



Performance Principles

Scientific research has confirmed that the following principles, when utilized synergistically, will stimulate one's ability to achieve peak athletic performance.

- **Progressive Overload**

The load or amount of weight lifted for each exercise is the most fundamental component of a strength and power training program. The application of the load has a crucial impact on the specific development of certain neuromuscular qualities. When muscles are stressed to a level beyond their normal training capacity overload occurs. This overload causes the active muscles to fatigue to a point of breakdown or catabolism. The body then responds, with the aid of proper nutrition and rest, by building up (anabolism) the affected muscles. It is this building up or anabolic phase that develops new strength, power, size and/or endurance within the muscles.

Intensity and volume are the key factors we manipulate to progressively control the overload of the neuromuscular system. By increasing the load we increase intensity, and by increasing repetitions we increase volume. Each of these methods brings about specific adaptations. Lifting heavy loads for low repetitions develops muscular strength; lifting varied loads explosively develops power; and lifting lighter loads for high repetitions develops muscular endurance.

- **Periodization Application**

Strength and power will eventually plateau and even diminish if the same combination of sets and repetitions are followed. The way we avoid this is by applying periodization or cycling to our training plans. Cycling uses different combinations of volume and intensity, or phases, each translating into different responses by the body. Traditionally, we begin a cycle with a base phase then progress to a strength phase and finish with a peak phase.

- **Split Routine**

Whether we prescribe a two, three or four days per week workout, we implement a split routine. A split routine simply means alternating the type of exercises performed and/or body parts trained on alternate days. An example being perform explosive lifts on Mondays and Thursdays and slower strength lifts on Tuesdays and Fridays. Another example of a split routine would be to train chest, shoulders and triceps on Mondays and Thursdays, and legs, back and biceps on Tuesdays and Fridays.

The benefits of utilizing a split routine are that it allows for greater recovery between workouts, and allows for greater specialization or specificity.

- **Heavy - Lighter System**

We make more progress over longer periods of time if we do not work at maximum loads during each workout. The heavy-lighter system eliminates overtraining and mental burnout.

With it, there is only one maximum workout per week for each type of lifting and/or body part. The second day is a lighter workout, in which either the volume and/or intensity are reduced. With only one heavy workout a week for the explosive exercises and one for the strength exercises, we will be ready both physically and mentally, as the loads become greater. Generally the first workout(s) of the week are the heavy days (the body is less fatigued after a weekend of rest), and the last workouts are the lighter.

• **Specific Energy System Training**

The primary objective of conditioning is to improve the energy capacity of an athlete to improve performance. For effective conditioning, training must occur at the same intensity and duration as the athlete competes in order to develop the proper energy system predominately used (training specificity).

ATP, or adenosine triphosphate, is the immediate energy source for all muscle contractions. It comes from the breakdown of the food we eat. It is supplied by the interaction of three types of energy systems. The first system is the ATP-PC system. High intensity, short duration activities such as the 40-yard dash or push press are performed using energy from this system. Energy is supplied immediately, and the amount of force generated from the muscle contraction is high, but the amount of energy readily available is limited and ATP is depleted within approximately six to ten seconds.

The second energy system is the lactic acid system (glycolysis). The amount of force generated by this system is less than from the ATP-PC system. This system has two phases. During the first phase ATP is produced from the breakdown of glycogen in the absence of oxygen and a metabolic byproduct called lactic acid is produced. The highest accumulation of lactic acid is reached during activities that last from one to three minutes. Too much lactic acid builds up when the energy system is depleted. This causes pain which results in a loss of coordination and force production like often happens at the end of a 400 or 800 meter run.

The third system is the aerobic system. This system is more specific to the slow twitch muscle fibers used during activities requiring endurance over a long duration at a low intensity. After about three minutes of low intensity exercise, ATP is almost completely supplied from the aerobic system.

As you can see, which system ATP is supplied from depends upon the intensity and duration of the exercise. The first step we use in setting up a conditioning program is to determine the energy system used by the activity according to the intensity and duration of it. Then a similar type of activity is used for conditioning. That way the proper energy system will be trained.

• **Multiple Joint Actions**

In order to optimally develop athleticism our strength and conditioning programs are based on exercises and drills involving multiple joint actions. Sport skills such as jumping, running, or taking on an opponent require multiple joint actions timed in the proper neuromuscular recruitment patterns

An example of this multiple joint action is the execution of the hang clean. It requires joint actions at the hips, knees, ankles, shoulders, elbows and wrists to work together as a unit generating explosive force. Isolating a single joint action might work for body building to target a single muscle, but athletes need to concentrate on activities involving multiple joint actions to improve functional strength and performance.

• **Ground-Based Exercises**

The majority of sport skills are initiated by applying force with your feet against the ground. When possible we select lifting exercises and conditioning drills that apply force with the feet

against the ground such as squats, lunges, hang cleans, push presses or plyometrics. The more force our athletes can apply against the ground, the faster they will run, the higher they will jump and the more effective they will be in sport skills.

• Explosive Movements

Strength gains are not only determined by the size of the muscles, many times an athlete will get stronger because of an improved ability of the nervous system to recruit motor units. A motor unit is a motor nerve and all the muscle fibers that it innervates. The more fibers a motor unit consists of, the more force it can generate. Through both heavy training (=>80% of max) and explosive training the body learns to recruit more motor units so that more force can be generated.

The amount of force required for a given activity is regulated by the use of two different types of motor units found in the body, fast twitch and slow twitch, which vary greatly in their ability to generate force. The number of fibers a fast twitch motor unit innervates is greater than that of a slow twitch, and the contractile mechanism of fast twitch muscle fiber is much larger. These factors combined mean a fast twitch fiber generates a force four times greater than a slow twitch fiber. Training explosively and/or heavy allows more fast twitch muscle fibers to be recruited and in return improves an athlete's performance potential.

• 3-Dimensional Movement

Sport skills involve movements in the three planes of space simultaneously: forward-backward, up-down, and side to side. Our strength and conditioning program improves functional strength and power with exercises and drills approximating these 3-dimensional skills.

In strength and power training, only free weights allow movement in three dimensions simultaneously. This makes the transfer of strength and power easier to merge with the development of sport skills. Machines limit the development of sport skills. For example, when you use free weights, the muscles regulate and coordinate the movement pattern of the resistance, while machines use lever arms, guide rods, and pulleys to dictate the path of the movement. An additional benefit from using free weights is their ability to help prevent major joint injuries. The smaller synergistic muscle groups involved in free weight exercises develop joint integrity better than machines do due to the balancing action required with free weights. For example, squatting using free weights requires the back and abdominal muscles to stabilize the torso isometrically. This allows the legs and hips to work with the back and abdominals as a unit to perform the lift. Whereas the adjustable seat back on the hip sled or leg press substitutes as the back and abdominal stabilizers restricting movement and isolating muscle contractions to the hips and legs.

When we develop a running program, explosive footwork and agility drills, similar to specific sport movements are used. It is important for our athletes to be quick and to possess breakaway speed, but they must be able to control their bodies and execute change of direction quickly on the field or court to be effective.

• Interval Training

Our conditioning programs are based on interval training principles. Interval training is work or exercise followed by a prescribed rest interval. Our programs meet the specific conditions for each sport. With interval training we stress not only the work phase but also the recovery phase between work intervals. If the rest period is too short, the amount of energy is not sufficient to meet the demands of the next maximum intensity effort, and force output will be reduced. The higher the exercise intensity the longer the recovery phase should be in relation to work time.

Ideas borrowed from:

University of Nebraska, *Husker Power Performance Principles*, 1997.

Hatfield, Frederick C. 1997. *Powerlifting and Speed-Strength Training*.

<http://www.sportstrength.com/1speed.htm>

NSCA, *Essentials of Strength Training and Conditioning*, 1994.