METABOLIC EFFICIENCY PROFILE

CLARK COLLEGE

Fitness Testing Lab

J. SAMPLE, YOUR TRAINING HEART RATE ZONES ARE LISTED BELOW

The following heart rate zones were determined from your exercise test. Your heart rate and oxygen consumption level at threshold were used to construct each training zone specifically for you. These zones are a representation of your individual exercise capacity and unique metabolic response to exercise.

Heart rate zones	HR	Low HR	High HR	Kcal/hour	Fat Kcal/hour	Watts
Zone 1 (HR @ 80-85% LT)	138	130	138	1020	120	204
Zone 2 (HR @ 90-95% LT)	154	146	154	1230	0	234
Zone 3 (HR @ LT)	162	156	162	1350	0	265
Zone 4 (HR @ 105% of Peak LT)	170	162	170	1419	0	305
Zone 5 (Peak effort)	180	172	180	1502	0	334
Zone 6 (Recovery)	1 Min 142	3 Min 97	6 Min 87	N/A	N/A	N/A

ZONE	% LT	SYSTEMS CHALLENGED	TRAINING TYPE	DURATION OF EXERCISE
1	< 80% RPE 1-2	**Oxidative** ↑Aerobic energy sources & pathways ↑Capillary density, distribution ↑Use fat while sparing glycogen ↑musculoskeletal adaptations **Easy and relaxed pace, gentle breathing**	**Active Recovery** Base building Over-distance Active Living	1-5 days/wk 20-240 min. or more per session
2	80-90% RPE 2-3	**Oxidative** ↑Aerobic endurance ↑Economy of motion ↑Health enhancement **Comfortable pace, deeper breathing**	**Endurance** Aerobic intervals	2-3 days/wk 30-120 min. + Intervals (20-30min.)
3	91-99% RPE 3-4	**Muscular endurance** ↑Aerobic energy pathways & economy ↑ VO^2 Kinetics (Transport) ↑Slight increase in LT **Breathing begins to become labored**	**Sustainable Power** Long intervals Tempo work	1-2 days/wk 20-60 min. Intervals (10-30 min.)
4	100-105% RPE 4-6	**Muscular Endurance & Power** ↑ Aerobic energy pathways ↑LT & Lactate clearance **All out pace to sustain up to an hour of activity**	**LT Intervals** Fartlek Race pace Speed work	1-2 days/wk 20-40 min. Intervals (5-20min.) Recovery (1-5 min.)
5	>106% RPE >6	**Anaerobic endurance & Speed** ↑Anaerobic energy sources ↑Neuromuscular coordination ↑Strength & Power	Race Speeds + Anaerobic intervals	1 day/wk 30 sec. – 2 min. Recovery (1-3 min.)
6	N/A	**1, 3 & 6 Minute Recovery Heart Rates** Aerobic energy pathways & recovery Lactate clearance	N/A	N/A

THE KEY DATA POINTS FROM YOUR TEST AND WHAT THEY MEAN.

Max Fat Zone –The point at which you maximize fat utilization for fuel. Ideally this would be as high a point (intensity, HR, Watts, etc.) as possible for an endurance athlete to preserve glycogen for when it matters most.

1.36	**L/min**
17.3	**ml/kg/min**
76/1	**Heart Rate/RPE**

Aerobic base- Defined as the point at which you transition to more than 50% of your energy being derived from glycogen instead of fat. The higher this number (i.e., the higher the level of exertion) the better, because it means you can "spare" more glycogen for when you need it, and use as much fat as possible energy.

Your Aerobic Base:

2.02	**L/min**
25.7	**ml/kg/min**
98/2	**Heart Rate/RPE**

60% peak *VO2*– this is roughly the highest level of energy output a well-conditioned person can sustain for several hours. Some might call this "all-day speed." When doing a very long swim or bike ride (say, north of 4 hours), this is the maximum average power output one can sustain.

Your 60% peak VO2:

3.04	**L/min**
38.8	**ml/kg/min**
127/3	**Heart Rate/RPE**
86	**% Glycogen dependence**

Anaerobic threshold (AT)– as we measure it, this is the point at which your body starts to accumulate lactic acid faster than it can metabolize, or clear, it. We use this as a pretty good (but not perfect) approximation for when your body transitions from being aerobic (able to process fat or glycogen in an oxygen-rich cellular environment) to being anaerobic (only able to process glycogen in an oxygen-poor cellular environment). Aerobic metabolism is much more efficient than anaerobic metabolism, hence you want this threshold to be as high as possible, and ideally you want this point to be determined by lactate generation, and not substrate cross-over (i.e., inability to burn fat).

Your AT:

4.5	**L/min**
57.7	**ml/kg/min**
162/6	**Heart Rate/RPE**
100	**% Glycogen dependence**

Max *VO²*– this is where you fall off the bike or treadmill. It's the last bit of what we refer to as "anaerobic cap" performance. You can only sustain it for fraction of time, but it's a 100% glycogen-dependent state of maximum output**.**

Your Max VO²:

5.11	**L/min**
65.2	**ml/kg/min**
180/9	**Heart Rate/RPE**

HOW YOUR VO² MAX RESULTS COMPARE TO AGE & GENDER NORMS

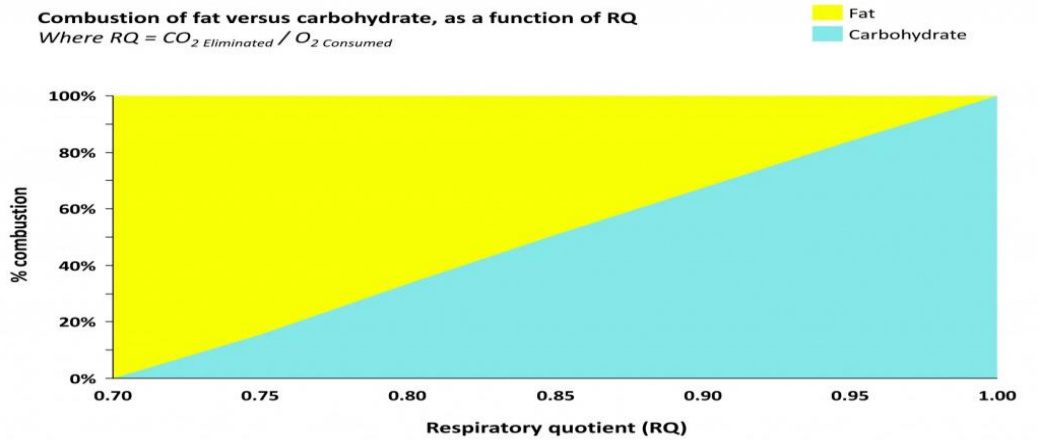
MALE **Your VO² Max 65.2 ml/kg/min** **FEMALE**

Age	Ex	Good	Average	Fair	Poor		Ex	Good	Average	Fair	Poor
<29	>53	44-52.9	34-43.9	25-33.9	<2.9		>49	39-48.9	31-38.9	24-30.9	<23.9
30-39	>50	42-49.9	31-41.9	23-30.9	<22.9		>45	37-44.9	28-36.9	20-27.9	<19.9
40-49	>45	39-44.9	27-38.9	20-26.9	<19.9		>42	35-41.9	25-34.9	17-24.9	<16.9
50-59	>43	38-42.9	25-37.9	18-24.9	>17.9		>40	34-39.9	22-33.9	15-21.9	>14.9
60-69	>41	36-40.9	23-35.9	16-22.9	<15.9		>37	33-36.9	21-32.9	13-20.9	<12.9

So what does all this tell us? Basically it breaks athletes down into two main groups. Group 1: Your goal is to be more metabolically flexible and efficient in the aerobic environment, a particularly important factor for those who compete in events longer than a few minutes (e.g., 10K, marathon, triathlon), but less so for those doing short-burst activity. Improved aerobic efficiency and fuel adaptation means that we rely on much more fat, rather than glycogen, during prolonged exertion. This frees one up from needing to be constantly eating during long exercise bouts. Group 2: Your goal is more recreational than competitive with a focus on weight management and using exercise as a tool to achieve a healthy lifestyle. If you fall into this group then metabolic efficiency may be counterproductive. For

many recreational athletes, often choosing to participate in a sport for the benefit of being able to eat more and still lose weight, metabolic efficiency may result in frustration. A recreational athlete, many think that training will allow them to eat more, but unless metabolism is raised simultaneously with training, weight gain is more likely to result than weight loss.

PERFORMANCE TRAINING TO IMPROVE METABOLIC EFFICIENCY



How do we train to become more fuel efficient? On the following pages are some strategies to help you achieve your physiologic potential. The most agreed upon way to improve your ability to oxidize fat—turn fat into energy—is to train for long hours at a relatively slow pace. Base training, Long Slow Distance (LSD) whatever you call it training in **Energy Zone 1** is the most efficient way to maximize your fat burning potential.

ZONE	% LT	SYSTEMS CHALLENGED	TRAINING TYPE	DURATION OF EXERCISE
1	**80% RPE 1-2**	**Oxidative** ↑Aerobic energy sources & pathways ↑Capillary density, distribution ↑Use fat while sparing glycogen ↑musculoskeletal adaptations **Easy and relaxed pace, gentle breathing**	**Active Recovery** Base building Over-distance Active Living	1-5 days/wk 20-240 minutes or more per session

The bulk of research on ways to speed up the process of adapting to fat as fuel are centered around diet, but opinions differ and no one method seems to work for all athletes. There are no hard and fast rules to follow, but there is some agreement on general guidelines. Avoid processed carbohydrates – essentially sugar. Even in white bread, baguette and white pasta as these elicit an insulin response and result in less fat oxidation. Consume unsaturated fats such as olive oil and sunflower oil as these are very reactive and easily used as energy – long lasting energy. Eat fiber from fruit & vegetables – a good gastric inhibitor that allows your energy to be released slowly. Avoid sugary soft drinks – drink water! Even fruit juices, "energy drinks" or "electrolyte replacement drinks" are just as bad as pop. As you approach your food selection and preparation, prioritize your meals and snacks. First on the plate should be a source of lean protein and healthy, omega-3 rich fat. Second up is a healthy portion of fruits and/or vegetables. That's it. Try to reduce or eliminate whole grains during this time in order to balance your blood sugar better and not have such a high carbohydrate diet when you are not training much.

Follow the 90/10 rule. Stay on track with these steps 90% of the time and allow yourself to "miss" the other 10% of the time. Remember, you are human and life happens. Don't stress out if you have the occasional miss (sweets, alcohol, chips, etc.). Approach your nutrition plan as you do your exercise plan and allow some room to deviate. At the end of this document are a several research summaries on training methods that have achieved some success with metabolic efficiency and performance.

Remember this is a gradual process. If you currently take in a lot of sugar before and during your runs and you suddenly stop supplying it to your body, you'll bonk, and it'll be dangerous. Introduce these concepts slowly and gradually, and always carry a few gels with you for emergencies.

RESEARCH SUMMARY ON TRAINING TO IMPROVE METABOLIC EFFICIENCY

A modified high fat diet called "periodized nutrition," in which five to six days of high-fat intake is followed by a day of carbo loading, leading into a race simulation. Your body adapts to the high-fat diet after five to six days and shifts into a fat burning machine, and many studies have found that this shift persists even after the carbo loading day. In theory, this type of diet is promising because athletes can do most of their training on a normal high-carb diet, which is optimal for intense endurance training, then switch to a high-fat diet for five to six days, carbo load for a day and then race with a full tank of glycogen and an enhanced ability to burn fat. But researchers L. Havemann et al found that these periodized diets reduced one's ability to do intense workouts and periodized diets have little or no effect on enhancing one's endurance.

Zero Calorie Exercise. A somewhat risky tweak you can implement in your training to improve your ability to burn fat for fuel—regular workouts on water. This approach has a big effect in activating the genes that stimulate the production of enzymes involved in fat oxidation, as shown in a 2005 study by L.J Cluberton et al. At first be very cautious as it is very easy to bonk with this method of training. But as the body adapts, so will your ability to go longer. If you decide to implement these water-only session in your training, remember that these workouts are depletion sessions, which leave you drained, and should always be followed by recovery days. I would recommend beginning with a modified version of these water-only rides that allows one to maximize the stimulation of fat oxidation without requiring so much recovery. In short, do the first two hours of every training session on water alone and then add slowly absorbable, solid carbs, such as whole grain sandwiches or oatmeal-based energy bars. This process keeps the blood sugar levels in check so as to avoid bonking and keeps the intensity up late in the sessions. Early in the year, when intensity is more important, fuel rides from the start and only do a water-only session once a week.

Extend your warm-up period. If you're standing still and you suddenly bolt off running, your physiology changes. Your body senses something is up and starts burning the sugar fires, since sugar is great for short bursts of energy. But that's exactly what you don't want to happen on your long run. So warm up <u>extremely slowly</u>. Walk for the first few minutes. Over the course of 10 or 15 minutes, build up to your long-run speed. Run slow! You want to stay below your LT for as long as possible, so your body can get used to burning fat for fuel. So go really slow, think Zone 1 your goal is to do this enough that your threshold increases, i.e., you can run faster yet still stay in this aerobic, fat-burning zone.

A study in 2011 by Paoli, A., et al. found that with moderate intensity exercise (65% of heart rate reserve) subjects burned a higher percentage of fat calories at 12 and 24 hour intervals post-exercise in a fed state than in a fasting state. This phenomenon is known as EPOC (Excess Post-exercise Oxygen Consumption) sometimes referred to as exercise after-burn. Although the study did not measure fuel sources during exercise the results suggest that eating a light, easily digestible meal 30 minutes to one hour prior to exercise primes the furnace to burn fat at a greater rate after exercise.