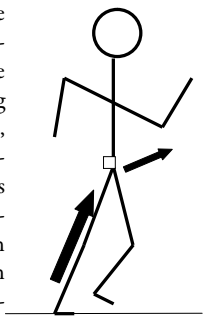
Creating Efficient
Horizontal Propulsion

Despite what most runners and their coaches believe, technique plays an enormous role in sustained fast running. Most runners subscribe to one of two basic paradigms of propulsion. Unfortunately, both are flawed. One creates more upward than forward propulsion; the other isolates a relatively small, weak muscle group instead of harnessing a number of muscles to work together to produce propulsion. Learning to use large muscle groups to create horizontal propulsion with minimal vertical oscillation will help you run farther and faster.

Upward Thrust Method

One challenge for runners is creating propulsion as close to purely horizontal as possible. Excessive vertical displacement dramatically increases the energy cost of running. Most runners develop propulsion using the upward-thrust method. At toe-off, the knee is straightened forcefully, thrusting the body up and forward.

This technique wastes a tremendous amount of energy, leads to local muscular fatigue in the quadriceps, and slows turnover. It also increases impact stress, which leads to more injuries.

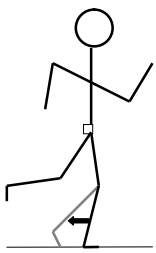


As indicated by the large black arrow in the illustration, the direction of the force created by extending the knee is slightly forward, but mostly upward. The extended flight time decreases turnover, more than offsetting the slight increase in stride length, resulting in slower running speed and increased energy cost. This up-and-down method of running, employed by most runners to some degree, is extremely inefficient. If your quadriceps fatigue during long runs even at easy pace, you probably use the upward thrust method of propulsion.

The quadriceps muscles work primarily vertically. On flat ground, the quadriceps should only contract at the moment of foot-strike to hold the body up. They minimize knee-bend at foot-strike, catching bodyweight, but should not create propulsion. This is especially important for triathletes, who must run with quadriceps fatigued from the bike.

Pull-Through Method

Another common error of propulsion is the pull-through. The runner avoids the upward-thrust push-off, instead creating propulsion by bending the knee and pulling his body forward with the hamstring muscles.



This running style is reasonably energy-efficient. It does minimize vertical displacement and landing impact, however, the problem with this running style is the demand that it places on the hamstring muscles. The hamstrings are a relatively small and weak muscle group. When they are almost exclusively responsible for propulsion, they fatigue easily. Using larger muscles along with the hamstrings enables a runner to take advantage of the benefits of the energy-efficient (horizontal) style, but prevents local muscular fatigue in the hamstrings by spreading the workload over greater muscle mass.

If an athlete suffers from hamstring fatigue or cramping during long or hard runs, while the rest of the body feels fairly comfortable, he probably uses pull-through propulsion. Learning to engage more and larger muscles for propulsion while maintaining horizontal movement will increase speed and endurance.

Foot Drag

The two common errors of creating propulsion for running involve movement at the knee. However, when using optimal technique for creating propulsion when running on flat ground, a runner neither straightens nor bends the knee, instead, pivoting from the hip, using a movement called the "foot-drag."

Efficient runners pivot the leg backward from the hip with the entire leg as a fixed unit. The knee should be slightly bent, but the knee angle should not change from just before foot-strike, through the period of contact with the ground, to the follow-through. *Through the entire propulsion phase, the knee angle should be slightly bent and should not change.* This technique accomplishes a number of the goals of efficient, fast, sustained running.

First, the foot-drag movement creates almost perfectly horizontal propulsion. Vertical displacement, and all the problems associated with it, are minimized. Newton's Law states that "every action has an equal and opposite reaction." It follows that, to create horizontal propulsion, we must pull straight back against the ground instead of pushing down into the ground. The foot-drag movement accomplishes this goal.

The foot-drag movement also takes advantage of the attachment points of the muscles on the posterior aspect of the hips and thighs, and spreads the work of propulsion among a much larger muscle mass than other methods of propulsion. Using greater muscle mass to accomplish a certain amount of work decreases the relative intensity of the work

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for each muscle. If more muscles are doing the same amount of work, each muscle is working more easily.

The hamstring muscles are unusual in that they cross two major joints. The hamstrings attach above the hip, cross both the hip and the knee joints, and attach below the knee. Due to this unique attachment, they serve two major functions: extending the hip joint and flexing the knee joint. The gluteus maximus muscles, on the other hand, cross only one major joint, the hip. The glute muscles' only major action is hip extension.

The pull-through method of propulsion creates nearly horizontal propulsion, but it fails to engage the largest and strongest muscle in the body, the glutes. Which do you think would be stronger, your hamstring muscles, or your hamstring muscles and your glutes working together? That answer is obvious. If knee flexion is the primary producer of propulsion, the hamstrings have to create the force by themselves. By using hip extension instead of knee flexion to create propulsion, the hamstrings work in conjunction with the glutes and therefore each muscle is required to produce less force. Obviously, this minimizes fatigue.

Pull-through runners frequently have extremely tight hip-flexors, preventing correct hip extension. Stretching these muscles will enable you to incorporate better technique for developing propulsion, allowing you to create high levels of horizontal propulsion without local muscular fatigue.

Developing a stride which uses hip extension as the primary method of propulsion will enable you to move more horizontally and to use large muscle groups to do the work. This will allow you to run farther and faster than ever before.

Ken Mierke is author of The Triathlete's Guide to Run Training and Evolution Running: Run Faster and Farther Without Injury (due out 2008). Ken developed Evolution Running, a system of running techniques that increases efficiency and injury resistance. He coaches several of the fastest runners in the sport of triathlon, and is Head Coach of Fitness Concepts (www.Fitness-Concepts.com). His book, DVD, and event schedule are available at www.EvolutionRunning.com. ★

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tinue consuming them through the remainder of your workout.

Bars: You have to chew, but you can get the most calories in for the bite. Bars are great when you are out on long bike rides. The downside - if you are training at a high intensity, you may have a harder time breathing and chewing.

Electrolyte Chews: Again, chewing can be an issue, but the electrolytes and calories can do your body good.

Liquids: Includes sports drinks, protein dinks, and a mixture of both. The downside for protein drinks - you must have some sort of electrolyte replacement if you are going to be training longer than 90 minutes. The good news is that there is a wide range of products available that have varying calorie, fat, carbohydrate, and protein ratios. You will need to try different products to see what works best for you.

"Real Food:" Can spoil, depending on what you are using; then you would really have problems. However, a good peanut butter and jelly sandwich may help break up the monotony between the gels and bars. The downside - they can be hard to carry with you. Buying food at a gas station stop is one option, or store food in a sag vehicle, if you are lucky enough to have one during your ride.

Tablets - salt, electrolytes: These products are not going to provide any calories, but can aid in replacing lost salt and potassium. The downside - they may cause adverse reactions in some people, including stomach cramps, weakness, and nausea.

Holly O'Connor, RD and Elizabeth Rahavi, RD are both Registered Dietitians and members of the American Dietetic Association. To find a nutrition professional in your area, go to the Association's web site: www.eatright.org. ★

I'd Pick More Daisies

If I had my life to live over,
I'd dare to make more mistakes next time.
I'd relax, I'd limber up.
I would be sillier than I've been this trip.
I would take fewer things seriously,
take more chances, take more trips.
I'd climb more mountains,
and swim more rivers.
I would eat more ice cream
and less beans.
I would perhaps have more actual troubles,
but I'd have fewer imaginary ones.
You see,
I'm one of those people who lived seriously,
sanely, hour after hour,
day after day.

Oh, I've had my moments,
and if I had it to do over again,
I'd have more of them.
I've been one of those persons
who never goes anywhere without a thermometer,
a hot-water bottle, a raincoat, and a parachute.
If I had to do it again,
I would travel lighter than this trip.
If I had my life to live over,
I would start going barefoot earlier in the spring,
and stay that way later in the fall.
I would go to more dances,
I would ride more merry-go-rounds.
I would pick more daisies.
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