

The  
Five

**P**'s  
REPARATION  
ROPULSION  
USHOFF  
ULL THROUGH  
ERCUSSION  
**S**

of  
Running

Form

*by Matthew Barreau  
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Weights and Training*

# The Five P's of Running Form

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Instead of compiling a notebook of workouts I did this term, I figured I would put together a training schedule that would be typical of the athletes I would coach. Since there are innumerable styles and types of training one must go through to be a complete athlete, I decided to focus on one aspect of training: the running stride.

The ability of one to run fast is directly related to form. Simply put, the more efficient the stride, the more energy that can be turned into forward motion. In analyzing the stride, I will focus primarily on the lower half of the body, as it creates the primary propulsing forces. The upper body will be referred to, but only as a product of lower body forces. There is much truth to the theory that the “arms drive the legs,” but this report will separate the two halves. A quick description of the position of the upper body:

*Minimal rotation of the upper body is the goal, so a strong core is necessary. The abdominal and lower back muscles must be of sufficient strength to absorb as much rotational forces created by the lower body as possible. The arms, shoulders, and neck should be in a relaxed state, to allow for a greater freedom of motion. Tightness in one area of the stride has been known to affect other aspects of the stride, as everything is ultimately one interconnection motion. Elbow angle will range from slightly less than 90° at its forwardmost point, to 90° as it passes the side of the body, to slightly more than 90° as it swings behind the body. The range of motion will be greater and more forceful as the speed of running increases. The head should remain in a neutral position above the shoulders. Overall, there should be a slight forward lean in the body. This will help utilize gravity's forces to assist in the running process. Some people have described running as a continual process of falling and catching oneself repeatedly. This “falling” is due to the forward lean placing the center of mass (COM) just slightly outside of the body in the direction of movement.*

I have separated the running stride into the Five “P’s”: preparation, propulsion, pushoff, pull through, and percussion. The first four are actual patters of the stride, while the percussion is more of a tool of self-check. Included throughout the examination of the running stride will be a detailed list of running drills and their benefit as it relates to particular aspects of stride efficiency. Additionally, a 21-day mesocycle will be set up to include these drills, incorporated with the typical workouts an athlete of mine may encounter during that time period.

There is no clear place to begin talking about the running stride, as each phase’s successfulness is ultimately a product of how well the phase before it was performed. As will be explained later, I believe the recovery phase to be the most important of the running phases. Therefore, I will begin this discussion with the phase immediately following recovery, and build up to that crucial phase of form. That way, any errors in the recovery phase – being a product of things happening before it – will be able to be detected more easily.

# Preparation

The preparation phase begins after the foot has swung down from its recovery phase position close to the upper thigh, and come into the position it will hold until impact with the ground. This will be described as the time when maximum knee lift has occurred (this depends on the speed of the run, where faster running means more leg lift). The foot should be in a dorsi-flexed position, with the mid- to forefoot falling directly below the knee. As the knee is a support mechanism in running (detailed later), it stands to reason that it should be directly above the contact with the ground as the time of impact. The dorsi-flexed foot will minimize absorption of running energy by the calf muscle. If the foot is plantar-flexed, then as gravity pushes the body downward, the calf will be forced to lengthen in order to provide a pushoff role (see pushoff phase for more details). This eccentric contraction of the calf is extremely costly, as this type of contraction is the most straining on the body. Landing on the mid- to forefoot will also minimize “braking” and trauma on other joints. By landing on the heel, impact forces are transferred up the legs, and can even reach the back.

After the leg has got into the position described above, it begins the downward swing to the ground. Muscularly this is caused by the extension of the hip muscles (glutes, upper hamstrings). Because of this extension, which will continue throughout the running motion, your foot will actually be moving backward upon impact. Therefore, you want the foot to land slightly in front of the COM, so that by the time it becomes “useful” it will be directly under the center of mass, if not slightly behind. (The moment the foot touches the ground, it has merely made contact, and has not yet become a supporting mechanism. Since your body is traveling forward this entire time, the COM will move ahead of the footstrike by the time it becomes a supporter.) If the hip extensors are called into action while the foot is in front of the COM, then they are becoming active in simultaneously pulling and helping support the body’s weight, which is a great strain on the muscles and can eventually lead to great hamstring difficulties, including overuse injuries and premature tiring. Should the foot fall in front of the COM, a “braking” effect will occur. Tired quads can be a product of overstriding, as it causes the quads to support the body’s vertical and horizontal components simultaneously. Conversely, if the foot should fall behind the COM by too much, an inefficient falling motion will occur.

The knee must be slightly bent upon impact. This will allow the mid- to forefoot to position itself directly under the knee and the supporting system of the body. A straight leg will not only negate much of the lower leg’s power potential (quads), but it will also cause a greater strain on the hamstring and calf muscles when they are called into action to unbend the joint; moving any joint through a range of motion is significantly easier than the initial unbending of the joint itself.

## Drills

PREPARATION

**heel walks**  
By concentrating on keeping the toes off the ground, you are strengthening the anterior shin muscles. This will help in keeping the toes up just before the foot’s impact with the ground, minimizing “absorbing” by the calves.

**toe walks**  
This exercise strengthens the calves. These are mini-plyometrics, as each step produces a small bouncing motion. During the preparation phase, it is important to have strong calves to resist absorbing energy at the point of impact.

**‘A’ mechanics**  
The focus of this drill is to bring the leg as quickly as possible to the position it will be in just before it begins descending toward the ground; the knee will be at its highest point, and the toe will be positioned directly beneath it.

**‘B’ mechanics**  
From the ending position of ‘A’ mechanics (knee up, toe beneath it), this exercise is about bringing the leg down and backward. The foot will make a “scuffing” sound while moving down and back upon contact with the ground

**‘C’ mechanics**  
This is a range of motion exercise that mimics ‘A’ mechanics, but also includes repeating the motion with the knee pointing out to the side. This helps hip mobility, while maintaining ‘A’ form.



# Propulsion

For the most efficient stride, all of the energy of motion must be direction in the motion of travel, which – in the case of running – is forward. Any alternative motions are merely wasted energy. The COM should remain at a constant height so as to eliminate the use of energy in any vertical component of forces. In analyzing the forces in the running stride, a vertical component is present due to the need to counter the forces of gravity. However, to be most efficient, the forces supplied by the body will be just enough to counter the gravity, and not superfluous to that; in other words, no net change in COM height.

The forward motion is caused primarily by hip extension. In order to maximize each stride, the range of motion of the hip must be adequate enough to allow for maximal hip extension. Obviously, the farther one can push with each step, the longer the stride will be (frequency and stride length are the primary components in overall running speed). If you merely extended your hip without changing the angle of your knee or ankle, you would lower your COM. So, while your hip extends, your knee must extend simultaneously, also. The ankle comes into play at the end of the stride, which will be examined in the next section.

## Drills

walk-through lunges

This motion exaggerates the propulsion phase. Catching the weight on the landing foot will help strengthen the glutes for support while running, and the walk-through motion strengthens the glutes for their role in propulsion.

'B' mechanics

The benefit for this phase is merely a continuation of the last phase: in teaching the foot to be moving backward upon impact with the ground, the glutes will be able to provide more of a propulsion effort to the stride.



PROPULSION

# Pushoff

The pushoff phase is actually a continuation of the propulsion phase, but deserves special attention, as it can help determine whether you run forward faster, or run with more of a bounce in your stride. Seemingly more than any other phase, this final pushoff will be the cause of wasted energy.

## Drills

walk-through lunges

As you complete the walk-through portion of this drill, placing an emphasis on the extra push with the toes teaches the body to do the same during the running motion.

toe walks

If done with a little bounce in the stride, the plyometric effect of this drill will give the calves extra strength for pushing off. It is important to focus on the quickness of the bouncing in order to desensitize the golgi tendon organ, which causes muscle relaxation. This would diminish the calves' abilities to provide extra inches to stride length.



PUSHOFF

The two major components of the final pushoff are near-maximal knee extension and a plantar-flexion of the ankle joint. As previously described, the knee is primarily a height maintenance mechanism in running; as the hip extends, so must the knee. When the hip is at full extension, the knee has yet to completely extend. Hence, as there is no more extension of the hip, there is no need to further extend the knee. Doing so will only cause a greater vertical component to the running stride, and give the sensation of leaping or bounding with each stride, rather than running. As previously discussed, completely straightening the knee joint will require an undue stress on the hamstrings and calves in order to bend it for the recovery phase. Additionally, it will take more time to get the lower leg into the recovery phase, which will create more upper body twisting. Excessively tired quads can be a product of having too much of a vertical component in the running stride.

The final aspect of the movement aspect of the running stride is the toe-off. After the hip has been fully extended, the ankle joint is the last chance to add horizontal movement – and with it, length – to the stride. And with virtually no added time cost to this toe-off, there is

clear benefit to the motion. (I say virtually no added time because a small time component is present. For the toe-off to be a horizontal component, the leg must be as far back as possible. The timing of the toe-off also coincides with the beginning of the recovery phase [pull through] of the leg to minimize the extra time of contact on the ground.) To gain the greatest force from this toe-off, the principles of plyometrics must be heeded to: a loaded muscle will provide a greater response than an unloaded one. When the foot first strikes the ground, the added weight of the body on the calf muscle becomes the loading. If landing with the ankle in a plantar-flexed position, the loading will be too much and too slow, and the golgi tendon organ (responsible for muscle relaxation) will win out, canceling any potential load-fire coupling benefits. Additionally, any extra strain on the calf from the landing will tire the calf, naturally decreasing its potential to give back energy through the toe-off. Strong quads are then also important for a proper toe-off, as they will support much of the load of the body, leaving the calves available for propulsion rather than support.

## Pull Through

When training the body, it is said that increases in performance come during the recovery phase, rather than during the actual training bout. The same principle can be applied to the running stride; the increases in stride efficiency will come from the recovery phase of the stride, or how fast you can get the leg through in order to begin the next preparation-propulsion-pushoff cycle.

The pattern of movement for the pull through phase can be classified simply by the mnemonic “heel up, toe up, knee up.” This, again, emphasizes the need for a toe-off motion in completing the propulsion phase of the stride. The “heel up” begins with the toe-off creating the heel to rise, and continues with the need to get the heel to the upper thigh as quickly as possible. This will shorten the lever that needs to be brought forward, creating a faster pull through phase.

The toe up and knee up basically occur at the same time (keep in mind that all three of these events happen nearly simultaneously, as the goal is to have them occur as quickly as possible). As the heel is being brought to the upper hamstring, the knee is already being driven forward. As the foot swings through, it is then dorsi-flexed (toe up), and placed in the position it will remain in until contact with the ground. This flexing of the anterior shin muscles also helps begin the flexing of the knee.

Bringing the knee up is almost a misnomer, as it gives the illusion that the goal is to create a vertical component of movement. However, the primary thought behind “knee up” is in allowing the lower leg a slight amount of extra time to fall down into position for the landing. In essence, this is merely a slight pause in the motion of the upper leg while the lower leg uncoils.

### Drills

- PULL THROUGH -

**carioca**  
The major action in this drill is the quick raising and lowering of the back-side leg. The emphasis on quickness and raising the leg will greatly involve the hip flexors, which are the primary movers in the pull through phase.

**walk-through lunges**  
When beginning the walk-through motion, the pattern of movement mimics running. The need for getting the leg through quickly is important in this drill because if you don't you will fall; essentially the same as in running.

**'B' mechanics**  
Especially when doing drills such as continuous fast leg, these drills can place an emphasis on leg recovery. To focus on the pull through phase, begin with the hip fully extended, and do heel up, toe up, knee up as quickly as possible.

**'A' & 'C' mechanics**  
Both of these drills are involved with this phase of running because of their involvement with strengthening the hip flexor muscles. For best results, focus on quickness of hip flexion.



The reasoning behind bringing the leg as close to the body involves more than just creating a shorter lever for quicker movement. By bringing the lower leg up against the upper leg, the hip flexors (a traditionally weaker muscle) do not need to exert as much force during the pull through phase. Instead, the hamstrings help support the weight of the lower leg during this phase. Raising the leg higher will also make the legs less of a rotational force. Because of this, the upper body does not need to counteract as much rotary movement, allowing for a more forward-focused movement. A strong core will assist even more with this process, as it will provide additional inhibition of rotary movement through its stabilization properties.

## Percussion

The final “P” of the running stride is percussion. This is merely a means of self-check in the absence of technical coaching and/or video equipment. Looking in a mirror does not provide great feedback, as a head-on mirror will reflect too small an image and not allow adequate time to get to a cruising speed (when a patterned stride occurs). A mirror on the side requires a turn of the head, which is not a natural part of the running stride, and will therefore provide inaccurate assessments of form.

Energy cannot be created nor destroyed, it merely changes forms during its existence. One of these forms is movement, and another is sound. Optimally, while running, the goal is to put complete energy into movement. This, then, leads to the assumption that the most efficient stride will also be the quietest (assuming all other things are equal). The sound produced by your feet hitting the ground is a transfer of energy your body is producing to the noise you hear, and is a result of the vertical component of force you place into the ground (and it conversely gives back to you). In a gravitational environment, some vertical component will always be necessary, so some sound will occur. The goal is to simply minimize it.

### Drills

running

From one thing evolves another, and such is the whole of the running motion. As running is a cyclical pattern, an error can compound itself many times over. Ultimately, the most basic test of form is the sound the foot makes with the ground. Any noise is a transfer of energy in a downward motion, rather than the forward motion of running.

PERCUSSION

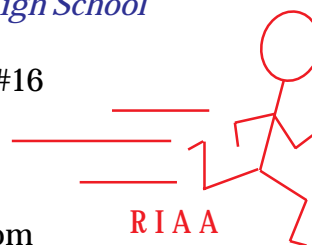


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**Business Card**

*(cut out for future reference)*

*This is a typical mesocycle my athletes would go through. The balance between the running, weights, and drills were all taken into consideration in order to allow for proper adaptation without overtraining. Adjustments to be made per individual athlete. If not during the competitive season, the only differences would be in the final Thu-Sat; these days would change to copy the previous week's Tue-Thu pattern.*

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
<b>Run:</b> 10k pace workout <b>Weights:</b> upper <b>Drills:</b> part of warmup	<b>Run:</b> Easy <b>Weights:</b> light lower <b>Drills:</b> stretch, mobility	<b>Run:</b> VO <sub>2</sub> max pace workout <b>Weights:</b> upper <b>Drills:</b> part of warmup	<b>Run:</b> Easy <b>Weights:</b> medicine ball core work <b>Drills:</b> stretch, mobility	<b>Run:</b> easy (after weights) <b>Weights:</b> heavy lower, power <b>Drills:</b> part of warmup	<b>Run:</b> 5k pace workout <b>Weights:</b> none <b>Drills:</b> part of warmup	<b>Run:</b> Easy <b>Weights:</b> none <b>Drills:</b> stretch, mobility
<b>Run:</b> 3k pace workout <b>Weights:</b> upper <b>Drills:</b> part of warmup	<b>Run:</b> Easy <b>Weights:</b> light lower <b>Drills:</b> stretch, mobility	<b>Run:</b> Long Run <b>Weights:</b> medicine ball core work <b>Drills:</b> nutrition replacement	<b>Run:</b> Easy <b>Weights:</b> medicine ball core work <b>Drills:</b> stretch, mobility	<b>Run:</b> (PM) Easy <b>Weights:</b> (AM) heavy lower, power <b>Drills:</b> part of warmup	<b>Run:</b> VO <sub>2</sub> max pace workout <b>Weights:</b> upper <b>Drills:</b> part of warmup	<b>Run:</b> Easy <b>Weights:</b> none <b>Drills:</b> stretch, mobility
<b>Run:</b> 1500m pace workout <b>Weights:</b> upper <b>Drills:</b> part of warmup	<b>Run:</b> Easy <b>Weights:</b> light lower <b>Drills:</b> stretch, mobility	<b>Run:</b> 800m pace workout <b>Weights:</b> upper <b>Drills:</b> part of warmup	<b>Run:</b> Moderate <b>Weights:</b> medicine ball core work <b>Drills:</b> stretch, mobility	<b>Run:</b> Easy <b>Weights:</b> light medicine ball core work <b>Drills:</b> after run; stretch, mobility	<b>Run:</b> Goal Race <b>Weights:</b> none <b>Drills:</b> part of warmup; stretching, mobility after cooldown	<b>DAY OFF</b> <i>*only if sufficient cooldown yesterday</i>

*(Note: Races can be substituted for Saturday workouts, provided they meet the goal of the training session.)*