April 2002
Volume 1, Number 4
www.nsca-lift.org/perform

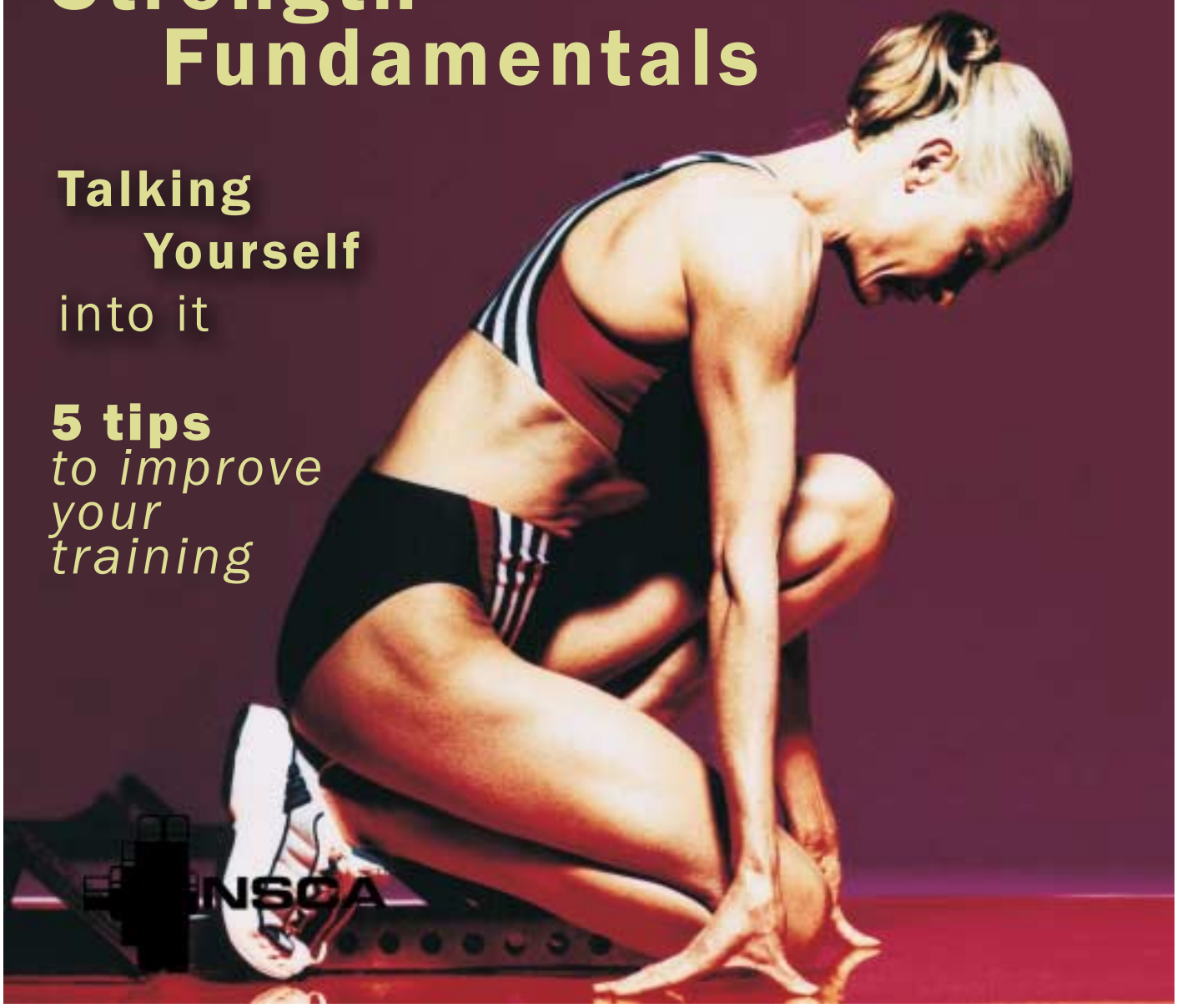
NSCA's

Performance Training Journal

Strength Fundamentals

Talking Yourself into it

5 tips *to improve your training*



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NSCA's Performance Training Journal

NSCA's Performance Training Journal is a publication of the National Strength and Conditioning Association (NSCA). Articles can be accessed online at **http://www.nsca-lift.org/perform**.

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Mission

As the worldwide authority on strength and conditioning, we support and disseminate research-based knowledge and its practical application to improve athletic performance and fitness.

AskTheExperts

Q. "I don't have a lot of time to work out. How can I make the most of my time in the gym?"

A. Here are five tips for maximizing your workouts:

1. **Find a training partner.** A training partner can help you reach your goals by giving you that extra push when you don't want to push, give you physical support as well as mental support, and help you stay focused during a workout. The best training partner will have goals similar to your own.
2. **Vary your routine.** Variety in training helps prevent burnout, staleness and boredom, and will prepare your body for a variety of challenges and activities. Variety in your exercise routine will also continue to stimulate your muscles or cardiovascular system, preventing you from over-training or reaching an unwanted plateau.
3. **Get adequate rest/recovery.** Recovery between sets will help you attain your goals. Rest between workout days will allow your body to repair itself before the next workout, and will help prevent over-training. Symptoms of over-training include elevated resting heart rate, emotional and sleeping disturbance, diminished appetite, plateau in workouts or a decrease in workout results, feeling of exhaustion on an average day, and increased frequency of illness.
4. **Use weight belts only when necessary.** Weight belts should be used only when lifting near or at maximum weight. Take the weight belt off between sets, or at least loosen the belt. If weight belts are used when lifting light loads, they prevent your core musculature from gaining the strength needed to keep your torso stable during everyday use.
5. **Water, water and more water.** Nothing out there can replace water., and proper hydration throughout the day will benefit your workout. Drink water between sets and exercises—don't wait until you are thirsty to get a drink.

About the Author

Brian Newman, MS, CSCS, earned a B.S. from the University of Southern Mississippi in Coaching and Sports Administration and an M.S. in Exercise and Sport Science from Colorado State University. Brian is the Senior Education Programs Coordinator at the NSCA, and serves as a personal strength and conditioning coach for junior high and high school athletes.

TalkToUs

Share your questions and comments. We want to hear from you. We will choose one question each month for the "Ask the Experts" column. Write to *Performance Training* Editor, NSCA, 1955 North Union Blvd., Colorado Springs, CO 80909 or send email to webmaster@nsca-lift.org.

FitnessFrontlines

Edmund R. Burke, Ph.D., CSCS

Runners' anemia . . .

Runners' anemia is caused by the pounding of the feet on pavement. Symptoms include an increase in plasma with disintegration of red blood cells, and in long-distance runners, gastrointestinal blood loss. This syndrome was probably first noted in 1881 when a German soldier passed dark urine after long strenuous field marches. It was documented in 1943 through studies of long-distance runners, but it was not until 1964 that an explanation was provided. It was suspected that forceful striking of the feet destroyed red blood cells in two track runners. Runners' anemia is often elusive in the diagnosis process as symptoms may indicate a wide spectrum of possible diagnoses. This article works with a case study of a female patient suffering from eight years of chronic fatigue that occurs at the end of a normal working day. Her normal exercise regimen included an eight-kilometer run every other day. She was eventually diagnosed with Runners' anemia after numerous diagnostic tests over a long period of time. Recognition of the symptoms of Runners' anemia is important in exercisers with a complex presentation of anemia and chronic fatigue. Reaching a diagnosis at an earlier stage may circumvent many diagnostic tests, as well as reassure the runner and avoid unnecessary therapies. The author suggests that individuals with mild anemia that is tolerated by an avid runner should raise the possibility of a diagnosis of Runners' anemia.

The Journal of the American Medical Association. 286(6): 714 - 716, 2001

Strength key to throwing performance?

Can weight training improve baseball players' throwing speed? Researchers from the University of Sydney, Australia, showed that 71% of the variation in throwing speed of adolescent baseball players, ages 13 to 16, could be explained by measuring the isometric (static) strength of the shoulder internal rotators and the concentric strength of the elbow extensors. In other words, the greater the strength in these particular areas, the faster the player could throw a ball.

Physical Therapy in Sport 2(3): 123-131, 2001

Benefits of corporate fitness . . .

Despite the prevalence and popularity of corporate wellness programs in America, documentation regarding their effectiveness has managed to remain a bit elusive. Now there is a growing body of evidence to support the fact that such programs are doing exactly what they're intended to do—i.e., reduce healthcare costs. A new study conducted at a Xerox Corp. manufacturing complex in Rochester, NY, has found that employees who participate in a corporate wellness program can significantly reduce the frequency, seriousness, and corresponding costs of work-related injuries. The study, published in the *Journal of Occupational and Environmental Health*, examined on-the-job injuries of over 3,000 Xerox workers between 1996 and 1999. Approximately one-third of the workers had taken part in the company's health risk appraisal program—a key component of its wellness plan. Of those who took part in the appraisal, only 5.6% made workers compensation claims, compared with 8.9% of the non-participants. The former group also had a lower average cost per injury—$6,506 versus $9,482 for non-participants. According to an estimate by the National Safety Council, in 1999, on-the-job injuries cost the American economy $125 billion, including $62 billion in lost wages and productivity and $19.9 billion in medical costs—or approximately three times as much as the cost of workers compensation insurance for that year.

Club Business International, February 2002, page 21

About the Author

Edmund R. Burke, Ph.D., CSCS, is Professor and Director of the Exercise Science Program at the University of Colorado at Colorado Springs. He served as Coordinator of Sports Sciences for the U. S. Cycling Team leading up to the Olympic Games in 1996 and was a staff member for the 1980 and 1984 Olympic Cycling Teams. Dr. Burke is a Fellow of the American College of Sports Medicine and a Certified Strength and Conditioning Specialist (CSCS) with the NSCA. He has authored or co-authored fifteen books on training, fitness and nutrition.

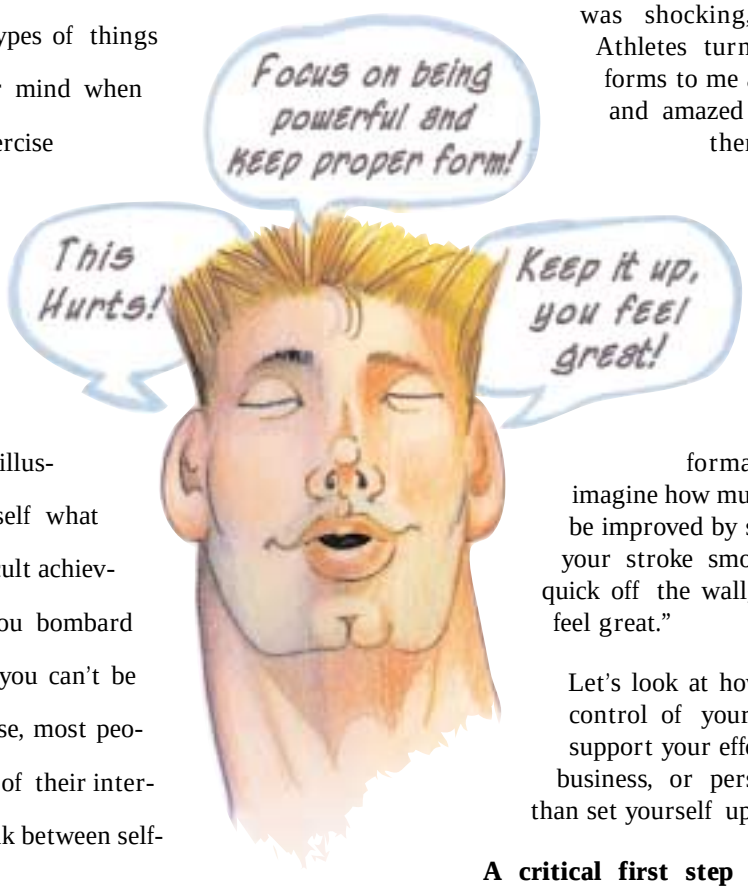
Suzie Tuffey, Ph.D., NSCA-CPT

Talking Yourself into It

"I'll never make this putt . . . win this point . . . be able to hold this pace."

"I've never lifted this much before; there is no way I can do it."

Do you find yourself saying these types of things in your mind when you exercise or participate in a sport? Is this type of internal self-talk familiar to you? Do you tend to do a great job of telling yourself all the things you can **not** do (as the examples above illustrate) as opposed to telling yourself what you can do? It becomes very difficult achieving your athletic goals when you bombard yourself with the message that you can't be successful. To make matters worse, most people are unaware of the negativity of their internal dialogue and do not see the link between self-talk and performance.



I was involved in a study of swimmers looking at self-talk in training—but the swimmers were unaware of what we were studying. They were asked to complete a test set of 6 x 200 meter swims on increasingly faster intervals. They were then asked to try to recall their self-talk on each of the 6 intervals. The self-reported feedback was shocking, to say the least! Athletes turned in the completed forms to me and were embarrassed and amazed at how they talk to themselves— saying things like "This hurts"; "I hate this"; "There's no way I can continue to go faster." This type of feedback to oneself certainly does not help performance. One can only imagine how much performance would be improved by self-talk such as "Keep your stroke smooth and steady," "Be quick off the wall," or "Keep it up, you feel great."

Let's look at how you can take better control of your internal dialogue to support your efforts, whether in sport, business, or personal matters, rather than set yourself up for defeat.

A critical first step is to increase your awareness—of both what you say and the situations that seem to trigger negative self-talk. Random and purposeful internal "ramblings" are going on all the time; the challenge is to become more aware of the times when negative, defeatist talk rears its ugly head. For example, you may find that negativity is triggered by defeat (losing a point in tennis, slicing a drive in golf), new chal-

lenges (attempting a Personal Best lift), or discomfort (working hills in cycling or threshold training).

The next step is to figure out what you would rather be saying to yourself in these situations. Instead of telling yourself "I hate squats; my legs are weak" how about "focus on being powerful and keep proper form?" Or, instead of "this hill is going to kill me," you could be telling yourself "slow and steady." The key is to identify more productive self-talk— figure out the internal dialogue that is more likely to help your performance.

The last step is to replace your negative talk with the more productive talk that you have identified. You can be proactive and use your identified positive self-talk when you find yourself in one of your "trigger situations"—the key is to use it before the negative self-talk manifests itself. For example, every time you ride or run towards a hill, tell yourself "slow and steady" throughout the hill. There will be no "mental room" to tell yourself how much hills hurt.

Or, when you find that your self-talk is already destructive, cue yourself to STOP this thinking then replace this mental "void" with the more positive self-talk you have already identified. I find it much more productive to replace positive self-talk rather than simply trying to clear your mind of the negatives as this void in thinking is tough to maintain.

Now, it is time for you to give it a try. Discipline your thinking so you are your own best friend. You know the saying ... "if you think you can or think you can, either one is probably true." Start thinking that you can.

About the Author

Suzie Tuffey received her Master's and Ph.D. in Sport Psychology/ Exercise Science from the University of North Carolina-Greensboro. She has worked for USA Swimming as the Sport Psychology and Sport Science Director, and now is Associate Director of Coaching with the USOC where she works with various sport national governing bodies (NGBs) to develop and enhance coaching education and training. Additionally, Suzie is an NSCA-certified personal trainer.

Basic Principles of Strength Training and Conditioning

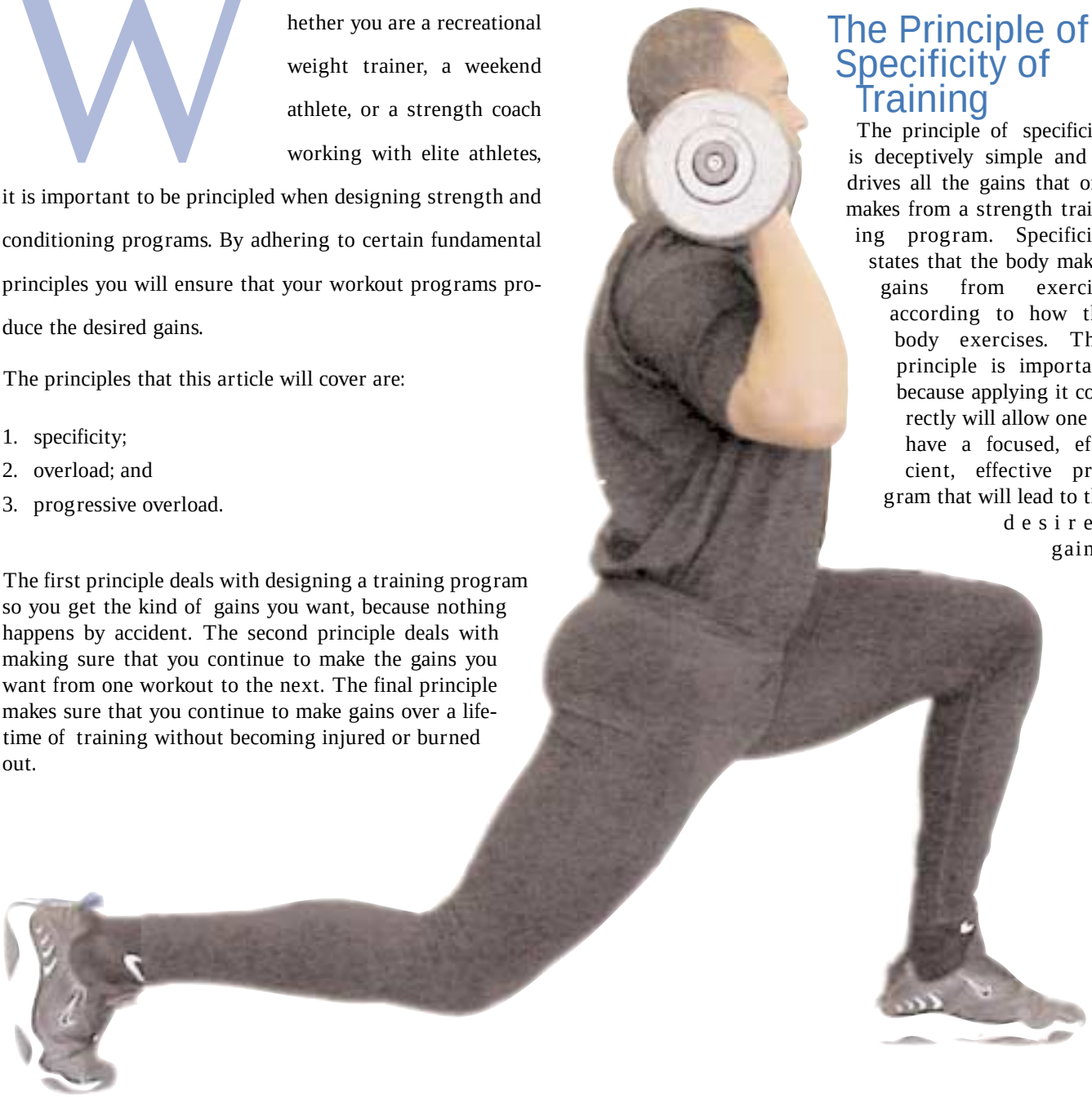
John M. Cissik, MS, CSCS

Whether you are a recreational weight trainer, a weekend athlete, or a strength coach working with elite athletes, it is important to be principled when designing strength and conditioning programs. By adhering to certain fundamental principles you will ensure that your workout programs produce the desired gains.

The principles that this article will cover are:

1. specificity;
2. overload; and
3. progressive overload.

The first principle deals with designing a training program so you get the kind of gains you want, because nothing happens by accident. The second principle deals with making sure that you continue to make the gains you want from one workout to the next. The final principle makes sure that you continue to make gains over a lifetime of training without becoming injured or burned out.



The Principle of Specificity of Training

The principle of specificity is deceptively simple and it drives all the gains that one makes from a strength training program. Specificity states that the body makes gains from exercise according to how the body exercises. This principle is important because applying it correctly will allow one to have a focused, efficient, effective program that will lead to the desired gains.

Failing to apply it will result in wasted energy and time, and it will result in frustration as gains do not materialize.

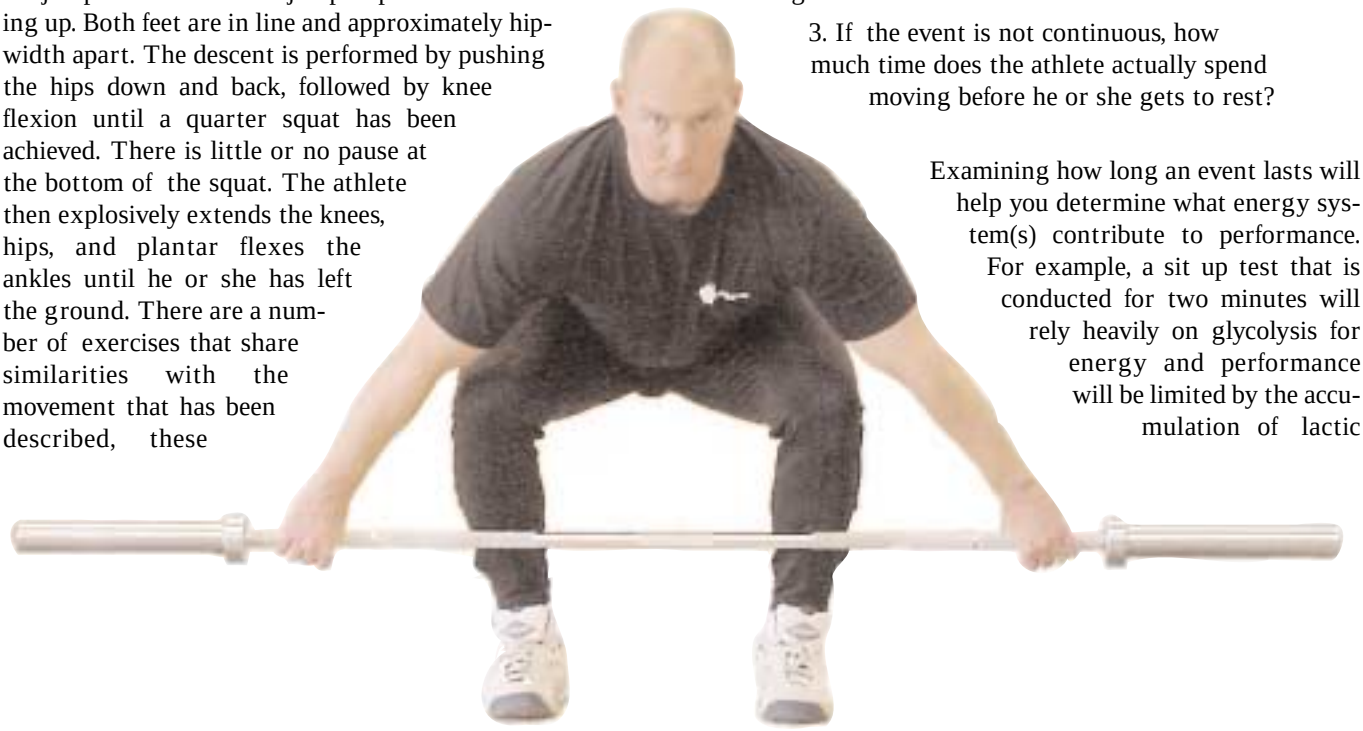
When developing a conditioning program, you should consider the following:

- the movements to be trained;
- the muscles and joints to be trained;
- the energy system(s) to be trained; and
- the speed of movement.

Strength and conditioning programs can be designed to enhance movements that are performed in athletics. This is important because this may improve an athlete's performance. It may do this by strengthening the movement; it may also accomplish this by allowing the athlete to practice the movement with resistance. It is also important because it can maximize an athlete's training time and be used to help prevent injuries in the athletic event. A number of questions should be considered to help with this:

1. Is the activity performed standing?
2. What joints perform the activity?
3. Do the joints work together or sequentially? If sequentially, what is the sequence of movement?
4. What motions are performed by each joint?

For example, basketball players want to become better vertical jumpers. The vertical jump is performed standing up. Both feet are in line and approximately hip-width apart. The descent is performed by pushing the hips down and back, followed by knee flexion until a quarter squat has been achieved. There is little or no pause at the bottom of the squat. The athlete then explosively extends the knees, hips, and plantar flexes the ankles until he or she has left the ground. There are a number of exercises that share similarities with the movement that has been described, these include: the back squat, the front squat, the power clean, the power snatch, and the jerk to name a few. While exercises like the leg extension and the leg curl may strengthen the knee flexors and extensors, they do not involve exerting force against the ground and do not prepare the athlete to use his or her hips, knees, and ankles together.



While movements are important, there are times when you may want to address specific muscles or joints in a conditioning program. This may be to prevent injuries, to rehabilitate injuries, or to achieve a certain appearance. For example, a baseball pitcher may want to train the rotator cuff muscles, or a sprinter may want to address the hamstring muscles. You may want to target certain muscles to make them hypertrophy for appearance, for example a body builder's biceps. While movements are important for designing a conditioning program, addressing specific muscles or joints may be necessary at times.

Addressing movements, muscles, or joints assists with selecting exercises. Things like workload, rest, and intensity are driven by the energy system(s) that you want to train. Energy system training is critical to improving athletic performance. Often performance is limited by your energy stores and your ability to replenish them, both of which are trainable. You can design conditioning programs to enhance the energy system(s) that are used in an athletic event. To do this, consider the following:

1. How long does the event last?
2. Is the event performed continuously? Or does the athlete get to rest?
3. If the event is not continuous, how much time does the athlete actually spend moving before he or she gets to rest?

Examining how long an event lasts will help you determine what energy system(s) contribute to performance. For example, a sit up test that is conducted for two minutes will rely heavily on glycolysis for energy and performance will be limited by the accumulation of lactic

acid. A hundred meter sprint that lasts ten seconds will rely heavily on the available stores of ATP and will be limited by the amount on hand.

The length of the event can be deceptive, however. For example, a football game might last two hours. Just looking at the length of time might seem to indicate that the aerobic energy system needs to be trained for football players. In this case one needs to consider if the athletes are moving continuously. In the case of football the answer is no, the athletes rest between plays and have a chance to recover their energy stores. In this case one should consider how much time the athlete actually spends moving before they get to rest. The average play may only last five or six seconds, which would indicate that the sport is primarily dependant upon the levels of ATP in the muscles.

Energy system training is an important consideration because it helps to dictate how much weight to use, how many repetitions to perform, and the amount of recovery time. If you are interested in increasing the stores of ATP, then training will involve heavy weight, low repetitions, and lots of rest. Glycolytic training will involve moderate reps, moderate weight, and little rest. Aerobic training means lighter weights, many repetitions, and no rest.

A final consideration with specificity concerns the velocity of movement. The gains from exercise are specific to the velocities that the exercises are performed at. If exercises are performed at slow speeds, then we become stronger at slow speeds; however, there is little transfer to faster speeds. If exercises are performed at faster speeds, then we become stronger at faster speeds. This is important for athletics because few sports are performed at slow speeds.

If one is designing a conditioning program for a sport that is performed at high speeds, then one will need to include exercises that make athletes stronger at high speeds. These include things like the variations of the Olympic-style lifts (the clean, the snatch, and the jerk), plyometric exercises, and sprints.

The principle of specificity is important because it dictates what gains are made. The next principle is important because it ensures that you continue to make gains from your training.

The Principle of Overload

The overload principle states that in order to keep making gains from an exercise program, you must find some way to make it more difficult. This is because bodies adapt to exercise. The problem is that once your body adapts to a given workload, it will not continue to adapt unless the workload is increased somehow. If you do not continue to adapt, then eventually you will plateau and regress.

Having stated that it is necessary to make conditioning programs more difficult, one caution should be kept in mind: you must observe specificity when applying the overload principle. Performing a set of twenty might be a way of making the workout more difficult, but if you need to enhance the phosphagen energy system then you are violating specificity.

There are a number of ways to apply the overload principle to a strength and conditioning program:

1. increase the weight lifted;
2. increase the volume of work;
3. change the exercises employed;
4. modify the order of the exercises; and
5. alter the rest periods.

Increasing the weight that is lifted will make the workout more difficult. Heavier weights will force your muscles, connective tissue, bone and nervous system to adapt. Lifting heavier weights will also cause you to initially perform fewer repetitions with the weight.

Increasing the volume of work—either number of sets, number of repetitions, or some combination thereof—will result in your body having to adapt to it. This is one of the main ways to elicit larger muscles and connective tissue adaptation from strength training. One should be careful with this method of applying overload; a volume that is too great will train the wrong energy system.

Changing the exercises employed is a way to increase overload that many individuals are reluctant to use. Many people feel that the exercises they are performing are the only ones that can elicit certain gains. This is not so. Changing the exercises has a number of benefits, including keeping the workouts interesting and requiring your body and nervous system to adapt to resistance imposed in a totally different way.

There are many exercises that train the same movement and the same muscle groups, this means that you do not have to rely on one exercise to train a given area. For example, the back squat trains the muscles of the hip, knee, and ankle in a manner that involves exerting force against the ground, it loads the bones of the vertebral column and lower body, and is performed standing up. There are a number of exercises that do the same thing and that may be substituted for the back squat:

- Pause squats;
- Eccentric squats;
- Front squat; and
- One-legged squats.

Any of the above exercises may be used to increase lower-body strength in a way that also loads the bones of the spine and lower body and is performed standing up.

The order that exercises are performed is another way to provide overload. By changing when exercises are performed, you make some exercises more difficult to perform and others easier. For example, in your current workout your exercise order may look like this: bench press, incline press, dumbbell flies. Now, let's change the order of exercises so that the new workout looks like this: dumbbell flies, incline press, bench press. The result of this change is that you will be able to lift more weight on the dumbbell flies and incline press, because they are performed while you are fresher. You will lift less weight on the

bench press, because it will be performed while you are fatigued. Not only will you become stronger on the first two exercises, but you will also keep your workouts interesting and this will also help your body to adapt in a different manner because you are focusing on the first two exercises instead of the bench press.

A final way to provide overload is to modify the amount of rest. This must be used carefully to ensure that you are observing specificity. By increasing the amount of rest in between sets, you allow your body to recover more completely. This means you will be able to lift heavier weights with a greater number of repetitions. The benefit oft this approach to training is that it allows you to increase your strength on exercises. Conversely, if you shorten the amount of rest in between sets, you do not allow yourself as much recovery. It becomes more difficult to lift a given amount of weight. While this does not do as good a job of increasing strength, it does force the muscles to grow to adapt to the rest period.

Overload is not something that only needs to be applied on a daily basis, it must be applied over a lifetime of training. The final principle deals with the importance of applying overload logically over time.

The Principle of Progressive Overload

Progressive overload involves two areas:

- The exercises that are employed in a training program; and
- The total amount of work that is done in a training program.

The exercises that are performed by an individual beginning his or her training career should be less complicated than one who has been training for a longer period of time. A beginner should be expected to master certain fundamental skills in the training program. Once those skills are mastered, they may be applied to more complicated exercises. Failure to master these skills may result in injury, wasted time in the weight room, and incomplete development. Two examples of learning fundamental skills before progressing to more complicated ones concern the back squat and the Olympic-style lifts:

- The back squat is typically learned before the front squat, overhead squat, or other variations. This is because the back squat teaches correct posture when squatting, foot placement, keeping the heels on the ground, squatting by pushing the hips back and then flexing the knees, ascending with the hips and shoulders moving up at the same speed, etc. If one does not posses those skills then the front squat, overhead squat, pause squat, eccentric squat, etc., will be much more difficult to learn.
- Generally the Olympic-style lifts are learned from the top down. This breaks down a complicated exercise and makes it easier to master. For example, by learning the power clean initially with the bar above the knees, we learn to explosively extend the hips while shrugging the shoulders up and plantar flexing the ankles. We learn to receive the bar in a quarter squat and how to recover from that position. This is difficult to learn. Adding correct starting posture with the bar on the ground, lifting the bar from the ground to the knees, getting the bar around the knees, and then explosively extending the hips while shrugging the shoulders up and plantar flexing the ankles will prove too much for many to master initially.

In order to make gains from training over time, you must find a way to perform more work. This may be more weight lifted, more repetitions performed, more sets, or some combination of the three. As we discussed in the overload section, this is necessary to keep your body making adaptations. This also needs to be conducted with caution, as progressing too quickly can result in injury and burnout. The best way to do this is to apply some type of systematic approach to training. The one most commonly used is periodization of training, which essentially consists of breaking the training process down into smaller, more manageable units. Periodization is a way to organize your training over your career; this includes the weight lifted, the volume of work, the exercises employed, rest, recovery methods, etc. All of this is done in a way that ensures that you are in the best possible shape when it counts—during the competition.

The principles of exercise that this article have covered are very important for making sure that you get the most out of your strength and conditioning programs. Applying specificity means designing conditioning programs to elicit the development of desired qualities. Applying overload means that strength and conditioning programs will be difficult enough to be effective. Applying progressive overload allows for strength and conditioning programs to be effective over your training career.

About the Author

John M. Cissik, MS, CSCS is the Director of Wellness Services at Texas Woman's University. He also owns and operates Fitness and Conditioning Enterprises, which provides speed and agility instruction primarily to children and teens. He is the National Strength and Conditioning Association's State Director for Texas.

Lee E Brown, Ed.D., CSCS,*D

Muscle Fiber Types

To paraphrase George Orwell, "All muscle fibers are not created equal, some are more equal than others." In the course of everyday life—and especially in sporting activities—we call upon our muscles to exert force against objects around us in order to complete functional activities or perform in athletic events. Each muscle in our body is made up of many thousands of individual fibers. They are bundled together in units of 10 to 1,000 and each bundle is controlled by one nerve.

Simply stated, these units receive a signal from the brain and then contract to make themselves shorter. Each unit is connected to a neighboring unit, so in the course of thousands of individual fibers contracting, the entire muscle contracts. The muscle is connected to tendons, which are in turn connected to bones—thus we have movement of our limbs. This is skeletal muscle, and it is made up of two primary fibers called Type I and Type II that occur in varying percentages in every human being. There are many other sub-types, maybe as many as eight or ten[3], but they are primarily derivatives of either Type I or II and therefore we will confine our discussion to the major two.

Type I

Type I are also called Red, Small or Slow. These fibers are the first to contract when the brain sends a signal, thus the term Type I. They use oxygen gathered from the blood in metabolic processes (thus the term Red) and are designed to work repetitively (aerobic). They generally consist of only a few number of fibers per unit and contract at a gradual rate when stimulated, thus the terms Small and Slow respectively. Because they contract slowly and contain only a small number of fibers per unit their capacity to produce force or velocity is very limited—but they can produce low levels of each for long periods of time. Type I fibers are the workhorses of daily life because they are constantly contracting at a submaximal rate in order for us to accomplish all the every day activities required of us. They are used in sports for long repetitive bouts of exercise such as long distance running or cycling or swimming. Therefore, Type I fibers are primarily used during long duration aerobic activity involving submaximal force requirements[4].

Type II

Type II fibers are also called White, Large or Fast. They are the second to contract when a brain signal is received because they wait for the demands of the activity to exceed that of the Type I's, thus the term Type II. They work well in the absence of oxygen (White), contain many hundreds of fibers per unit (Large) and contract at a high rate of speed (Fast). Since they are both large and fast they are able to produce high force and velocity outputs, but since they contract in the absence of oxygen they can work for only brief periods of time. Therefore, Type II fibers are primarily used for short-term anaerobic emergency actions during daily life or explosive sporting activities such as jumping or sprinting or weightlifting[4].

Conclusion

Any particular individual's ceiling of human performance is to a large extent restricted by his or her relative percentage of each muscle fiber type. In other words, it may be that we do not pick the sports we participate in as much as the sports pick us based on our general muscle make-up. Laboratory procedures can be used to determine an individual's relative percentage of each type of muscle fiber[5] and it has been well documented that different fiber types will produce different levels of performance when asked to execute force[3] or velocity[1] specific activities. This information may assist in choosing a specific type of activity best suited to an individual's musculature.

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Strength, Size, or Power?

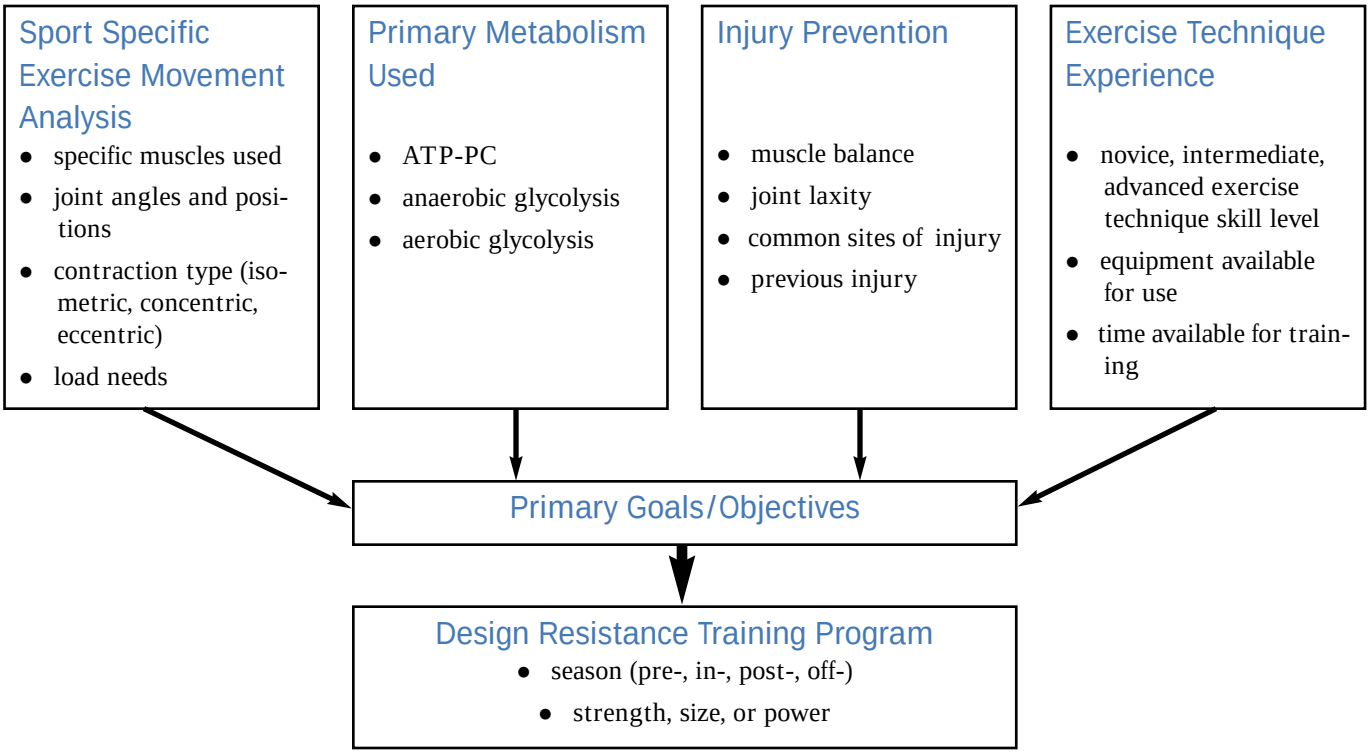
Helen M. Binkley, Ph.D., CSCS*D, NSCA-CPT

Which one are you training for—strength, size, or power? First, let's identify what each of these are. Strength is the ability to produce or generate force. Size, also referred to as hypertrophy, is the growth or enlargement of muscle. Power is the ability to produce or generate force quickly, which is a function of time and/or speed of movement. There are specific differences in training for strength, size, or power, even though at times there may be some overlap in your training related to your sport.

Strength

Strength, in some form, is involved in every sport. It is important to develop a general base strength, and then enhance the general strength with sport specific strength training. The strength training exercises selected should follow specific movement patterns and muscle actions that are involved in your sport. Muscular balance should also be considered when strength training to avoid injuries, especially not having one muscle or group of muscles significantly stronger than another. Strength training uses concentric (tension in a muscle as it shortens), eccentric (tension in a muscle as it lengthens) and isometric (tension in a muscle when the length does not change) muscle actions to produce strength gains. This type of training emphasizes the force produced and increases the activation of the neuromuscular reaction to build strength. One can become stronger without getting significantly bigger using this type of training. The

Figure 1: Needs Analysis for Identifying Primary Goals



Modified and adapted from Baechle and Earle[1], and Fleck and Kraemer[4].

movements that are most important to your sport should be emphasized early in the workout in order to focus on the skills most similar to the sport movement before the muscles become fatigued. Strength training uses heavy intensities of work, with low repetitions, moderate to high number of sets, with moderate to long rest periods (see Figure 2).

Hypertrophy

Hypertrophy training is best represented in the sport of bodybuilding (see photo). However, this type of training can also be used with beginning lifters to increase muscular development, with athletes that want to go up a weight class (in sports like boxing and wrestling), or with athletes such as football linemen and shotputters who will benefit from an increase in mass. Hypertrophy training uses a variety of exercises including isolation exercises with concentric and eccentric movement patterns using a variety of joint angles. Muscle groups that the athlete wants to emphasize are targeted first or very early in the workout. Hypertrophy training uses moderate to high intensities of work to the point of muscle exhaustion, with high repetitions, and back-to-back sets of exercises for the same muscle group, with short rest periods (see Figure 2). Hypertrophy can be used as part of the beginning phase of an off-season (2 - 4 weeks) and pre-season (1 - 2 weeks) training program in a year-round training program. If you want to get big, but you are not as concerned about absolute strength or power, then hypertrophy training is for you. If muscular strength and power are your primary concerns, then hypertrophy training should be kept to a minimum.

Power

Power training is used to cause an increased speed of movement and explosiveness in muscles generating a force; therefore strength and velocity need to be emphasized in this type of training. Power exercises help to enhance the nervous system and the coordination of muscle actions to become faster, smoother and more precise. There are many ways to train for power using concentric and eccentric exercises; plyometrics (an exercise where the muscle is loaded eccentrically followed by and

Figure 2: Summary of Training Types and Variables

Training Goal	Load (% 1RM)	Repetitions	Sets	Rest between Sets
Strength	≥85	≤ 6	2 - 6	2 - 5 minutes
Power				
Single-effort	80 - 90	1 - 2	3 - 5	2 - 5 minutes
Multiple-effort	75 - 95	3 - 5	3 - 5	2 - 5 minutes
Hypertrophy	67 - 85	6 - 12	3 - 6	30 seconds - 1.5 minutes

Modified and adapted from Baechle and Earle[1].

immediate concentric contraction, also know as the stretch-shortening cycle), and isokinetic exercises involving changes in the speed of movement through a motion with a constant resistance. Power training typically involves exercises that employ multiple joint movements (i.e. running, jumping, Olympic-type exercises such as the power clean, hang-pulls, snatches, push press, etc.). These exercises are performed early in the workout before other strength exercises. Power training uses high intensities of work, with low repetitions, moderate number of sets, with moderate to long rest periods between sets (see Figure 2). In order to improve power production, a base level of strength needs to be in place to increase performance and decrease risk of injury. Power training can be done year round. However, more emphasis may be placed on power toward the end of the off-season and during pre-season training because it prepares the body to respond and react in a way to mimic sports movements closer to the actual speed of performance.

Identify Primary Goal

In order to determine which one of these resistance-training programs is correct for you, identify your primary goal by evaluating your needs and objectives (See Figure 1). Even though you may have more than one goal, it is best to focus on one goal at a time. For example if you wanted to increase your size and strength, focus on hypertrophy first for a time (i.e. 4 - 6 weeks) and then switch to focus on strength (i.e. 4 - 6 weeks) after size has been developed. (Remember that hypertrophy and strength overlap—you cannot completely separate the two.) This gets into an area of training called periodization, which involves manipulating workouts in calendar time periods for specific goals and objectives[3]. A general seasonal guideline is indicated in Figure 4. So focus on your goals, know what you are training for and why you are training.

Figure 3: How to Test One Repetition Maximum (1RM)

1. Warm up with a light resistance that allows 5 - 10 repetitions easily.
2. Rest for 1 minute.
3. Estimate a warm up load that will allow 3 - 5 repetitions:
   - 10 - 20 lbs (5 - 10%) for upper body
   - 30 - 40 lbs (10 - 20%) for lower body
4. Rest for 2 minutes.
5. Estimate a conservative near maximum load that will allow 2 - 3 repetitions:
   - 10 - 20 lbs (5 - 10) for upper body
   - 30 - 40 lbs (10 - 20%) for lower body
6. Rest 2 - 4 minutes.
7. Add load:
   - 10 - 20 lbs (5 - 10) for upper body
   - 30 - 40 lbs (10 - 20%) for lower body
8. Attempt 1RM.
9. If successful, rest 2 - 4 minutes then repeat step 7 and 8.If unsuccessful, rest 2 - 4 minutes then subtract:
   - 5 - 10 lbs (2.5 - 5%) for upper body
   - 15 - 20 lbs (5 - 10%) for lower body

   and then go back to step 8.
10. Continue increasing or decreasing the load until 1RM can be completed with proper exercise technique. Typically this should be accomplished in 5 testing sets.

Figure 4: General Sport Season Training Focus

Sport Season	Actual Sport Practice Emphasis	Resistance Training Emphasis	Resistance Training Frequency	Focus of Resistance Training
Pre-Season	Moderate level	Moderate level	3 - 4	Sport-specific (strength, power, endurance) movements are emphasized.
In-Season	High level	Low level	1 - 2	Maintenance of pre-season goals.
Post-Season	Variable level	Variable level	1 - 3	May include a variety of any type of sport or movement skill. Also known as an active rest period with no specific training.
Off-Season	Low level	High level	4 - 6	Progression from hypertrophy and muscular endurance training to strength and power (specific to and dependent on sport).

Modified and adapted from Baechle and Earle[1].

Figure 5: A Sample Program Differentiating the Types of Training

Exercise Selected	Hypertrophy Training (load x repetitions x sets) (exercise order)	Strength Training (load x repetitions x sets) (exercise order)	Power Training (load x repetitions x sets) (exercise order)
Lower Extremity			
Back Squat	75 x 10 x 5 1	90 x 4 x 6 1	75 x 5 x 5 3
Dead Lift	75 x 10 x 5 3	90 x 4 x 4 2	75 x 5 x 3 4
Leg Press	67 x 12 x 4 4	90 x 4 x 6 3	No
Quadriceps Extension	67 x 12 x 4 2	85 x 6 x 4 4	No
Hamstring Curls	67 x 12 x 4 5	85 x 6 x 4 5	No
Calf Raise	75 x 10 x 6 6	85 x 6 x 6 6	No
Clean	No	No	80 x 3 x 4 1
Snatch	No	No	80 x 3 x 4 2
Upper Extremity			
Bench Press	75 x 10 x 4 1	90 x 4 x 6 1	75 x 5 x 5 2
Overhead Press	67 x 12 x 3 2	85 x 6 x 5 2	No
Bent-over Row	75 x 10 x 4 4	90 x 4 x 6 3	No
Lat. Pull-down	67 x 12 x 3 5	85 x 6 x 5 4	No
Biceps	67 x 12 x 4 6	90 x 6 x 4 5	No
Triceps	67 x 12 x 4 3	90 x 6 x 4 6	No
Wrist Curl	67 x 12 x 3 7	85 x 6 x 2 7	No
Push Jerk	No	No	80 x 3 x 5 1
	Rest 1 minute betw. sets	Rest 3 minutes betw. sets	Rest 5 minutes betw. sets

Performing a four-day split routine with upper extremity on Monday and Thursday, and lower extremity Tuesday and Friday. The exercises selected on this table are not all inclusive. This program is a sample of how to manipulate the load, repetitions, sets and exercise order to obtain the desired training results. Some exercises are performed in one type of training, but not necessarily in other types of training. A percentage of the 1RM is listed for the load. When "no" is next to an exercise, it would not typically be performed for that type of training session.

Designing the Program

Once a training program has been selected, one must design the actual program. To determine the intensity of each exercise you need to determine your one repetition maximum (1RM)(see Figure 3). From the 1RM, your weight load for a particular exercise is calculated based on a percentage of the 1RM. Your workouts will be designed based on the calculated weight loads. After training for a while (when the exercise becomes easier to perform, or when repetitions are completed with additional repetitions), it will become necessary for the intensity to change. A conservative method of increasing the weight load is the "2-for-2 rule." This suggests that when an athlete can perform two or more repetitions over their assigned repetition goal in the last set of the exercise for two consecutive workouts, weight should be added to that exercise for the next workout.[2] Using this rule will help to keep the training workouts progressing and maintaining intensity as strength, power and size are improved. A sample program differentiating the types of training is shown in Figure 5.

Summary

There is a specific use for training strength, size and power in sport. Knowing your sport and your goals will help to determine what you should focus on in your year-round training program. Hypertrophy for muscle growth, strength for generating force, and power for generating force with speed. For more information and direction in this area contact a local Certified Strength and Conditioning Specialist.

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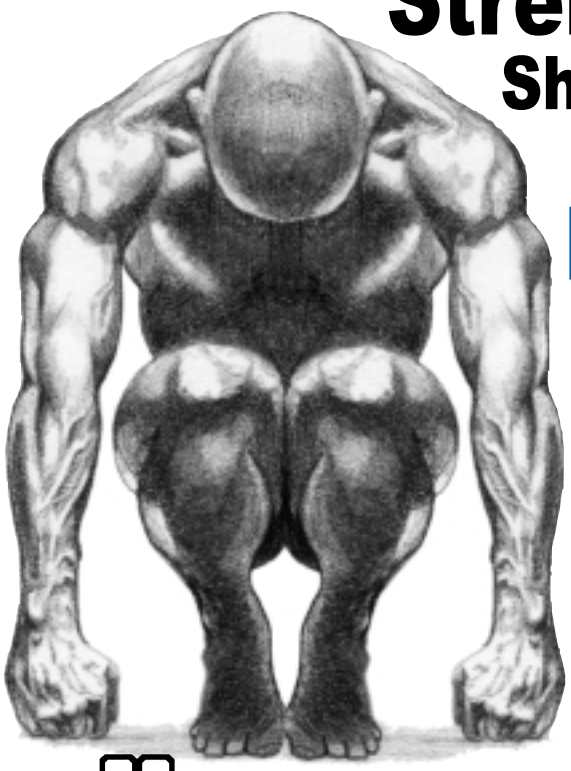

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