LESSONS I HAVE LEARNED FROM PHYSIOLOGY AND HOW THEY CAN MAKE YOU A FASTER RUNNER

WORDS : **JASON KARP, PhD**

ABOUT THE AUTHOR:

"Jason Karp, PhD, is the owner of Run-Fit, LLC, 2011 IDEA Personal Trainer of the Year, and creator of the Run-Fit Specialist™ certification.
He has more than 200 published articles in international running, coaching, and fitness magazines, is the author of six books, including The Inner Runner, and speaks around the world. For training programs and autographed copies of his books, go to *http://run-fit.com.*

– Jason Karp, PhD

One of the things I love most about the sport of distance running is that, in its simplicity of putting one foot in front of the other, it is also extremely complex. When done correctly, it is a scientific endeavor to maximize one's speed and endurance. Here are three lessons I have learned from physiology and how they can make you a ***faster runner.***

"AN **IMPORTANT PHYSIOLOGICAL VARIABLE** THAT **DEMARCATES THE TRANSITION** BETWEEN RUNNING THAT IS ALMOST **PURELY AEROBIC** AND **RUNNING** THAT INCLUDES SIGNIFICANT **OXYGEN-INDEPENDENT (ANAEROBIC)** METABOLISM."

01 LACTATE THRESHOLD AND RUNNING ECONOMY ARE MORE IMPORTANT THAN VO2MAX.

While VO2max has received most of the attention among runners and coaches, a high VO2max alone is not enough to attain elite-level performances; **it simply gains one access into the club, since you need a high VO2max to be a good runner.** The other two physiological factors of distance running—lactate threshold (LT) and running economy (RE)—exert a greater influence on your performance and are more responsive to training. I have tested many athletes in the laboratory with an elite-level VO2max, but few of them were capable of running at the elite or even sub-elite level because they did not have a high LT or were not very economical.

LT is an important physiological variable that demarcates the transition between running that is almost purely aerobic and running that includes significant oxygen-independent (anaerobic) metabolism. It represents the fastest speed you can sustain aerobically. Since the LT represents your fastest sustainable pace, the longer the race, the more important your LT is. LT pace is about 6 to 9 seconds per kilometre slower than 5K race pace (about 10K race pace) for recreational runners and about 15 to 18 seconds per kilometre slower than 5K race pace (about 9 to 12 seconds per mile slower than 10K race pace) for trained runners. The pace should feel comfortably hard.

Running Economy (RE) is the volume of oxygen consumed at submaximal speeds and is probably even more important than LT in determining running performance because it indicates how hard you're working in relation to your maximum ability to use oxygen. For example, if two runners have a VO2max of 70 milliliters of oxygen per kilogram of body weight per minute, but Jack uses 50 and Jason uses 60 milliliters of oxygen while running at 5:00 per kilometre pace, the pace feels easier for Jack because he is more economical. Therefore, Jack can run faster before using the same amount of oxygen and feeling the same amount of fatigue as Jason. I have yet to see a runner who has superior RE who does not also have a high VO2max and LT.

Although many runners and coaches think that RE is a reflection of running form, it is more influenced by capillaries and mitochondria, which influence oxygen delivery to and used by the muscles. Research has shown that runners who run high volume (more than 100 kilometres per week) tend to be more economical, which leads one to believe that running high volume improves RE. In addition to increasing mitochondrial and capillary density, a high volume also increases the repetition of running movements, resulting in better biomechanics and muscle fibre recruitment patterns. RE is also improved by the weight loss that often accompanies a high volume. Improved RE may be the most significant attribute gained from running high volume. However, it's not entirely clear whether high volume runners become more economical by running more kilometres or are innately more economical and can therefore handle higher volume.

02 THERE ARE DIFFERENT MUSCLE FIBRE TYPES.

Humans have three different types of muscle fibres, with gradations between them. **Slow-twitch (ST) fibres are recruited for aerobic runs, while fast-twitch B (FT-B) fibres are recruited for short anaerobic, high-force production activities, such as sprinting. Fast-twitch A (FT-A) fibres, which represent a transition between the two extremes of ST and FT-B fibres,** are recruited for prolonged anaerobic activities with a relatively high-force output, such as racing 400 metres. Distance runners have more ST fibres than FT fibres. However, even within a group of distance runners, there is still a disparity in the amount of ST fibres. Some runners may have 90 percent ST and 10 percent FT fibres (marathoners), while others may have 60 percent ST and 40 percent FT fibres (1,500-metre runners).

Understanding your fibre type can help you train smarter. While most runners do the same workouts to focus on a specific race, your training and racing should reflect your physiology. For example, if you have 90 percent ST and 10 percent FT fibres, your best race will be the marathon and your training should focus on volume and tempo runs. If you have 60 percent ST and 40 percent FT fibres, your best race will be 800 or 1,500 metres, and your training should focus less on mileage and more on interval training. If both runners want to race a 5K or 10K, the former runner should initially do longer intervals, trying to get faster with training, such as 1,200-metre reps at 5K race pace, increasing speed to 3K race pace or decreasing the recovery as training progresses.

The latter runner should do shorter intervals, trying to hold the pace for longer with training, such as 800-metre repeats at 3K race pace, increasing distance to 1,200 metres or increasing the number of reps as training progresses. Thus, there can be two paths to meet at the same point.

"HUMANS HAVE **THREE DIFFERENT TYPES OF MUSCLE FIBRES,** WITH GRADATIONS BETWEEN THEM"

> "REGULATED BY ITS PATRIARCH - **OXYGEN.** THE AVAILABILITY OF OXYGEN DETERMINES WHICH **METABOLIC PATHWAY PREDOMINATES**."

03 METABOLISM IS TIGHTLY REGULATED BY ENZYMES AND OXYGEN.

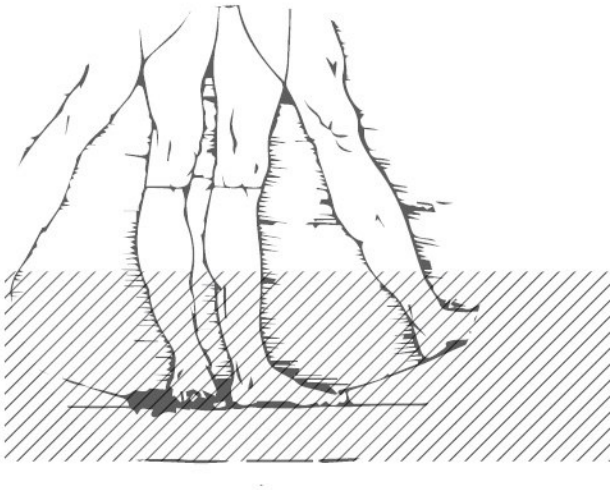
The activity of an enzyme controls which metabolic pathway is used. For example, having more aerobic enzymes steers metabolism toward a greater reliance on aerobic metabolism at a given submaximal speed. Thus, enzymes essentially control metabolism and therefore control the pace at which you fatigue.

Metabolism is also **regulated by its patriarch—oxygen.** The availability of oxygen determines which metabolic pathway predominates. **For example, when there is adequate oxygen to meet the muscle's needs, the final product of glycolysis—pyruvate—is converted into an important metabolic intermediate that enters the Krebs cycle for oxidation.**

This irreversible conversion of pyruvate inside your muscles' mitochondria is a decisive reaction in metabolism since it commits the carbohydrates broken down through glycolysis to be oxidized by the Krebs cycle. However, when there is not adequate oxygen to meet the muscle's needs, pyruvate is converted into lactate.

An associated consequence of this latter fate is the accumulation of metabolites and the development of acidosis, causing your muscles to fatigue and you to slow down.

The more aerobically developed you are, by focusing on increasing your volume and doing LT runs, the more you'll steer pyruvate toward the Krebs cycle and away from lactate production at a given pace. That's a good thing, because the amount of energy you get from pyruvate entering the Krebs cycle is 19 times greater than what you get from pyruvate being converted into lactate. While pyruvate will always be converted into lactate given a fast enough speed, the goal of training is to increase the speed at which that occurs.



> "IF YOU WANT TO GET THE MOST FROM YOUR **TRAINING,** LEARN THESE LESSONS. NOT ONLY WILL YOU BE **REWARDED** WITH HIGHER LEVELS OF FITNESS AND NEW PERSONAL BESTS YOU'LL MAKE A COMPLEX SPORT A **LITTLE SIMPLER.**"