large doses of moderate daily activity of our ancestors the best way to improve your aerobic system is to

commit to being "in training" to improve endurance and build an aerobic base. You must have faith that this is the best way to tackle other concerns, such as weight control, lack of speed, or hill-climbing ability.

Activity, Exercise, and Training

Activity – The natural physical activity that is part of everyday life.

Exercise - Separate activity, purposely performed. Artificial activity.

Training – The program of exercise, organized or fragmented, or absent, intended to improve health and fitness.

Training = Workout + Rest.

This equation emphasizes that *gains are made during recovery*. Exercise is stress. The body's natural response is to reinforce the systems that were stressed, to better withstand similar stress in the future. This is, of course, the reason why regular exercise works. But it is worth emphasizing that exercise is in itself stressful to your body, and unless you allow enough recovery time, you will not receive the full benefit of your training. Over time, your performance will plateau, and your fitness may actually decline. **Overtraining** is the common term for this condition.

Thus, the proper role of exercise is to apply enough stress to the body in each workout to foster incremental gains in the recovery period, without risking injury or overtraining over the course of the training program. It so happens that different systems need different amounts of recovery time. Intuitively we know that it will take longer to recover from a weight lifting session than from a one-hour walk. Using our new terminology, we can say that *workouts that target the aerobic system require much less recovery time than do those that target the anaerobic system*. This is why experts say: never perform strength training on back-to-back days, schedule a rest day after a race or long workout, take a day off when you feel fatigued, etc.

This leads to another truism: If you want to increase your training volume (i.e. hours/week or hours/year), it is most efficient to add aerobic workouts to your program. In general, workouts done at an aerobic pace can be repeated on consecutive days. Anaerobic workouts (hard rides, spin class, intervals, weight lifting) need at least one, and sometimes more days of recovery

Training Zones

But what does “training aerobically”, or “at an aerobic pace”, really mean? Current theory divides exercise intensity into zones of effort:

Zone	Perceived Exertion	Benefits	Percent of Training Volume
1 Recovery	Very, Very Light	Rest may be better for novices	0-20
2 Extensive Endurance or Aerobic	Very Light to Fairly Light. Conversational	Builds aerobic base. Should be the most common training zone	50-70
3 Intensive Endurance	Somewhat Hard. Short talks	Generally avoided: too hard to promote aerobics, not hard enough to work muscles	0-10
4 Threshold or Muscular Endurance	Hard. Breathing becomes labored. Maintain for minutes, not hours	At Lactate Threshold. Trains fast-twitch muscles, promotes lactate toleration and clearing Improves “race pace”	10-20
5 Anaerobic Endurance	Very Hard Not sustainable - Intervals are common	Excess time in this zone is a leading cause of overtraining	0 - 10
6 Power	Very, Very Hard	Minimal benefit, possible injury 2+ days of recovery	0 - 5

Experts agree that the majority of training time, especially early in the year, and for people new to training, should be spent in the extensive endurance, or aerobic zone. Once an aerobic base has been developed, work in and around the **lactate threshold** (LT; the point at which the body begins accumulating lactate) is proving to be most beneficial for improving general performance in competitive events. Interested readers should review Mr. Friel’s books for insight into the details involved in LT training. For our purposes, think of LT as the point at which breathing becomes

labored, and you know you can’t maintain the pace for long, such that in a matter of minutes you will have to back off.

Heart Rate Monitoring

If training in the proper zones is so important, how do we know which zone we are in? Modern training methods lean heavily on heart rate monitoring, attaching a range of heart rates to each zone. In reality, this is a good approximation but not the only method. Once one has become accustomed to using a heart rate monitor, the conscientious athlete should compare heart rate with other methods, such as Perceived Exertion and personal experience, to confirm that he is training in the proper Zone.

To start aerobic training, without a previous training background, try Dr. Maffetone’s 180 formula:

180 – age = Maximum Aerobic heart rate

-10 if recovering from major illness

-5 if not exercised before, exercised irregularly, has ongoing injuries, or overtrained

As is if exercising regularly (4 times weekly) for up to two years without problems

+5 if competitive athlete training for more than two years without problems, and have made progress in competition

Use a zone of **10 beats below up to your maximum aerobic rate**. This will seem too low for most people. It should feel conversational, as if you could almost do the same workout over again once you complete it. The key is to have faith that exercising at this pace over time will force your body to adapt, increase its aerobic abilities, and over time you will have to go faster to maintain the same level of effort (as measured by heart rate).

There are other ways to calculate a training heart rate. In general, the 180 Formula jibes with others that are designed to increase endurance by training in the upper end of your Zone 2 - Extensive Endurance. Be cautious of the standard “ $220 - age = maximum\ heart\ rate, exercise\ at\ 85\% \text{ of this for cardio}$ ” dogma at gyms and on machines. This may be in the dreaded intensive-endurance zone (zone 3 in the previous table).

Maximum Aerobic Function (MAF) Test

A standardized test to track your training progress/regression. This should be done once or twice a month. After a recovery day, at the same general time of day, do a good warm-up (at least 10 minutes, building up to Maximum Aerobic Heart Rate), then perform a controlled, uniform workout at your Maximum Aerobic Heart Rate, and record the results.

Running: On the same running track, warm up, then time one or more miles at your Maximum Aerobic Heart Rate. Record results in your log.

Biking: On a standard, flatish, non-traffic, bike course (good luck finding this) of 20 to 40 minutes, warm up, then ride at Maximum Aerobic Heart Rate and record your total time for the course.

Indoor: Using a cardio machine (ideally the same machine, in good condition), after warm-up, workout at Maximum Aerobic Heart Rate for a set period of time, for example 10 or 20 minutes. Record the appropriate measure (e.g. total miles).

Proper training will cause the MAF times to improve from month to month. Worse times may indicate problems such as overtraining, or a need to refocus training on endurance. Inconsistent conditions of MAF tests can swamp the meaningfulness of the test, including: not performing it when rested and fully hydrated, weather differences, equipment differences at the gym, and traffic. So be sure that the test method you choose is as uniform and repeatable as possible.

Aerobic Workout Basics

The vast majority of workout time in the first year or two of training should be devoted to developing an aerobic base. Most workouts should be focused on maintaining aerobic levels of effort. Here are some general guidelines:

Time not Distance – To improve endurance, aerobic workouts must be based on time. Since workouts are performed at the same relative level of effort, if they are based only on distance, they will get shorter and shorter as fitness improves.

Endurance Workouts Can be Short – Don't think that long workouts are necessary to build endurance. If you have the time for long workouts during the week that's great. But 30 to 60 minute workouts are highly effective, and you may be able to fit more of them in your week. Don't yield to the temptation to work harder because it's "only 45 minutes".

Warm-up, Warm-down – Count these as part of the workout. For example, a 60-minute aerobic workout may include a 15-minute warm-up, 30 minutes at target heart rate, and a 15-minute gradual warm-down.

Stretching - Stretching before an aerobic workout may not be necessary. It may be better to bike or run slowly for the first part of your workout as your warm-up than to spend time stretching cold muscles. If you desire increased flexibility (and who doesn't), it may be better to focus on this as it's own goal, and add a flexibility-oriented workout to your regimen.

Heart Rate Monitor – Get one, and use it. There is no better way to know if you are training properly. It is also critical for the MAF tests.

Cross Train – The best aerobic workout for cycling is to ride at a comfortable spin cadence within your aerobic zone for 20 minutes or more at a time. This requires a relatively flat, non-traffic route. Hills, traffic, weather and seasonal changes conspire against this, especially in the Bay Area. Good additions to road riding are walking, running, swimming, and gym workouts on treadmills and stationary cycles.

Don't Get Sidetracked – Your goal should be to build an aerobic base through consistent, monitored, efficient aerobic workouts. Don't rationalize that a weekly group ride will satisfy your endurance training. Weekend group rides are generally too long, too variable, and not ridden at your own optimal pace to count as good aerobic builders. They are very important, but must be supplemented with focused work at your individual aerobic level.

Keep a Log – Make a goal. Set a plan. Then record your progress. If you are properly developing your aerobic base, you will see it in your log within a month or two. There is no better motivation than keeping and using your log.

Don't Cry Over Missed Workouts – People often worry that if they don't get the 10 hours in Week X that they scheduled, that they have to make up for it. If you find yourself continually undershooting your plan, then your plan needs changing to make it more realistic, and your workouts need changing to make them easier to do and to enjoy.

Other Workouts

Most people should first concentrate on building their aerobic base. But other types of workouts are useful, and fun, as long as they are viewed as secondary. For example, **spin classes** build anaerobic endurance and muscular endurance, as well as improving pedaling dynamics. **Group rides** add a mix of training for aerobic endurance (spinning in your comfort zone), anaerobic endurance (spinning faster than your comfort zone), muscular endurance (enduring lactate buildup), force (climb hills seated), power (climb short hills fast), and occasionally speed (the sprint to the finish). Older athletes may benefit from **weight training**, since muscle mass declines faster than aerobic capacity as we age.

Planning

Planning is what turns regular exercise into a “training program”. Many people exercise regularly and never bother to make or follow a training plan, feeling that it is too complicated, that they are not “competitive types”, that formal plans are better left to professional trainers, or that they have a set routine that “works” for them and why change it. Others jump from program to program, never finding the “right one”. Many of us even fight recurring injury, or accept diminished expectations rather than change our workout regimen.

But you can convert your current health and fitness history into your own customized training plan by following a simple structure:

- Set Goals
- Get the Right Equipment
- Build an Aerobic Base
- Monitor and Modify Your Plan

Goal Setting

1. **Set Primary Goals.** First, consider what your primary goal is. It may be to lose weight or body fat, get in better shape, or to be competitive in local races. While these are all actually related, it still helps to have a specific focus for your training.
2. **Make Goals Realistic and Challenging.** Be honest in assessing whether your goal is achievable, and in what time frame. For example, say your goal is to lose 100 pounds of excess weight and qualify for the Boston Marathon and you are new to running. This may be a fine long-term goal, but not for one season. You need to:
3. **Set Secondary Goals.** These should refine your primary goals, not expand them. These must also be realistic and achievable. For the above example, on the way to completing the Boston Marathon, maybe finishing a local Marathon by the end of the season is an appropriate secondary goal, or finding out if you even like running and can train for a season without injury. Competitive athletes set **seasonal goals** (i.e. qualify for the Hawaii Ironman), and **seasonal objectives** that support the seasonal goals (improve open water swim technique, break 10 hours at full Ironman distance) in the same manner.

4. **Review Your Goals Regularly.** Write your goals in your workout log. Regularly assess whether you are working toward your goals, or have been sidetracked by someone else’s program, or the magazine workout of the month. Stay focused. You should feel that every workout plays a known role in achieving your goals.

Equipment

This may seem elementary, but serves as a good reality check for your program. For example, if you envision staying in racing shape for cycling throughout the winter, do you have an indoor trainer or access to a gym on those dark, rainy days? If not, are you prepared to perform other non-cycling workouts to maintain your fitness? Proper clothing and accessories can extend the amount of time you have for training when it gets dark and rainy. Setting up a specific bike for commuting can be a motivator. And the most important piece of equipment is your **training log**. Your log should have your primary and secondary goals listed in a separate section (I like the back of the front cover), where they can be reviewed and changed as needed. You should keep a tally of your standard workout strategies, such as your training heart rates, results of MAF tests, and favorite workouts (I staple extra pages in as needed).

Build an Aerobic Base

For all the reasons previously described, building an aerobic base should be central to your training plan. It takes discipline to resist the temptation of turning an “easy” workout into a “good, hard” workout even when you have targeted the workout as aerobic in your schedule. If you leave it to chance, the “old ways” will maintain control, and will sabotage your training effort.

Monitor and Modify Your Plan

You must regularly ask, “Am I getting what I want out of my training program?” If the answer is “No”, you must change the plan. This may sound simple, but people rarely do it. Often, it’s because they don’t have goals that are measurable, and don’t have tools with which to measure their progress. You, on the other hand, have just set achievable, measurable, goals. And you have the MAF testing methodology to help you. Properly applied, the MAF test will tell you if you are progressing. Equally important, if you are regressing, the tests can warn you before you have wasted a season, incurred overtraining, fatigue, or injury, or just need renewed focus.

Scheduling

While the novice and the professional differ in goals and complexity of training, they can follow the same steps in developing their training schedule:

1. Determine how much time you have to train –

Be realistic in determining how much time you can devote to training. You must also compare your available time with your goals. For example, if you want to train to complete the Death Ride (129 miles, 15,000+ feet of climbing, 10 hours of riding) but cannot fit longer than a 2-hour bike ride into your weekly schedule, your goal may be unrealistic.

The time you allocate to training is your **Training Volume**, expressed in hours/week or hours/year. You can make a good guess at your current volume by adding up your regular activities.

2. Next, allocate your training volume across the season-

Periodic training refers to varying volume over time to peak at a certain time of year, usually for the “race season”, or for a particularly important event. For example, using months as training blocks, train for three weeks, ramping up the weekly hours, then use the fourth week as a recovery week. Then start a new block, with slightly higher training hours, etc. The general idea is that increasing weekly volume steadily, then letting up just before a race produces a temporary fitness **peak**. This works best when you have lots of time to train.

Periodic training blocks can be further defined for competitive types. For example, early in the season, the first three months are “Base”, focusing almost exclusively on aerobic work. Then maybe a month or two of “Build”, focusing on building muscular endurance, speed, and power, then a week of “Taper” before a race. This can get complicated for race geeks and triathlon wonks

A sensible and simple alternative for people with limited training time (i.e. most of us) is to train at a fairly **constant volume**, that being set by the time you have available. As you build an aerobic base, your mileage may increase, and you may add more intense workouts into the mix, but the total volume (time) may not vary much. The concept of peaking is less important in this scenario.

3. Include sufficient recovery time –

If you never work out on consecutive days, or train at lower volumes (less than 3 or 4 hours a week), then you are probably already including enough recovery time. But once you get the training bug, and start upping the weekly volume, you may want to exercise 5 or 6 days a week. If so, you may want to consider a **training block**: 2 or 3 weeks at full training volume, then a recovery week of 50 –75% of that volume in order to allow extra recovery time.

4. Set weekly goals –

Now that you have figured out how you want to spread out your training volume, it is time to map out weekly goals. Plug in known events, such as Centuries or races, or travel. Each week should have a targeted level of effort and objective. For example, if you can devote one weekend day for a longer ride and 2 to 3 hours a week for other workouts, such as shorter rides, running, and gym workouts, your training plan may look like this:

Simple Example: Assumes group rides are getting longer and longer (3 to 10 hrs)

Week	Weekly Objective	Planned Volume	MAF Test?
1	Base	3 hrs aerobic + group ride	Y
2	Base	3 hrs aerobic + group ride	
3	Base	3 hrs aerobic + group ride	
4	Recovery	2 hrs aerobic + group ride	Y
5	Base	3 hrs aerobic + group ride	
6	Base	3 hrs aerobic + group ride	
7	Base	3 hrs aerobic + group ride	
8	Recovery	2 hrs aerobic + group ride	Y
9	Base; Finish Met. Cent.	3 hrs aerobic + Metric Cent.	
10	Base	3 hrs aerobic + group ride	
11	Base; Finish Century	3 hrs aerobic + Century ride	
12	Vacation	Treat as Recovery	
13	Base	3 hrs aerobic + group ride	Y
14	Base; Finish Century	3 hrs aerobic + Century ride	
15	Base	3 hrs aerobic + group ride	
16	Base	3hrs aerobic + group ride	
17	Taper , Finish Death Ride	3 hrs easy + Death Ride	Y
18	Recovery	2hrs aerobic + group Ride	
...etc			

Use your log to plan your week in advance. Pencil in classes that you like to take. For example, if you generally do a spin class on Thursdays, you will see that the rest of your weekly workouts should be aerobic, since spin class is an intensive activity, and the group ride can not be counted on to provide a pure aerobic workout. Conversely, if your weekly goal is 8 hours, and you know you will not be doing a long 5-hour ride, you will know to put in extra workouts during the week to compensate.

Once you have transferred your schedule to your training log, you are ready to go. Now, when you work out, you will *want* to enter it into the log, because it will count toward your volume targets. A glance at your scheduled versus actual volumes over the past week or month will quickly tell you if changes are needed. And your regular MAF tests will show you how well you are building your aerobic base. You will be taking control of the hundreds of hours you are probably already spend exercising every year, and directing them towards meeting your goals.

Recommendations

I highly recommend Dr. Maffetone's book as a common sense introduction to training for the long term. For those who are interested in more detail and in training competitively, Mr. Friel has also written *The Cyclist's Training Bible* and *Cycling past 50*.

Sample Training Log Page

Attached is a sample training log page. If you make it into double-sided copies on a decent copy machine, you can stack the pages together, fold them down the middle, and staple them to make a training log for however many weeks you wish, two weeks per photocopy sheet. I use heavy card stock on the outside to form a cover.

The format is such that you can enter weekly goals at the top of the page, scheduled workouts at the bottom, and as much detail as you wish in the daily rows. For example, you may wish to use one column to track the time of each workout, making it easy to sum total time for the week at the bottom; another for the type of workout, and another for the distance and average speed. Since I train for triathlons as well as Centuries I use the 3 narrow columns to tally run, bike and swim workouts separately, and the notes to track how I felt, my heart monitor readings, and notes for the next workout.

Happy Training!

