The National Strength and Conditioning Association's (NSCA)

BASICS OF STRENGTH AND CONDITIONING MANUAL

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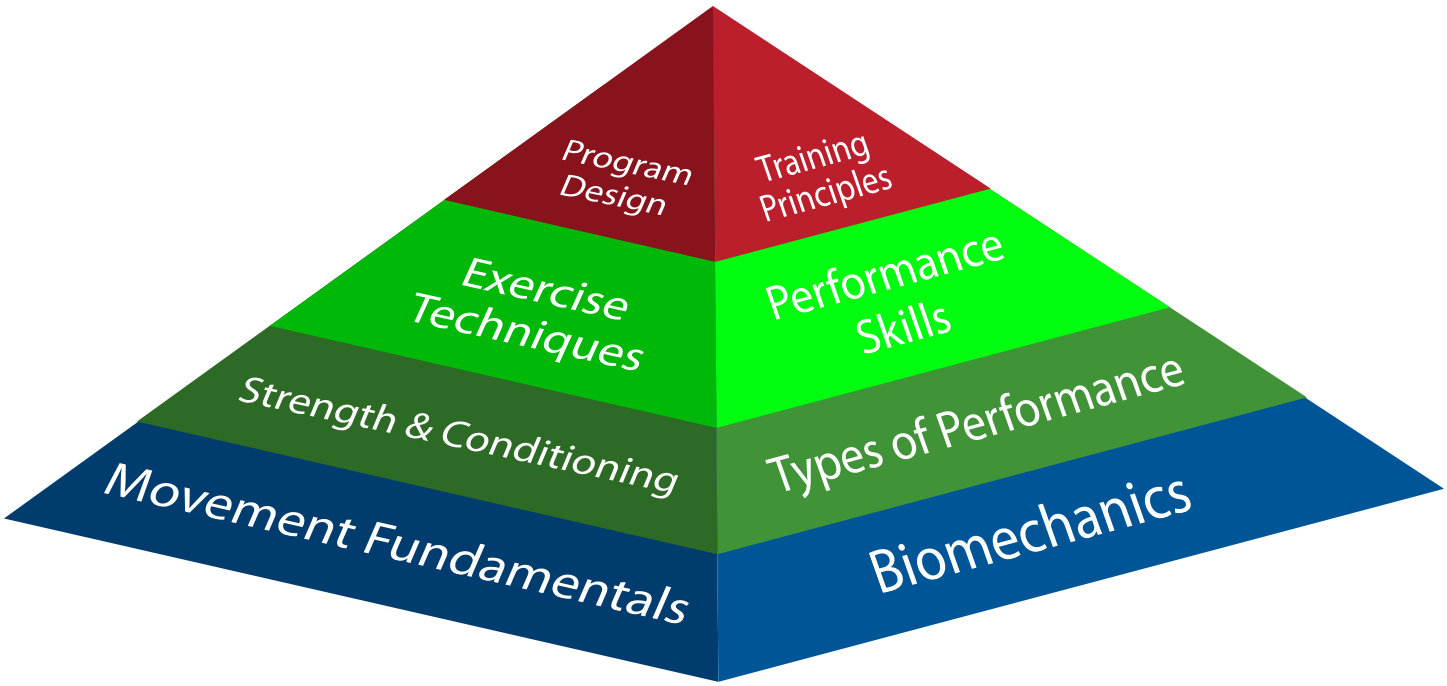


Performance Pyramid

Letter From the Founder

Dear NSCA Member:

The National Strength and Conditioning Association (NSCA) is excited to provide you with this Basics of Strength and Conditioning Manual. This manual is intended to assist Associate Members, however, it is available to all NSCA Members to help them learn the basic principles and movement fundamentals that should be included in every strength and conditioning program.

The first three levels of the Performance Pyramid covered in the Basics of Strength and Conditioning Manual will help prepare you to monitor or supervise strength and conditioning workouts. However, the NSCA highly recommends that any coach who wants to design or conduct an exercise program be CSCS® certified.

The top level of the Performance Pyramid is touched on briefly in the Basics of Strength and Conditioning Manual but to fully prepare for CSCS certification a coach would need to study the Essentials of Strength and Conditioning Text. In addition, certified strength coaches with two or more years experience can apply to be part of the NSCA's Registry of Strength and Conditioning Coaches (RSCC). Registered strength and conditioning coaches with 10 or more years of experience are classified by RSCC*D while RSCC*E indicates 20 or more years of experience and is the highest distinction a strength coach can achieve in the industry.

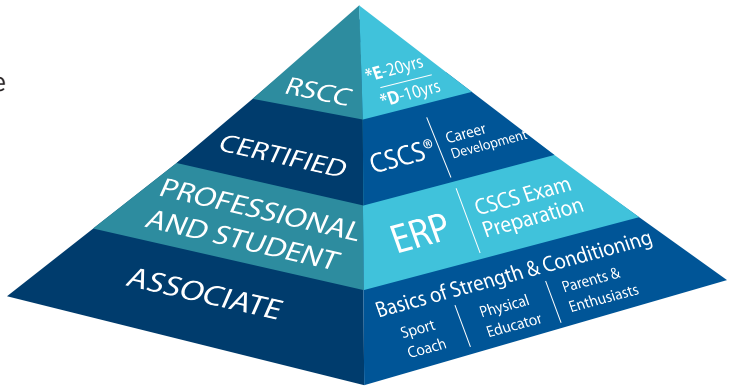
Please let us know if there is anything we can do for you as you move along the NSCA's Coaching Performance Path. More information can be found at NSCA.com.

Thank you for your support of the National Strength and Conditioning Association, and we wish you the best in your coaching endeavors.

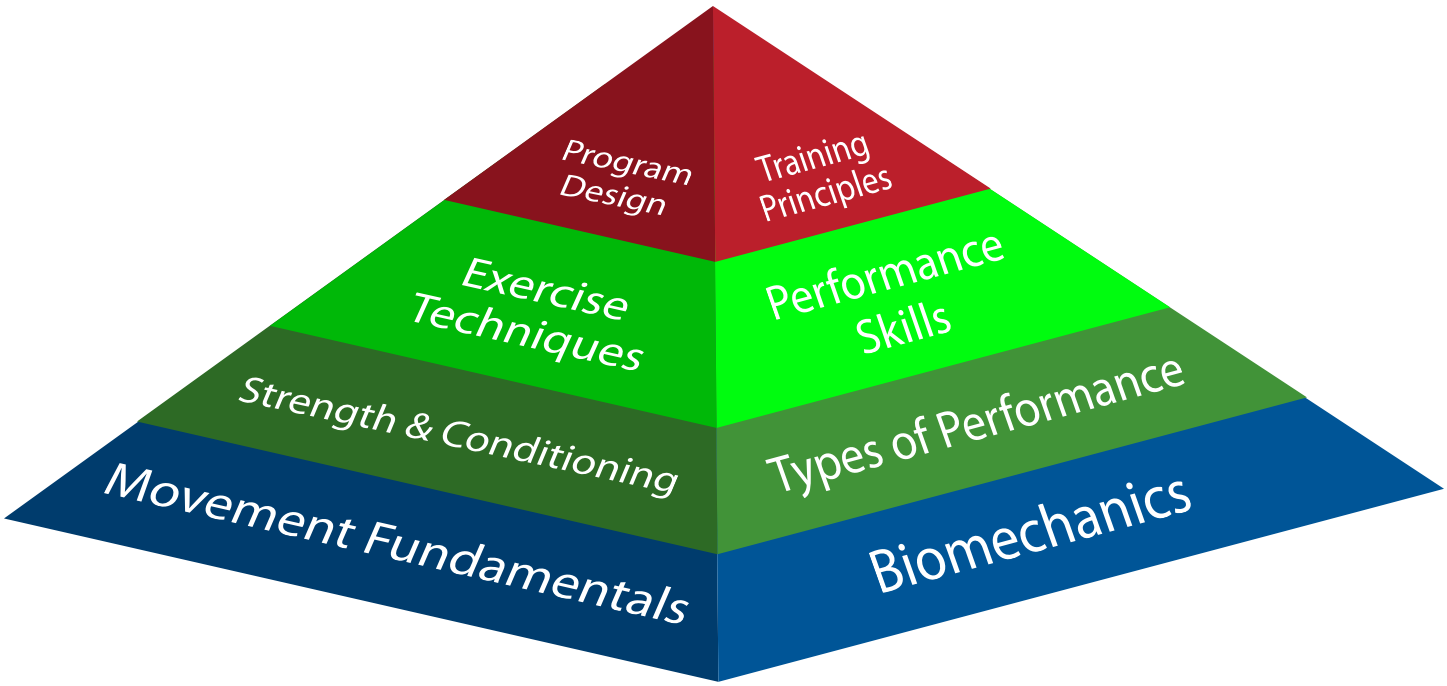
Respectfully,

Boyd Epley, MEd, CSCS,*D, RSCC*E, FNSCA

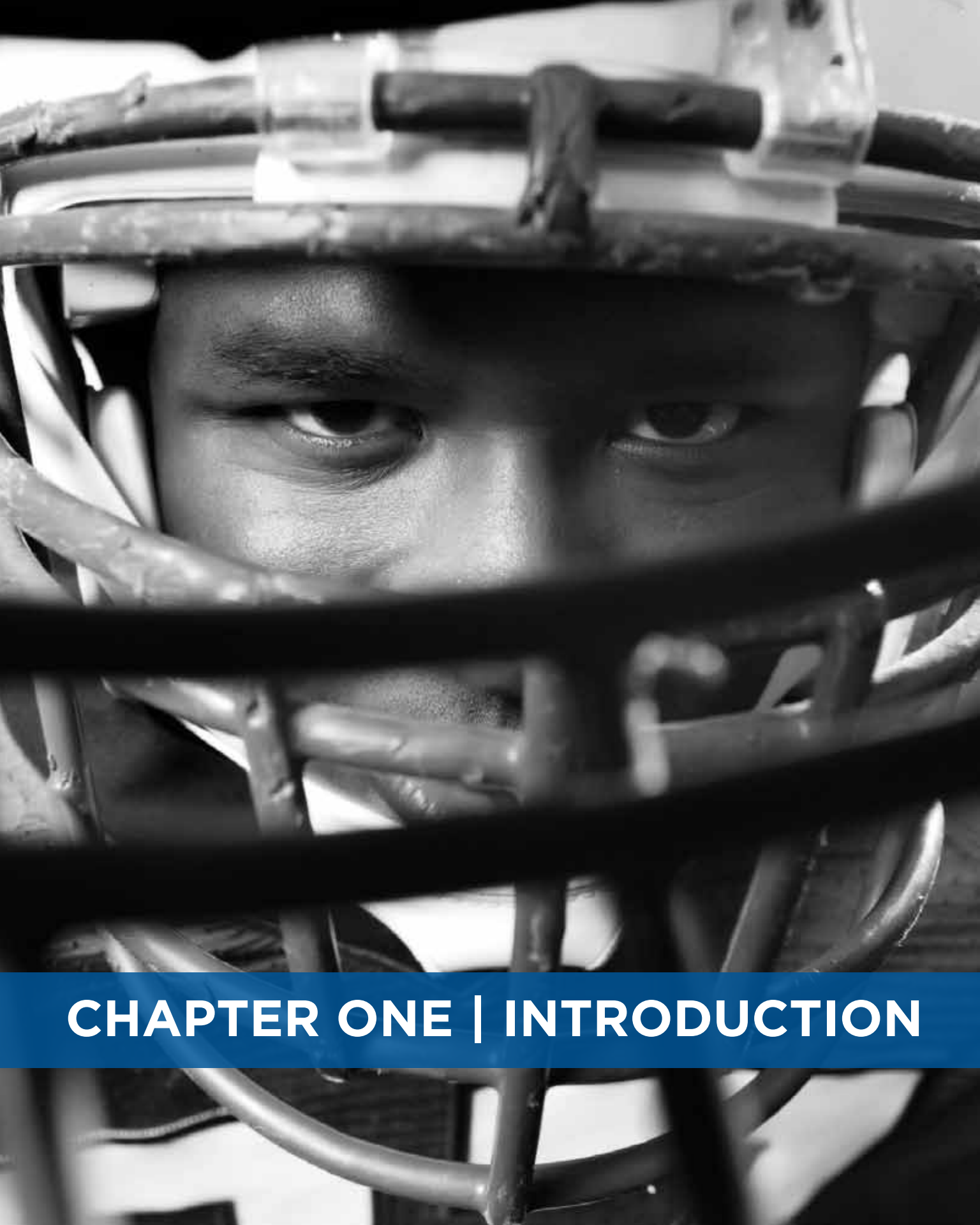
NSCA Founder



NSCA's Coaching Performance Path



Performance Pyramid



CHAPTER ONE | INTRODUCTION

Welcome to the National Strength and Conditioning Association's Basics of Strength and Conditioning Manual. The NSCA is the worldwide authority on strength and conditioning and this manual was been developed to help you start your journey into the area of strength training and conditioning with some of the foremost coaches in the world. This manual is not meant to make you an expert, but rather to increase your knowledge, skills, and abilities with three goals in mind:

- Increase safety awareness
- Develop your abilities to supervise strength training and conditioning activities
- Provide an overview of the basic information needed to be effective as a strength and conditioning professional

What is Expertise?

The time required to be an expert in any given area has been estimated at 10,000 hr, or approximately 10 years, of direct practice (3). This manual is for those interested in strength training and conditioning but are still in the formative stages, in other words – you are not an expert. Moreover, it is unlikely you will ever know everything there is to know about strength training and conditioning. A look at the number of variables involved in strength training and conditioning results in a list of about 50 (e.g., sets, reps, weight, exercise selection, technique, time of day, temperature, training status, etc.). We calculated the number of possible combinations of these variables and came up with a number so large that no one could possibly study and know all the combinations in a lifetime of effort. This means that strength training and conditioning involves such a vast area of knowledge that much of our job will be to reduce the number of things to know to a manageable level by emphasizing those that are the most important. The important things are the "big ideas" or "big things." It is vitally important that you get the "big things" right. The three objectives above, we believe, are the big things required for a basic understanding of strength training and conditioning.

Increase Safety Awareness

Clearly, first we must commit to doing no harm as strength training and conditioning professionals. Like all athletic activities, injury is a possibility and we must prepare such that we reduce the likelihood of injury. We will cover safety, injury prevention, and risk management in the final chapter to ensure you leave this manual with safety foremost in your mind. Fortunately, injuries in strength training and conditioning are rare but constant vigilance and good judgment are always required (6,7,8). Risk management is a tactic that is used to reduce the likelihood of injuries along with the likelihood of legal problems that often accompany injuries. Increasing your knowledge and awareness of the risks of injury through strength training and conditioning activities, and the risk of litigation or lawsuits due to poor judgment, we hope will keep athletes healthy and happy through competent strength training and conditioning decisions. We believe that the first step to safe performance is thorough and competent training of instructors and coaches.

Develop Your Abilities to Supervise Strength Training and Conditioning Activities

This manual draws a line between those who can design, administer, program, and plan strength training and conditioning activities, from those who can supervise and implement a program or plan. The knowledge, skills, and abilities needed to design a strength training and conditioning program require a higher level of knowledge than is covered in this manual. This manual will prepare you with a small amount of scientific information so that you can understand the basics of how strength training and conditioning affects the body, answer basic questions about training, and increase your scientific knowledge about training. The primary objective of this manual is to prepare you to identify flaws in exercise performance (e.g., posture and technique), fatigue, using too much resistance (or not enough), proper use of the appropriate metabolic energy system, and athlete readiness. As your knowledge and experience grow, you will acquire a "coach's eye" which allows you to see flaws in exercise performance almost instinctively. You will also develop a sort of "sixth sense" regarding the status of your athletes such that you can tell when they are fatigued or lack the safety-related exercise preparation skills.

An Overview of Strength Training and Conditioning

Basic principles permeate all of strength training and conditioning (refer to the pyramid diagram for an idea of how this manual will attempt to "divide and conquer" the important basic information you will need to effectively supervise and direct day-to-day training). For example, one of the pillars of strength training and conditioning is the idea of progression. Progression refers to the selection of exercises, loads or resistances, order of exercises, and readiness of the athlete that are just right (not too hard, not too easy) for the status of the athlete and the demands of the activity. Another basic principle is that of specificity, the body tends to adapt very narrowly to the nature of the exercise performed. Finally, even supervision itself comes in different forms, and it is important to know the circumstances when a particular form of supervision is ideal. Continuing the idea of a broad overview, let us look at the basic principles of training and a few definitions (2,4,9).

Training – Training is the process of preparing an athlete physically, technically, tactically, psychologically, and theoretically rapidly for the highest levels of performance (4). Training involves more than simple growth and maturation and, of course, the highest levels of performance will be relative to the current status and genetic gifts of the athlete.

Volume – Volume is the amount of work performed. Sets and repetitions of an exercise combine to make volume (1). If you are a runner, volume is the distance you covered. If you are strength training, volume is the product of sets x repetitions of an exercise.

Intensity – Intensity is the difficulty of the work. Intensity is the amount of weight or resistance used in a particular exercise (1). If you are a runner, intensity is running speed. If you are strength training, intensity is the resistance or weight lifted.

Volume-Load – Volume-load is the combination of volume and intensity. Volume-load is usually calculated as sets x repetitions x weight, or resistance used (1).

Frequency – Frequency is simply the number of training sessions expressed per day, per week, per month, and so forth (1).

Principles of Training

1. Principle of Individuality

Every individual is unique and will respond differently to the same training stimulus. Some of these differences can be influenced by many characteristics; biological age, training age, gender, body size and shape, past injuries and many more.

For example, a college athlete makes a copy of his exact training program and gives it to his little brother who is a freshman in high school. The younger brother does not miss a workout, and at the end of the program, he is disappointed in the results. Though many variables could play a role in the results, the primary factor is most likely the large range in biological and training age.

2. Principle of Specificity

Training adaptations for an individual will occur specifically to the muscle groups trained, the intensity of the exercise, the metabolic demands of the exercise, and/or specific movements and activities. In an attempt to perfect a specific skill or activity, you must perform that skill or activity with proper body mechanics to have correct technique.

For example, a 100-m sprinter is not going to train for an event by running three miles at a low intensity for an extended period. The sprinter will train by sprinting short distances at very high intensities.

3. Principle of Overload

In order for an individual to achieve a certain training adaptation, the body must be stressed by working against a stimulus or load that is greater than that to which it is accustomed. Overload, ensures improvement by challenging changes in resistance, terrain, movement complexity, and many others.

For example, if an athlete is trying to increase force production to jump higher, the athlete must train to increase overall strength and power. When training with the hang clean at three sets of five repetitions, the athlete should load the bar with a weight that will allow them to use great technique at a desired velocity. If the bar is loaded with a weight that prevents them from reaching their desired velocity, then the specific training adaptation will not be obtained.

4. Principle of Progression

In order to achieve the desired training adaptations for a certain activity or skill consistently, the training stimulus must gradually and constantly increase. This implies that there is an optimal level and time frame for the overload to occur. If overload increases too quickly, poor technique, improper muscle firing patterns, and injury may result. If overload progresses too slowly, improvements will be minimal or non-existent. Rest and recovery must also be included in the progression, as training hard all the time could result in chronic fatigue, a decrease in performance and eventually injury.

For example, at the beginning of the training program, an athlete may be able to perform three sets of ten repetitions at 135 lb. At first, this may be a tough task for the athlete to accomplish, but as the athlete consistently trains, the task will become easier and the load must be increased. The next week the load increases to 145 lb until all ten reps can be completed with correct technique. The athlete must progressively overload the muscles to increase performance.

5. Principle of Diminishing Returns

Performance gains are related to the level of training (training age) of each individual. Athletes that have never participated in a training program before can see huge initial performance gains in their program. On the other hand, athletes that have been lifting for several years will see smaller gains over longer periods of time. As an athlete nears their genetic potential, the gains in performance will be much harder to obtain. The key is to continue to show progress in the areas in which they have weaknesses.

For example, when an athlete first starts a training program as a freshman in college the athlete's vertical jump may improve from 22 in. to 30 in. in the first year. As the athlete continues to train through the next three years, their vertical jump performance may increase from 30 in. to 38. Achieving the eight-inch improvement in the final three years is much more significant and difficult than the eight inches in the first year.

6. Principle of Reversibility

When a training stimulus is taken away from an athlete for an extended period of time, they will not be able to maintain a certain level of performance. Over time, the gains that were achieved will return to the original level.

For example, when an athlete takes the summer off from training they can expect to become detrained. The decrease in performance is directly related to the inactivity of the muscles that have been atrophied from nonuse (5).

These principles of training will guide your decisions and determine how you will accomplish the three objectives listed at the beginning of this chapter. These guidelines will help you judge the direction of different training approaches and likely outcomes. Moreover, training principles simply help reduce the universe of ideas of which you need to consider. Another aspect of strength training and conditioning is the utilization of proper energy systems.

Overview of Energy Systems

The following section will review the energy systems associated with the production and use of energy within the body. The most efficient and effective strength training and conditioning programs are designed with an understanding of the transfer of energy between all of the biological energy systems. It is beyond the scope of this manual to define the specific chemical reactions and processes within the body that generate and replenish energy. For more complete information about the energy systems, please refer to the "Essentials of Strength Training and Conditioning" (3rd ed.) textbook (1).

Through various reactions within the body, an intermediate molecule called adenosine triphosphate (ATP) is generated, which allows for the transfer of energy from various reactions. This molecule is classified as a high-energy molecule because it stores large amounts of energy in its chemical bonds. Through the breakdown of ATP, the body is able to provide the necessary energy to perform activities (without an adequate supply of ATP muscular activity and muscular growth would not be possible). Since ATP is stored in such limited quantities within muscle cells, three main energy systems exist in muscle cells to replenish ATP and provide the constant energy needed for muscle action (1). All of the energy systems are active all of the time; however, the contribution of one energy system may be dominant based on the intensity and duration of a specific activity.

Phosphagen (ATP-PC) System

The phosphagen, or ATP-PC, system uses ATP primarily for short-term, high-intensity activities (1). This energy system is considered anaerobic because it does not require the presence of oxygen to metabolize energy. However, this energy system does not generate ATP for immediate use and has a low capacity for ATP stores. Since the phosphagen system cannot store large amounts of energy, it is the dominant energy system for high-intensity activities that last no longer than 20 – 30 s (1). If an activity lasts longer than 20 – 30 s, energy supply shifts to the glycolytic energy system.

Glycolytic System

The glycolytic system has a much higher capacity for storing energy. This energy system, which is often broken into fast and slow glycolysis, is also considered anaerobic because it breaks down carbohydrates to produce ATP. Since it has a higher capacity for storing energy, this system is dominant during activities that last between 30 s and 2 – 3 min (1).

Oxidative System

The oxidative energy system is considered aerobic. Whereas the phosphagen and glycolytic energy systems derive energy from carbohydrates for high-intensity exercise, the oxidative energy system shifts from carbohydrates to proteins and fats as energy substrates for prolonged, submaximal exercise. The oxidative energy system is dominant for activities of low intensity that last longer than three minutes.

The body shifts between the various energy systems on a moment-to-moment basis in order to provide the energy necessary for movement and restoration. The energy systems respond to training specifically, as described by the principle of specificity. Since all energy systems are active all of the time, it is important to understand and differentiate when each system is dominant for each specific activity in order to design efficient and productive training programs that meet the needs of the activity. For example, a football lineman should not perform long-distance runs to train for competition because the demands of training do not match the demands of the activity.

Conclusion

While you are confronting the large number of demands that you will face as a relatively new strength training and conditioning professional, keep in mind that your primary tasks are safety, vigilant supervision, and a watchful eye of the implementation of the designed training program. The watchful eye comes from using the principles of training as a sort of criteria gauntlet through which any training decision should pass. Moreover, you can use the information in this chapter as a frame or context within which the following chapters fit.

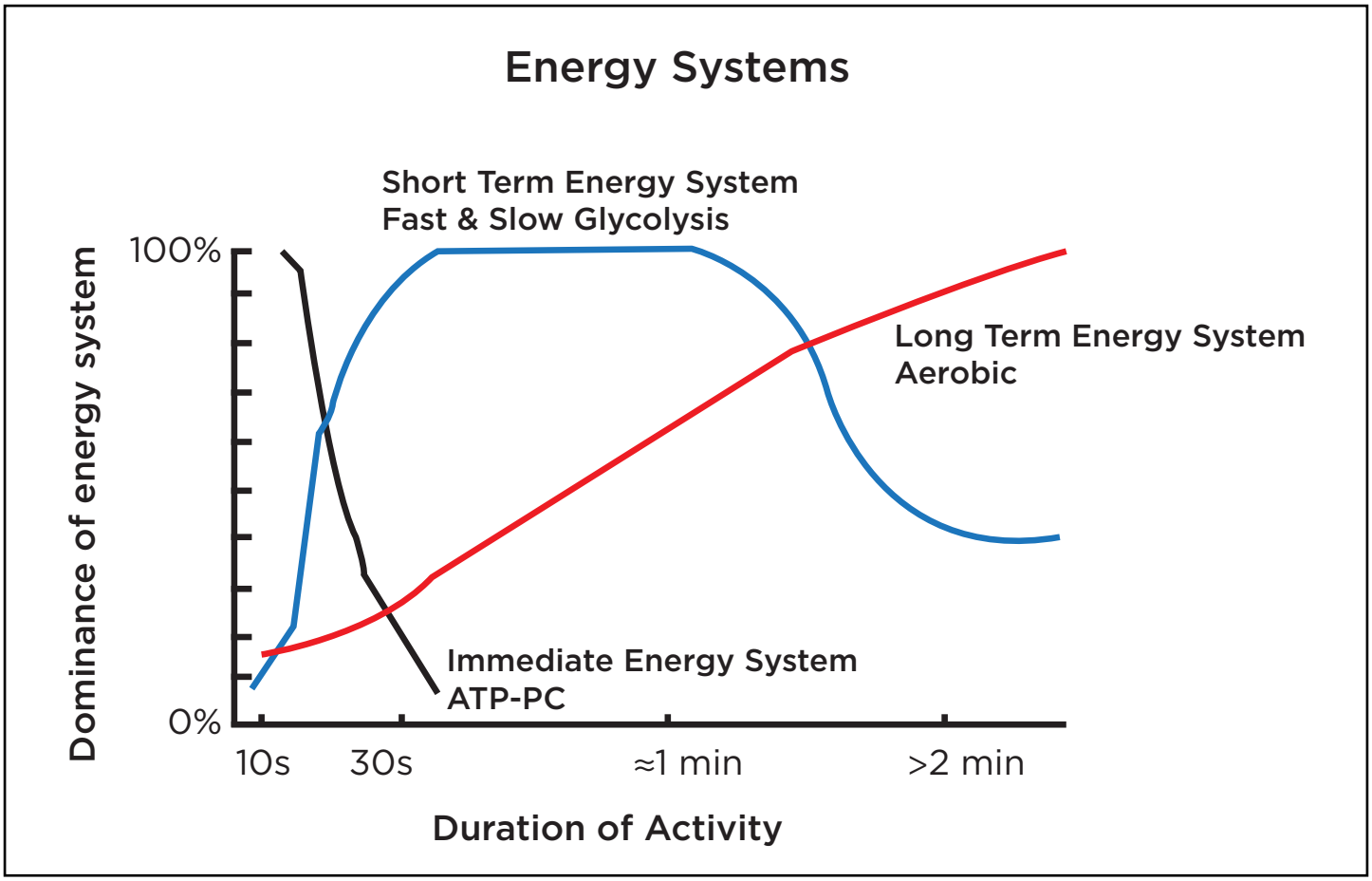


Figure 1-1. Dominant Energy System Based on Activity Duration

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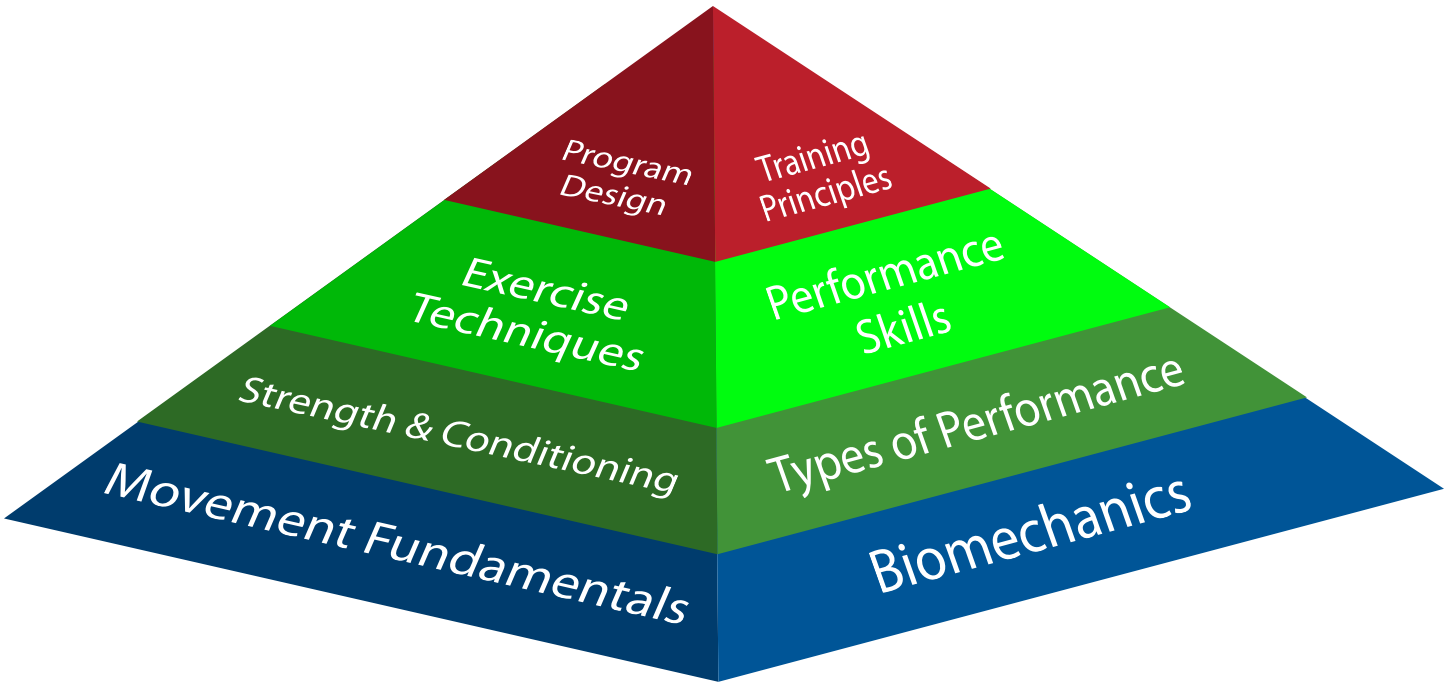
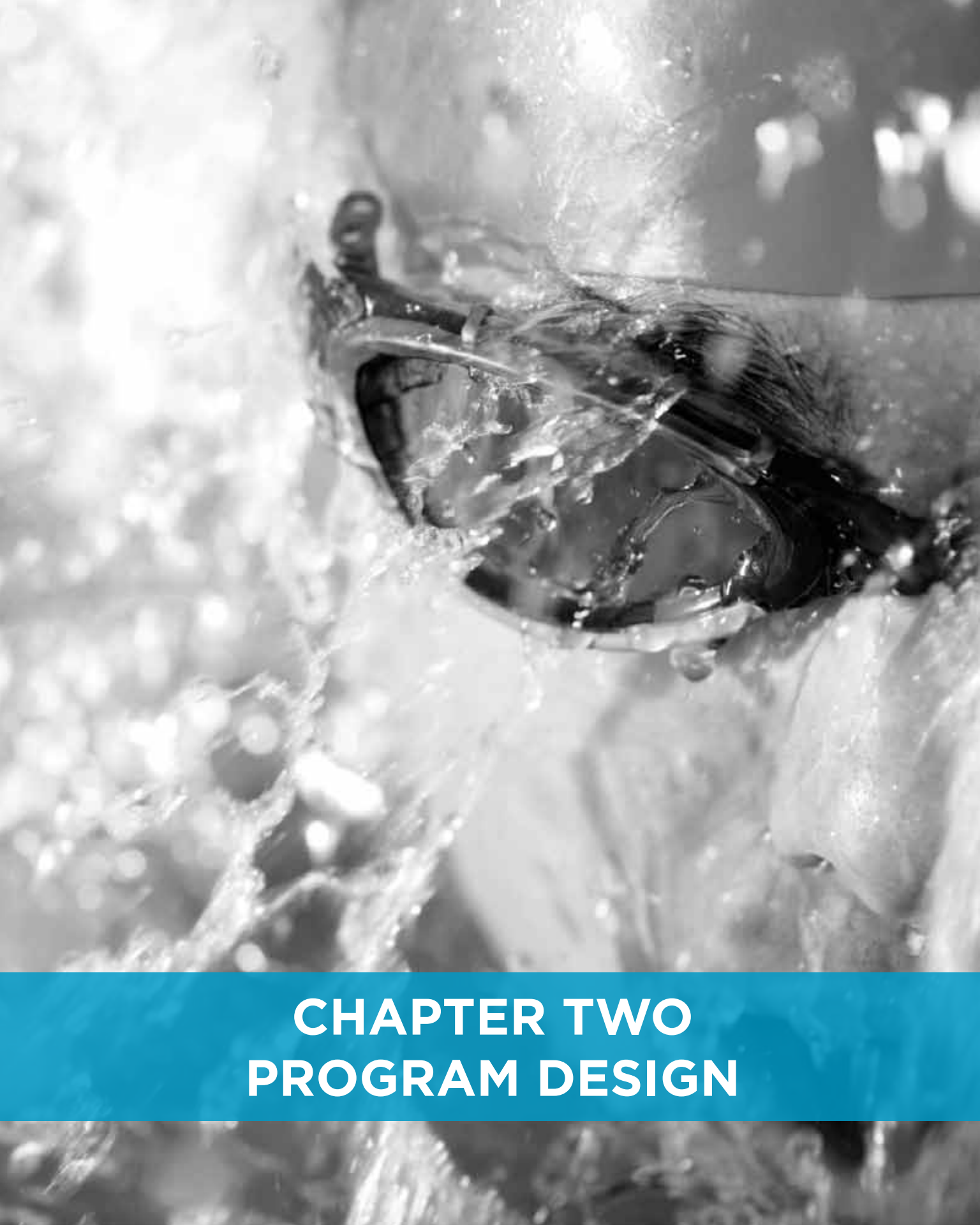


Performance Pyramid



CHAPTER TWO
PROGRAM DESIGN

This chapter provides information that pertains to planning the design of strength training and conditioning programs. Program design is an overview perspective on what strength training and conditioning coaches should do to prepare athletes for their preparatory and competitive seasons. Properly designed strength training and conditioning programs are vital to any athletic preparation. Strength training and conditioning programs can improve athletic performance, decrease the likelihood of injuries, and allow for the development of sound weightlifting and basic resistance training techniques (18,22,23,30,35). Development of these attributes allows athletes to gain a strong foundation of fundamental strength training and conditioning practices, and be adequately prepared for advanced strength training and conditioning programs (e.g., collegiate training programs).

How Do We Organize Training?

Training theory uses models of training application that have evolved over 60 years. A model is a simplification or simulation of a real-world complex process (8,9,10). One should know that a model is never exactly like the real-world situation, but attempts to simulate the most important aspects that need attention while ignoring those factors that are considered unimportant. The term used to describe the special planning that occurs with athletic training is "periodization." Periodization is composed of two major concepts that occur simultaneously. Training is divided into "periods," and these periods are cyclic in that various aspects of training are repeated and form a system (31).

Training Design Terminology

As with every other area covered in this manual, we have had to cover new terms that are a part of the knowledge area, and sometimes the culture of a particular facet of strength training and conditioning. The following list is a summary of some important terms that will be needed to carry on further in the study of training design.

Specific Adaptations to Imposed Demands (SAID Principle)

The SAID principle is a fundamental principle in the field of strength training and conditioning (7). The SAID principle states that an athlete's body will adapt to exactly what is demanded of it—no more and no less. This principle says that you must give the athlete's body an unambiguous message of what you want it to become by providing training stressors that mimic all, or parts, of the target physical capacities or skills. The SAID principle constrains strength training and conditioning coaches in their program designs to achieve specific adaptations based on the demands put on the system.

Annual Plan

Training theory goes to considerable lengths to describe the time dimension in designing training tasks. An annual plan is the calendar-based approach used to place the various demands of training within a calendar year. Usually, the annual plan begins immediately following the last competition of the previous season, and ends after the last competition of the succeeding season.

Macrocycle

The terms "macrocycle" and "annual plan" have occasionally been used synonymously (17). The macrocycle, for our purposes, is the linking of the general physical preparation phase, the specific preparation phase, the pre-competitive phase, the competitive phase, and the peak phase. As such, often it is convenient to link together all of the work leading to a single championship contest. If there is more than one major competition per year, then the year may need more than one macrocycle, typically one for each major season. For example, spring ball and fall ball in football, and the indoor and outdoor seasons of track and field will need to be considered two macrocycles per annual plan (or year).

Mesocycle

A mesocycle is an intermediate duration of time planning that usually lasts from weeks to a few months. The mesocycle is perhaps the first functional unit for training planning where specific training goals may be assigned and achieved during a particular mesocycle. For example, a pre-competitive mesocycle for basketball might be a period of a month or so where the dominant form of training is scrimmaging. Or, a mesocycle may be assigned to a shot putter in the early season to use strength training and conditioning to enhance his/her maximal strength.

Microcycle

A microcycle is a smaller time division that lasts from one to a few weeks. The microcycle is the smallest unit of planning in which we can expect to see the beginnings of relatively stable adaptations. Typically, it takes about a week of consistent training demands for the body to be pushed or forced to adapt, and thus change its chemistry, biomechanics, and/or skills to adapt to the training demands.

Training Lesson

A training lesson is a single bout of training where the athlete begins a session with a warm-up, practices some aspect of the sport or strength training and conditioning, and then ends the session with a cool-down. A single training lesson is relatively powerless in influencing the adaptation of an athlete. Only by the accumulation of about a week's (or microcycle's) worth of training stimuli is the athlete forced to adapt to the new training demands.

Program

In the strength training and conditioning world, a program is the actual exercises, sets, repetitions, resistances, inter-set rest periods, inter-lesson rest periods, and so forth. An example program is provided at the end of this chapter.

Basis of Program Design Decisions

You will find nearly all program design literature to be triphasic (3 phases), or have three periods/stages. For example, nearly all program designs are based on a simple yet profound idea proffered by Hans Selye called the General Adaptation Syndrome (GAS) (49,50).

The GAS consists of three phases: alarm, resistance, and exhaustion (16,17). The athlete begins with a level of being called "homeostasis" (7). The alarm phase occurs when the athlete is presented with a large enough stressor to evoke fatigue (16,17). Stress is defined as anything that causes an organism, or in this case an athlete, to react (49,50). The alarm stage is distinguished by markers of fatigue, reduced performance abilities, and decreased physical capacities. The resistance phase occurs when the body temporarily adapts to the applied stressor and is able to cope physically with the demands. The resistance phase indicates that the athlete has achieved a level of adaptation that is actually greater or better than his/her previous homeostatic level. Finally, if the stressor is too great to continue to resist, the stimulation increases, or the athlete is not allowed to rest, then the body slips into the exhaustion phase. During the exhaustion phase, symptoms of the alarm phase return but the magnitude is greater and the fatigue much more profound. Figure 2-1 shows the three stages of Selye's stress adaptation model (overreaching, supercompensation, overtraining), and demonstrates how performance is affected in each of the three phases.

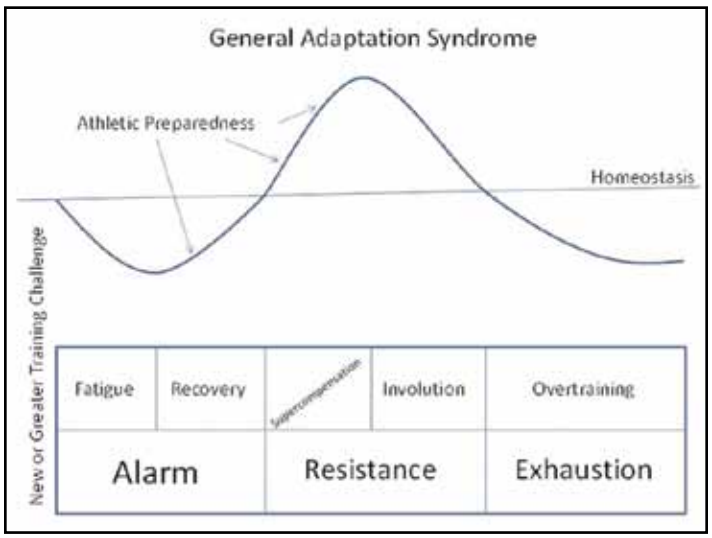


Figure 2-1. Selye's General Adaptation Syndrome (49,50)

In Figure 2-1, athlete preparedness is represented by a curved line at the top of the graphic. Homeostasis is the horizontal line labeled at the right. Note that the line that represents athletic preparedness shows that the athlete fatigues, recovers, and then supercompensates (enters the resistance stage). If nothing else is done, the athlete returns to homeostasis via involution, or descends into overtraining and exhaustion due to the return of fatigue and the inability of the athlete to continue to compensate for the applied stressors. Figure 2-2 shows the Selye-type curves of adaptation together with an example of training loads and how the training loads, adaptation, rest periods, and timing work together.

Training Load Prescriptions

Training theory is not useful unless it can be applied to the real world of training. Figure 2-2 shows how training loads are applied in a systematic fashion to take advantage of the GAS, and systematically improve athletic performance. Note that the principle of progression is important when prescribing training loads throughout a program to ensure proper, and desired, adaptations.

Rules for Exercise Selection and Prescription

The field of strength training and conditioning is driven by research-based information that allows for the proper utilization of sets, repetitions, volume, and rest periods to elicit desired physiological adaptations. The information surrounding these topics has been a topic of discussion for many years. Professional organizations have guidelines and recommendations associated with these variables that allow strength training and conditioning coaches to target specific adaptations to the physiological system (based on the guidelines provided) (3,4,5,24,26). It is imperative that strength training and conditioning coaches understand these guidelines, and the application of these guidelines, to induce the desired adaptations for the athletes that they work with. These guidelines and recommendations not only promote certain training adaptations, but also decrease the likelihood of injuries during training. Direct access to these guidelines and recommendations should be available to strength training and conditioning coaches at any facility. Access to this information will not only decrease the chance of injuries (due to improper programming) but also provide correct prescription to target physiological variables progressively during the course of a training macrocycle. Refer to the sample program at the end of this chapter for further information on program design.

Figure 2-3 shows the spectrum of various repetition ranges and their relative placement over time. Note that repetition ranges will be dictated by the resistance involved, such that one should attempt to keep the resistance in line with the repetitions diagramed in Figure 2-3.

Warm-Up and Stretching

A warm-up is designed to prepare an athlete for training or competition, and can improve subsequent performance and lessen the risk of injuries. A warm-up should be incorporated in every program design. A warm-up period is important before any athletic performance or physical activity, the goal being to prepare the athlete mentally and physically for exercise or competition. A well-designed warm-up should increase muscle temperature, circulation, and provide an opportunity for skill rehearsal (1,28,37,57). Moreover, one of the aspects of a warm-up is simply to "stir" cellular content so the sarcoplasm becomes liquefied (43,45,47,58). These warm-up effects can have the following positive impacts on performance:

- Faster muscle contraction and relaxation of both agonist and antagonist muscles (33)

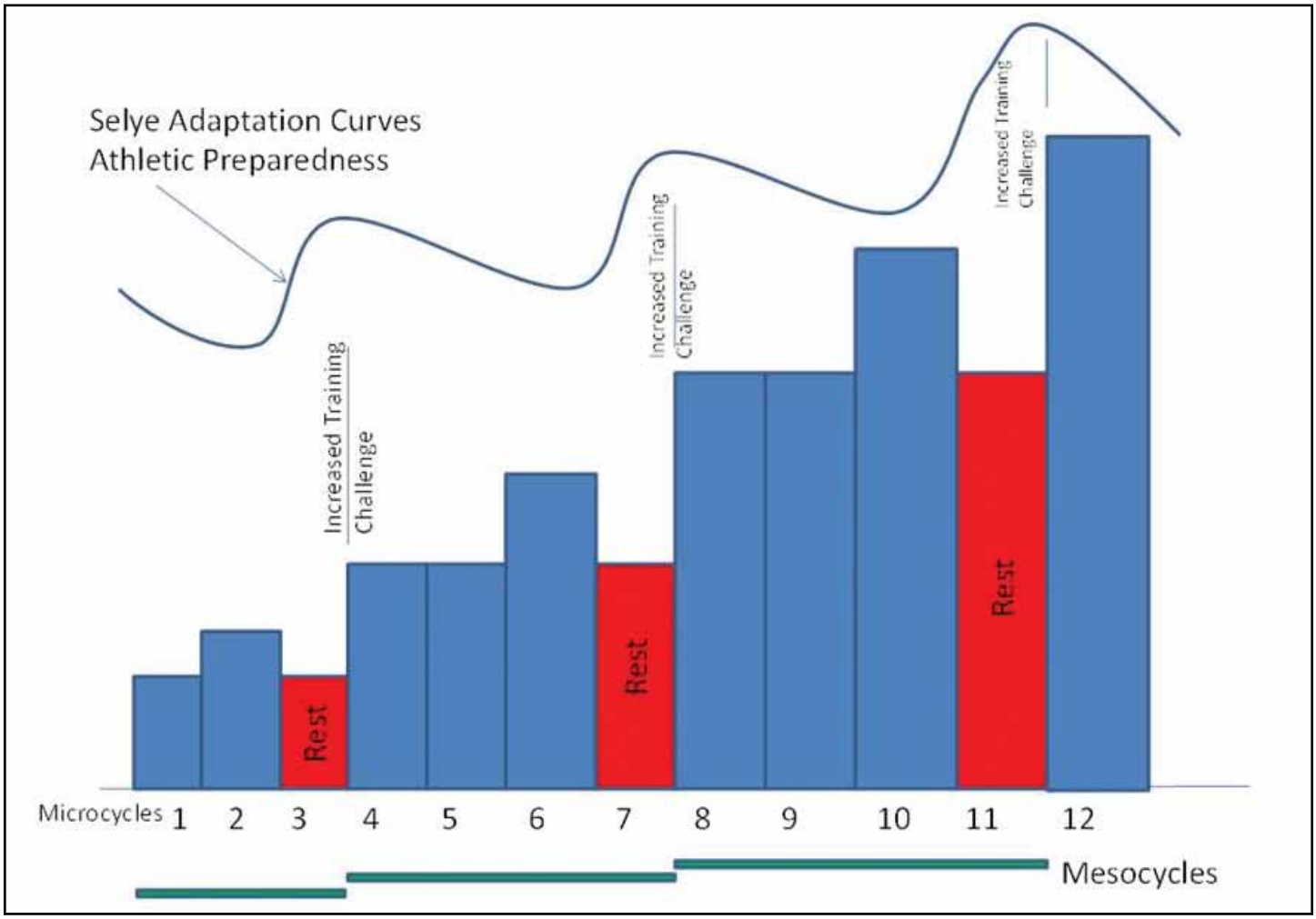


Figure 2-2. Combination of Training Design Aspects in Relation to the General Adaptation Syndrome (49,50)

- Improvements in the rate of force development and reaction time (2)
- Improvements in muscle strength and power (14,24)
- Lowered viscous resistance in muscles (6,42,47,58)
- Improved oxygen delivery due to the Bohr effect, whereby higher temperatures facilitate
- oxygen release from hemoglobin and myoglobin (39)
- Increased blood flow to active muscles (39)
- Enhanced metabolic reactions (24)

While the influence of a warm-up on injury prevention is unclear, the evidence suggests a positive effect, or no effect at all, on injury (15,21,29,52,53,59). The relationship between stretching and injury prevention is tenuous at best.

Components of a Warm-Up

A total warm-up program includes the following two components (17,28,31,37):

A general warm-up period may consist of 5 – 10 min of slow activity, such as jogging or skipping. Alternatively, low-intensity sport-specific actions, such as dribbling a soccer ball, can be productive during this time. This provides a very sport-specific general warm-up that aids in skill development and raises body temperature. The aim of this period is to increase heart rate, blood flow, deep muscle temperature, respiration rate, perspiration, and decrease viscosity of joint fluids.

A specific warm-up period incorporates movements similar to the movements of the athlete's sport. It involves 8 – 12 min of dynamic stretching that focuses on movements that work through the range of motion required for the sport, such as the walking knee lift. Sport-specific movements of increasing intensity, such as

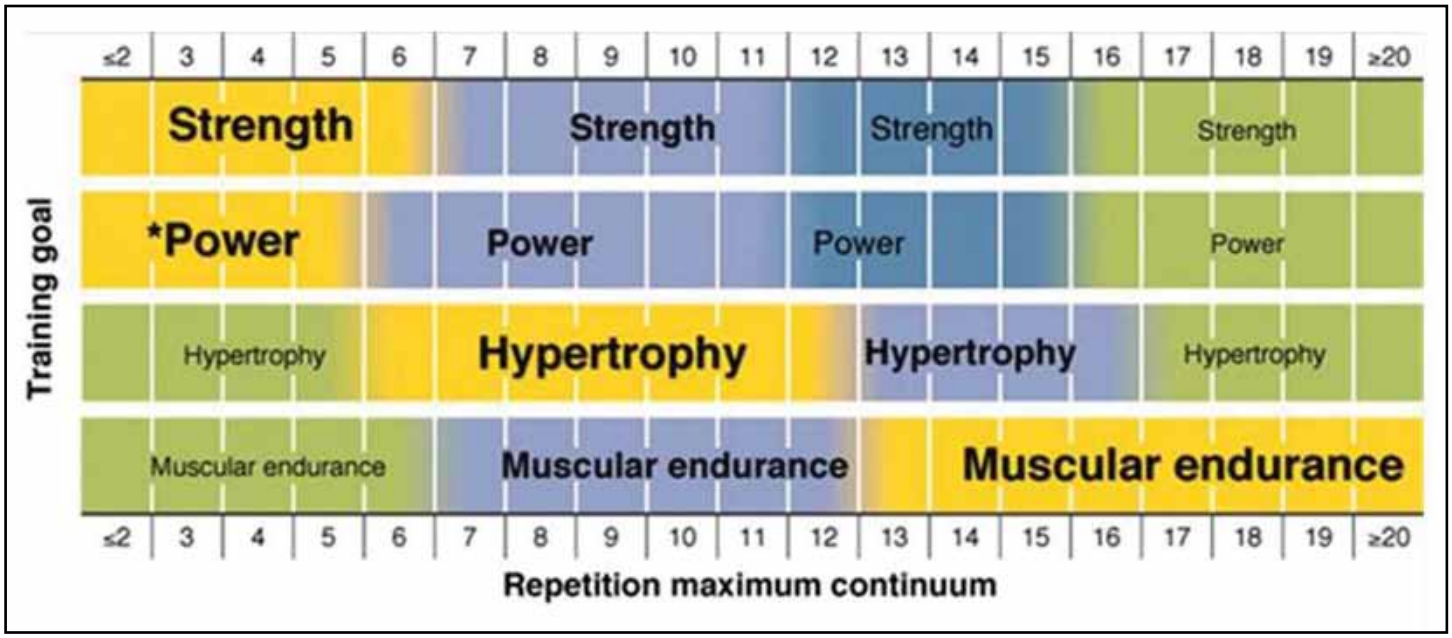


Figure 2-3. Repetition Ranges for Specific Training Outcomes

sprint drills, bounding activities, or jumping, follow the dynamic stretching. The more power necessary for the sport or activity, the more important the warm-up becomes. Including high-intensity dynamic exercises can facilitate subsequent performance. This phase should also include rehearsal of the skills to be performed.

A warm-up should progress gradually and provide sufficient intensity to increase muscle and core temperatures without causing fatigue or reducing energy stores. It is likely that there are optimal levels of warm-ups related to the specific sport, the athlete, and the environment, so no one warm-up routine is best for every athlete, or sport.

Stretching During Warm-Up

There are four main types of stretching: static, ballistic, dynamic, and proprioceptive neuromuscular facilitation (PNF). Static stretching has long been used in a warm-up, with the aim of enhancing performance. However, recent reviews of the literature surrounding the role of static stretching question this practice (51,52). There is little, if any, evidence that stretching pre- or post-participation prevents injury or subsequent muscle soreness (32,34,46,48,51,52). Although static stretching before activity may increase performance in sports that require an increased range of motion, such as gymnastics, stretching activities may or may not influence subsequent strength, power, running speed, reaction time, and strength endurance performance, and often depends on what intermittent activity was used between the stretching and the strength activity (11,12,13,19,20,36,40,41,44,48,54,55,56). In these cases it is important that the strength training and conditioning professional performs a benefit–risk analysis when choosing whether or not to include static stretching in a warm-up (38).

Dynamic stretching, which is functionally based and sues sport-specific movements to prepare for activity, does not seem to elicit the performance reduction effects of static and PNF stretching, but has been shown to improve subsequent running performance (27,60,61). Given these findings, the use of static, PNF, and ballistic stretching in a warm-up needs to be questioned. Based on current evidence, dynamic stretching is the preferred option for stretching during a warm-up.

The degree of stretching required in a warm-up depends on the type of sport. Sports that require increased flexibility, such as gymnastics or diving, require a greater degree of stretching (52). Additionally, those sports with high demands for a stretch-shortening cycle of high-intensity, as in sprinting and American football, are likely to require more stretching than those with low or medium stretch-shortening cycle activity, as in jogging or cycling (59). Strength training and conditioning professionals should look at the specific range of motion and stretch-shortening cycle requirements of the sport or activity and use this information to design an appropriate warm-up routine.

Conclusion

Program design must take into account many factors related to the life and training of each athlete. Program design is guided by theory and hands-on experience from many previous and current coaches and sport scientists. The following provides a 12-week strength and conditioning program as an example of how to develop and implement the lessons presented throughout this manual.

Sample Strength and Conditioning 12-Week Program

Base Phase

Basics of Strength and Conditioning - Twelve Week Program												
Monday - Explosive	**Week 1 - 65%**			**Week 2 - 70%**			**Week 3 - 65%**			**Week 4 - 75%**		
	Load			*Load*			*Unload*			*Load*		
Lifting Warm-up												
BB Rack Shrug OR Rack Jump OR Rack Clean	2x5			3x5			3x5			3x5		
BB High Pull	2x5			3x5			3x5			3x5		
BB Standing Shoulder Press OR DB Shoulder Raises	2x5			3x5			3x5			3x5		
Pulling Choice	2x10			3x10			3x10			3x10		
Bicep Choice	2x10			3x10			3x10			3x10		
Ab Planks	2x 15-30 seconds			3x 15-30 seconds			3x 30-45 seconds			3x 30-45 seconds		
Tuesday - Strength	**Week 1 - 60%**			**Week 2 - 65%**			**Week 3 - 60%**			**Week 4 - 70%**		
Lifting Warm-up												
BB Front Squat OR Modified Squat	2x10			3x10			3x10			3x10		
BB Romanian Deadlift (RDL)	2x10			3x10			3x10			3x10		
Single Leg Choice	2x10ea			3x10ea			3x10ea			3x10ea		
BB Incline Bench Press	2x10			3x10			3x10			3x10		
Triceps Choice	2x10			3x10			3x10			3x10		
AB Choice	2x10			3x10			3x10			3x10		
Thursday - Explosive	**Week 1 - 60%**			**Week 2 - 65%**			**Week 3 - 60%**			**Week 4 - 70%**		
Lifting Warm-up												
BB Rack Shrug OR Rack Jump OR Rack Clean	2x5			3x5			3x5			3x5		
BB High Pull	2x5			3x5			3x5			3x5		
BB Standing Shoulder Press OR DB Shoulder Raises	2x5			3x5			3x5			3x5		
Pulling Choice	2x10			3x10			3x10			3x10		
Bicep Choice	2x10			3x10			3x10			3x10		
Ab Planks	2x 15-30 seconds			3x 15-30 seconds			3x 30-45 seconds			3x 30-45 seconds		
Friday - Strength	**Week 1 - 65%**			**Week 2 - 70%**			**Week 3 - 65%**			**Week 4 - 75%**		
Lifting Warm-up												
BB Back Squat OR Modified Squat	2x10			3x10			3x10			3x10		
BB Romanian Deadlift (RDL)	2x10			3x10			3x10			3x10		
Single Leg Choice	2x10ea			3x10ea			3x10ea			3x10ea		
BB Bench Press	2x10			3x10			3x10			3x10		
Triceps Choice	2x10			3x10			3x10			3x10		
AB Choice	2x10			3x10			3x10			3x10		
Key	**Comments/Notes**											
BB - Barbell / DB - Dumbbell												
CB - Cable / MB - Medicine Ball												

Strength Phase

Basics of Strength and Conditioning - Twelve Week Program												
Monday - Explosive	**Week 5 - 75%**			**Week 6 - 80%**			**Week 7 - 75%**			**Week 8 - 85%**		
	Load			*Load*			*Unload*			*Load*		
Lifting Warm-up												
BB Hang Shrug OR Hang Jump OR Hang Clean	3x5			3x5			3x5			3x5		
BB Push Press OR Standing Shoulder Press	3x5			3x5			3x5			3x5		
Pulling Choice	3x5			3x5			3x5			3x5		
Pulling Choice	3x5			3x5			3x5			3x5		
Ab Planks	2x 15-30 seconds			3x 15-30 seconds			3x 30-45 seconds			3x 30-45 seconds		
Tuesday - Strength	**Week 5 - 70%**			**Week 6 - 75%**			**Week 7 - 70%**			**Week 8 - 80%**		
Lifting Warm-up												
BB Deadlift OR Modified Deadlift	3x5			3x5			3x5			3x5		
BB Romanian Deadlift (RDL)	3x5			3x5			3x5			3x5		
Single Leg Choice	3x5ea			3x5ea			3x5ea			3x5ea		
BB Incline Bench Press OR DB Incline Bench Press	3x5			3x5			3x5			3x5		
Triceps Choice	3x5			3x5			3x5			3x5		
Thursday - Explosive	**Week 5 - 70%**			**Week 6 - 75%**			**Week 7 - 70%**			**Week 8 - 80%**		
Lifting Warm-up												
BB Hang Shrug OR Hang Jump OR Hang Clean	3x5			3x5			3x5			3x5		
BB Push Press OR Standing Shoulder Press	3x5			3x5			3x5			3x5		
Pulling Choice	3x5			3x5			3x5			3x5		
Pulling Choice	3x5			3x5			3x5			3x5		
Ab Planks	2x 15-30 seconds			3x 15-30 seconds			3x 30-45 seconds			3x 30-45 seconds		
Friday - Strength	**Week 5 - 75%**			**Week 6 - 80%**			**Week 7 - 75%**			**Week 8 - 85%**		
Lifting Warm-up												
BB Back Squat OR Modified Squat	3x5			3x5			3x5			3x5		
BB Romanian Deadlift (RDL)	3x5			3x5			3x5			3x5		
Single Leg Choice	3x5ea			3x5ea			3x5ea			3x5ea		
BB Bench Press OR DB Bench Press	3x5			3x5			3x5			3x5		
Triceps Choice	3x5			3x5			3x5			3x5		
Key	**Comments/Notes**											
BB - Barbell / DB - Dumbbell												
CB - Cable / MB - Medicine Ball												

Peak Phase

Basics of Strength and Conditioning - Twelve Week Program												
Monday - Explosive	**Week 9 - 75%**			**Week 10 - 80%**			**Week 11 - 75%**			**Week 12 - 85%**		
	Load			*Load*			*Unload*			*Load*		
Lifting Warm-up												
BB Clean Shrug OR Clean Jump OR Clean	3x3			3x3			3x3			3x3		
BB Push Jerk OR Push Press	3x3			3x3			3x3			3x3		
Pulling Choice	3x3			3x3			3x3			3x3		
Ab Planks	2x 15-30 seconds			3x 15-30 seconds			3x 30-45 seconds			3x 30-45 seconds		
Tuesday - Strength	**Week 9 - 70%**			**Week 10 - 75%**			**Week 11 - 70%**			**Week 12 - 80%**		
Lifting Warm-up												
BB Front Squat OR Deadlift OR Modified	3x3			3x3			3x3			3x3		
BB Romainian Deadlift (RDL)	3x3			3x3			3x3			3x3		
Single Leg Choice	3x3ea			3x3ea			3x3ea			3x3ea		
BB Incline Bench Press OR DB Incline Bench Press	3x5			3x5			3x5			3x5		
Thursday - Explosive	**Week 9 - 70%**			**Week 10 - 75%**			**Week 11 - 70%**			**Week12 - 80%**		
Lifting Warm-up												
BB Clean Shrug OR Clean Jump OR Clean	3x3			3x3			3x3			3x3		
BB Push Jerk OR Push Press	3x3			3x3			3x3			3x3		
Pulling Choice	3x3			3x3			3x3			3x3		
Ab Planks	2x 15-30 seconds			3x 15-30 seconds			3x 30-45 seconds			3x 30-45 seconds		
Friday - Strength	**Week 9 - 75%**			**Week 10 - 80%**			**Week 11 - 75%**			**Week 12 - 85%**		
Lifting Warm-up												
BB Back Squat OR Modified Squat	3x3			3x3			3x3			3x3		
BB Romainian Deadlift (RDL)	3x3			3x3			3x3			3x3		
Single Leg Choice	3x3ea			3x3ea			3x3ea			3x3ea		
BB Bench Press OR DB Bench Press	3x3			3x3			3x3			3x3		
Key	**Comments/Notes**											
BB - Barbell / DB - Dumbbell												
CB - Cable / MB - Medicine Ball												

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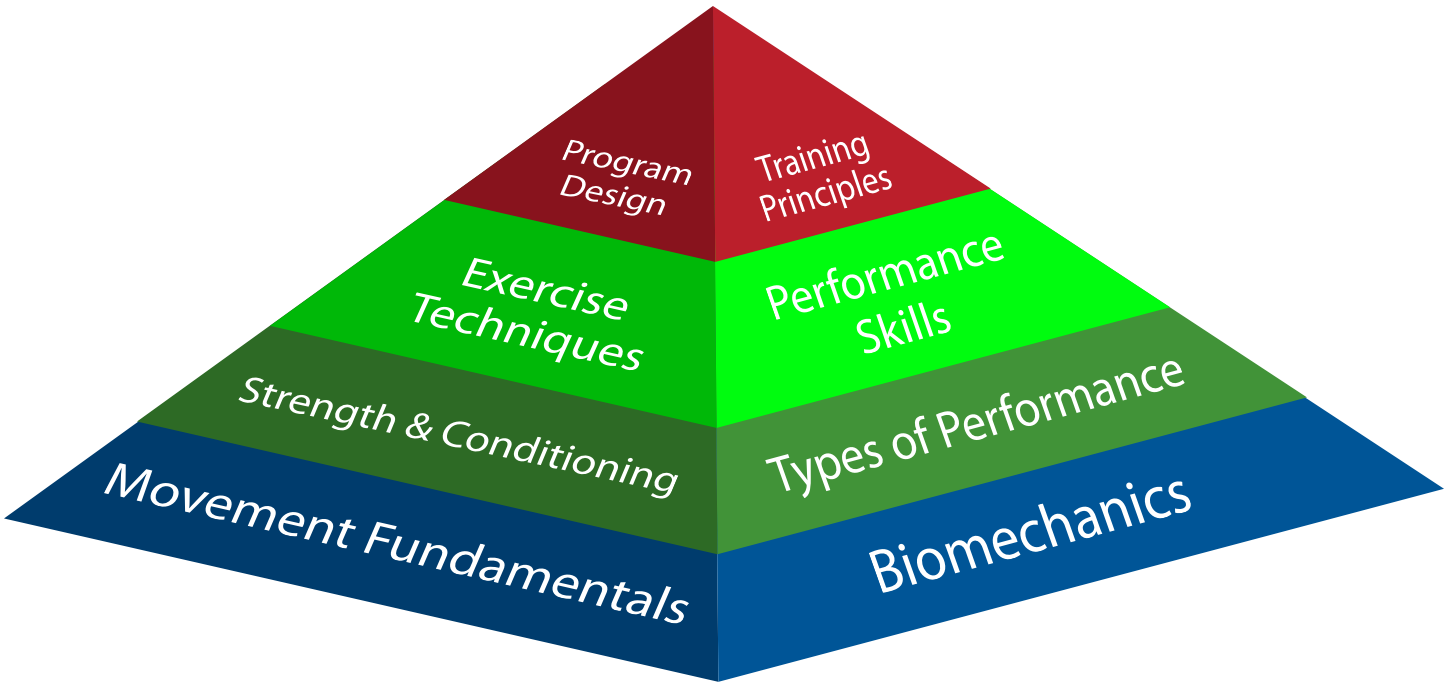
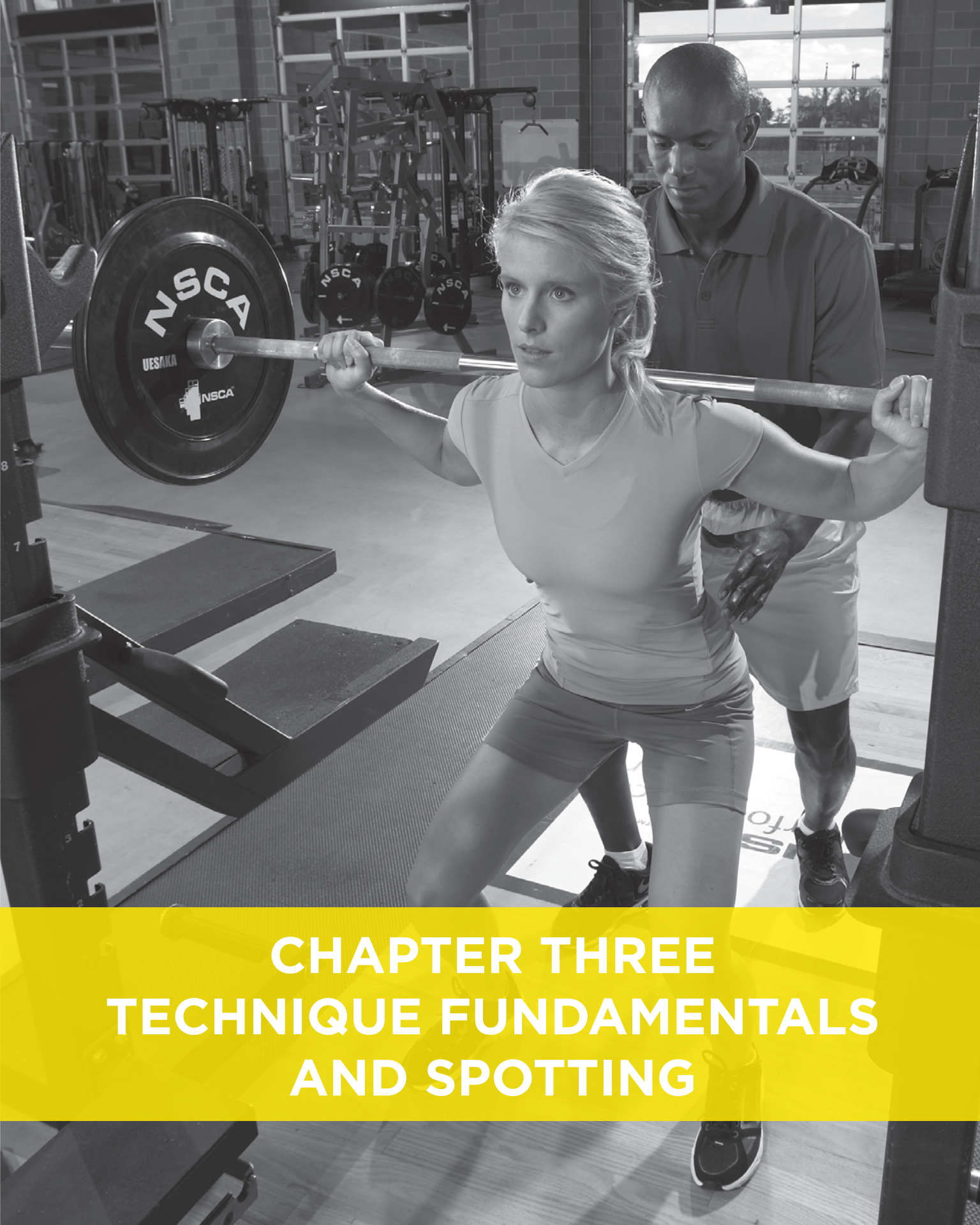


Performance Pyramid



CHAPTER THREE
TECHNIQUE FUNDAMENTALS AND SPOTTING

Proper exercise execution is at the core of safe and effective resistance training. Correct execution of exercises with the addition of competent spotting is a pillar of resistance training's contribution to injury prevention.

Technique Fundamentals

There are several commonalities amongst resistance training exercise techniques. Most free weight and machine exercises involve some sort of handgrip on a bar, dumbbell, or handle, and all exercises proceed from an optimal body or limb position, movement range and speed, and method of breathing. Additionally, some exercises may also warrant the use of a weight belt and certain procedures for lifting a bar off the floor (2).

Handgrips

Resistance training involves two main types of handgrips: (a) the pronated grip, with palms down and knuckles up as you face the bar, also called the overhand grip; and (b) the supinated grip, with palms up and knuckles down as you face the bar, also called the underhand grip (2). A neutral grip is the position where the palms face each other—as in a handshake. Neutral grips often apply to dumbbells and some specially designed angled bars. Two less common grips are the alternated grip, in which one hand is in a pronated grip and the other is in a supinated grip, and the hook grip, which is similar to the pronated grip except that the thumb is positioned under the index and middle fingers (2). The hook grip is typically used for performing exercises that require a stronger grasp on the bar due to the higher resistance (e.g., snatch). Note that the thumb is wrapped around the bar in all of the grips shown; this position is called a closed grip. When the thumb does not wrap around the bar, the grip is open, or considered a false grip. Establishing the proper grip in an exercise involves placing the hands at the correct distance from each other (referred to as the grip width) (2).

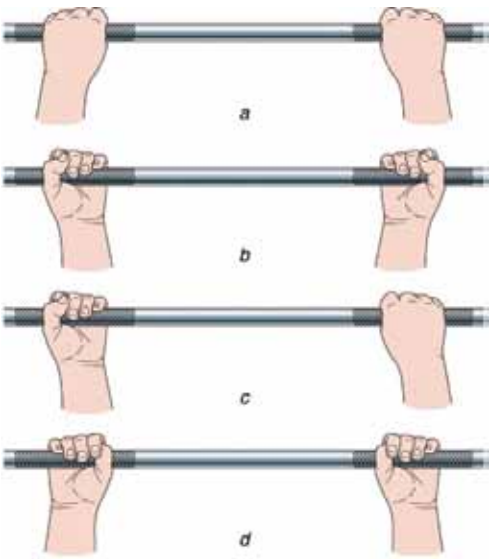


Figure 3-1. Examples of Different Barbell Grips: a) Pronated/Overhand, b) Supinated/Underhand, c) Alternated, and d) Hook

Grip Width

The three main handgrip widths are common, wide, and narrow. For most exercises, the hands are placed at approximately shoulder-width (2). Hand positioning for all exercises should result in a balanced, even bar (Figure 3-2).

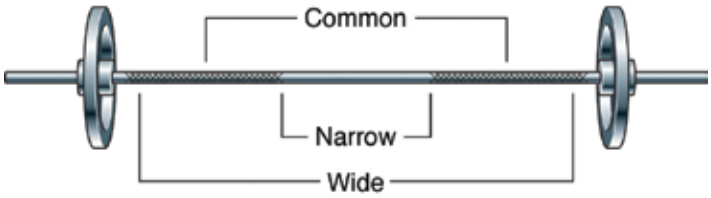


Figure 3-2. Grip Width Landmarks on the Barbell

Stable Body and Limb Positioning

Whether an exercise requires lifting a barbell or dumbbell from the floor, or pushing and pulling while on a machine, establishing a stable position is critical. A stable position enables the athlete to maintain proper body alignment during an exercise, which in turn places the appropriate stress on the target muscles. Exercises performed while standing typically require that foot position be slightly wider than hip-width with the heels and balls of the feet in contact with the floor. Establishing a stable position in, or on, machines sometimes requires adjusting the seat or movable resistance arm, fastening belts snugly, or correctly placing movable pads. Seated, or supine, exercises performed on a bench require a specific posture. The athlete should position the body to achieve a five-point body contact position:

1. Head in neutral position on bench or back pad
2. Shoulders and upper back set evenly on bench or back pad
3. Buttocks on bench or seat
4. Right foot flat on floor
5. Left foot flat on floor

Cam-, pulley-, or lever-based exercise machines that have an axis of rotation require specific positioning of the resistance and the athlete's arms and/or legs for reasons of safety and optimal execution posture. Align the target joint, and thus its muscle group(s) involved in the exercise, with the axis of the machine. Proper machine placement may require seat, roller pad, thigh pad, back pad, or chest pad adjustment.

Range of Motion and Speed

Nearly all exercises use the full range of motion of a joint or machine. Advanced training approaches (not covered here) sometimes use less than the full range of motion. When the goal is power or explosive exercise performance, the effort should accelerate the resistance to a maximal, controllable speed. Some machines do not permit rapid movements. Always check the manufacturer's instructions to determine a machine's proper use.

Breathing Considerations

The most strenuous position in the range of motion of an exercise is referred to as the "sticking point" (typically soon after the transition from the eccentric phase to the concentric phase) (2,3). Instruct athletes to exhale through the sticking point and to inhale during the less stressful phase of the repetition. Breath holding (called the Valsalva maneuver) is appropriate in some exercise situations. The Valsalva maneuver is reserved for advanced athletes, and can be helpful for maintaining proper vertebral alignment and support (1,2). The Valsalva maneuver involves expiring against a closed glottis, which, when combined with contracting the abdomen and rib muscles, creates more rigidity in the abdominal area to help stabilize the spine (1,2). The resulting increase in intra-abdominal pressure has potentially detrimental side effects, such as dizziness, disorientation, excessively high blood pressure, and blackouts. Breath holding should be transient, about 1 – 2 s, and allow the athlete to stabilize the spine during the high exertion range of motion and then breathe again.

Lifting a Bar from the Floor

Proper position of the feet and back enables the leg muscles to provide the major contribution for lifting from the floor. It is important to keep the bar close to the body and the back flat during the upward movement. Encourage the athlete to bend at the knees more than at the hips in order to lift the resistance from the floor.

Spotting

A spotter is someone who assists in the execution of an exercise to help protect the athlete from injury. Spotting resistance exercises is a skill. As a skill, spotting requires instruction and practice. A spotter may also serve to motivate the athlete and help in partner-assisted repetitions. However, the spotter's primary responsibility is the safety of the athlete.

Types of Exercises that Require Spotting

Free weight exercises performed over the head (e.g., barbell shoulder press), with the bar on the back (e.g., back squat), with the bar racked anteriorly on the front of the shoulders or on the clavicles (e.g., front squat), and over the face (e.g., bench press, lying triceps extension) are challenging for the athlete. When lifting heavy resistances, the role of the spotter increases due to the potential inability of the athlete to lift the weight to a safe position. Some specific exercises or lifts may require more than one spotter. For example, weights lifted to the side, or too heavy resistances for a single spotter to handle, may require the aid of other spotters to watch the weight(s) while another spotter assists the athlete. Vigilance is required whenever the bar is over the head, over the face, or otherwise unstable. Spotting dumbbell exercises typically requires more skill than spotting barbell exercises because there are two pieces of equipment to control. Contraindications for spotting include power exercises at high speeds.

Spotting Overhead Exercises

Ideally, to promote safety of the athlete during lifts with the bar on the back, or front of the shoulders, a power rack with the safety crossbars in place at an appropriate height is recommended. Clear all objects that might cause tripping from the lifting area. One of the most common causes of injury in a weight training area is tripping over a weight plate on the floor. Nonparticipating athletes should stay clear of the lifting area and avoid distracting the lifter's attention by standing or moving in front of the athlete. Spotters must be strong enough and tall enough to catch unstable weights and match the height of the athlete.

Spotting Over-the-Face Exercises

The spotter should grasp the bar with an alternated grip, usually narrower than the athlete's grip when spotting an over-the-face exercise. The spotter should use an alternated grip to pick up the bar and return it to the floor, or rack, and a supinated grip to spot the bar during the lift. The grips described help ensure that the bar does not roll out of the spotter's hands and onto the athlete's face or neck. For dumbbell exercises, the spotter should spot as close to the dumbbells as possible. In some dumbbell exercises, it is more practical to spot the arms of the athlete rather than the dumbbells. Spotting at the forearms near the wrists provides a safer technique in these situations. Note that for some exercises (e.g., dumbbell pullover and overhead dumbbell triceps extension) it is necessary to spot with hands directly on the dumbbells.

Spotting Considerations for Power Exercises

Spotting recommendations change for power exercises. Instead of spotting power exercises, the coach should teach the athlete how to get away from a bar that is out of control or unstable. Spotting these types of exercises is too dangerous to both the spotter and athlete. When the bar is in front of the athlete, the athlete should miss the lift by pushing the bar away or simply dropping it. If the bar becomes unstable behind the head, the athlete should release the bar and jump forward. For these reasons, a clear area and platform are necessary to avoid injury to the athlete and others.

Number of Spotters

The number of spotters is determined directly by the specific exercise and the load. The experience and ability of the athlete and spotters, strength of the spotters, and mutual experience also helps determine the number of spotters. Obviously, with heavier loads, the likelihood of injuries increases. Once the load exceeds a single spotter's ability to effectively protect the athlete (and him- or herself), incorporate another spotter.

Communication between Athlete and Spotter

Communication is a shared responsibility. Before beginning a set, the spotter(s) and athlete should establish and communicate how initial bar movements will occur, the intended number of repetitions, and signals for moving the bar into position. If the spotters do not have this information, they may take control of the bar improperly, too soon, or too late, and consequently disrupt the exercise or injure the athlete or themselves.

Amount and Timing of Spotting Assistance

Sometimes less is more. In addition to protecting the athlete from a fall or dropped weight, a spotter should know how much to assist the athlete when the situation demands only marginal assistance. At the first indication that a repetition is failing, the athlete should quickly ask or signal the spotter (sometimes with just a grunt or sound) for help, and the spotter needs to provide the amount of assistance needed for safe completion. If the athlete cannot contribute anything to the completion of the repetition, the athlete should immediately tell the spotter to "take it" or use a similar phrase. The spotter should take the bar from the athlete quickly and smoothly.

Spotting Techniques

Note that the exercises in this section serve as a model for spotting technique. Exercise technique for each exercise will be addressed in the next chapter.

Barbell Bench Press – Spotting Technique

Stand erect and very close to the head of the bench (but do not distract the athlete)

- Place feet shoulder-width apart with knees slightly flexed
- Grasp the bar with a closed, alternated grip inside the athlete's grip (Figure 3-3)
- Assist with moving the bar off the supports at athlete's signal (Figure 3-3)
- Guide the bar to a position over the athlete's chest and release the bar smoothly (Figure 3-4)
- Full attention should be given to the athlete through all repetitions of the set (Figure 3-5)
- At the end of the set, the athlete will signal for assistance in racking the bar (Figure 3-6)
- Keep a grip on the bar until it is racked (Figure 3-6)

Figure 3-3. Assisted Lift-Off

Figure 3-4. Lifting Position

Figure 3-5. Lowest Lifting Position

Figure 3-6. Racking Position

Dumbbell Incline Bench Press – Spotting Technique

- Stand erect and very close to the head of the bench (but do not distract the athlete)
- Place feet shoulder-width apart with knees slightly flexed
- Place hands near the athlete's wrists (Figure 3-7)
- Keep hands near the athlete's wrists and follow the path of the lift as the dumbbells descend and ascend (Figure 3-8)
- Grasp the athlete's wrists if they begin to struggle and/or get outside the path of the lift (Figure 3-9)

Barbell Standing Behind the Neck Shoulder Press – Spotting Technique

- Stand directly behind the athlete and place hands outside of the athlete's grip (Figure 3-10)
- Keep hands close to the bar, but not touching it, as the bar ascends and descends (Figure 3-11)
- If the bar descends too fast, or the athlete becomes off-balanced, assist in keeping the descent and movement slow and controlled (Figure 3-12)

Figure 3-7. Start Position

Figure 3-8. Bottom Lifting Position

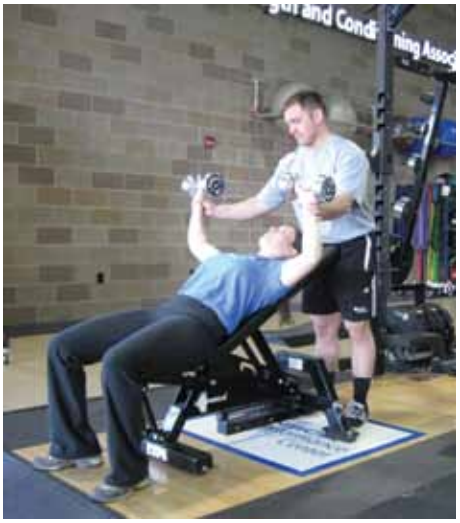


Figure 3-9. Spotter Assisting Ascent

Figure 3-10. Start Position

Figure 3-11. Highest Position

Figure 3-12. Spotter Assisting Descent

Barbell Back Squat – Spotting Technique with One Spotter

- Stand behind the athlete at a point where they will back out from the rack (Figure 3-13)
- Step up to the athlete after they have set their stance, set feet slightly wider than theirs, and position arms under the athlete's armpits, next to their side (Figure 3-14)
- As the athlete descends, descend in unison keeping arms under their armpits without touching (Figure 3-15)
- As the athlete ascends, ascend in unison keeping arms under their armpits without touching (Figure 3-16)
- Be ready to grasp the athlete around the torso if they fail to maintain proper technique and/or complete a repetition
- If the athletes fails, wrap arms under their armpits and around their torso to help them return to an erect position (Figure 3-17)
- If the spotter assists in a repetition, the athlete and spotter should walk the weight back to be racked (Figure 3-18)

Figure 3-13. Athlete Lift-Off

Figure 3-14. Start Position

Figure 3-15. Lowest Squat Position

Figure 3-16. Ascending

Figure 3-17. Spotter Assisting Ascent

Figure 3-18. Racking the Bar

Barbell Back Squat – Spotting Technique with Three Spotters

- The main spotter will stand behind the athlete at a point where they will back out from the rack
- The two side spotters will stand on each end of the barbell
- The main spotter will step up to the athlete after they have set their stance, set feet slightly wider than theirs and position arms under the athlete's armpits, next to their side
- The two side spotters will be in a "ready position" with their hands cupped near each end of the barbell (Figure 3-19)
- As the athlete descends, descend in unison keeping arms under their armpits without touching them
- Side spotters will descend evenly with the athlete keeping their hands near the ends of the barbell
- As the athlete ascends, ascend in unison keeping the arms under their armpits without touching them
- Side spotters will ascend evenly with the athlete keeping their hands near the ends of the barbell (Figure 3-20)
- The main spotter should be ready to grasp the athlete around the torso if they fail to maintain proper technique and/or complete the repetition, and side spotters should be ready to grasp the ends of the barbell
- If the athlete fails, the main spotter will yell "take it" and wrap their arms around the torso to help the athlete return to an erect position
- The side spotters will simultaneously grab each end of the barbell to assist the main spotter and athlete if a repetition is failed. All three spotters should assist evenly to ensure the safest condition for the athlete and spotters
- If the spotters assist in the repetition, the athlete and all three spotters should walk the weight back to be racked

Figure 3-19. Start Position

Figure 3-20. Lowest Position

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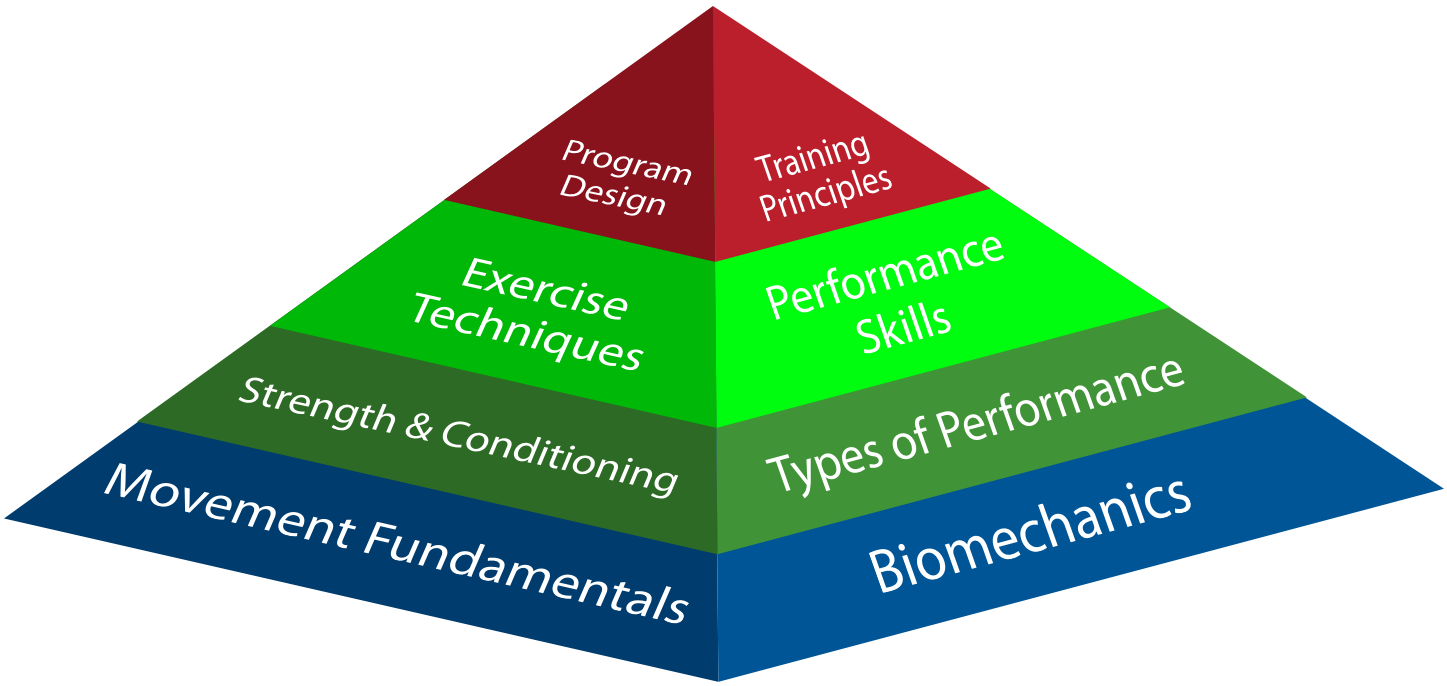

Performance Pyramid

CHAPTER FOUR
EXERCISE TECHNIQUE

The following information pertains to standard techniques for performing basic resistance training exercises and some of their variations. Many strength training and conditioning programs regularly use these foundational exercises. Everyone using these exercises should have a sound understanding of how each of these exercises and their variations are performed to optimize individual techniques and progress. The list of descriptions, coaching points, and other comments are categorized relative to the sample program provided in Chapter 2, and correspond to the explosive lifting day and the strength lifting day.

Explosive Lifting Day

1. Clean Progression (choose one exercise per phase)
   1a. Barbell Rack Clean (Rack Shrug OR Rack Jump)
   1b. Barbell Hang Clean (Hang Shrug OR Hang Jump)
   1c. Barbell Power Clean (Clean Shrug OR Clean Jump)

2. Barbell High Pull
   2a. High Pull from the Hang

3. Shoulder Progression (choose one exercise per phase)
   3a. Dumbbell Shoulder Raises (choose this if the athlete cannot stabilize the weight overhead) OR
   3b. Barbell Standing behind the Neck Shoulder Press
   3c. Barbell Push Press
   3d. Barbell Push Jerk

4. Pulling Choice
   4a. Pull-Ups
   4b. Standing Low Row
   4c. Lat Pulldown
   4d. Bent-Over Row

5. Bicep Choice
   5a. EZ-Bar Curl

6. Abdominals Choice
   6a. Hand Planks
   6b. Elbow Planks (front and sides)

Strength Lifting Day

1. Leg Progression (choose one per phase)
   1a. Barbell Back Squat
   1b. Barbell Front Squat
   1c. Barbell Clean Deadlift

2. Barbell Romanian Deadlift (RDL)

3. Single-Leg Choice (choose one per phase)
   3a. Forward Step Lunge
   3b. Walking Lunge

4. Pushing Progression (choose one per phase)
   4a. Barbell Bench Press
   4b. Barbell Incline Bench Press
   4c. Dumbbell Bench Press
   4d. Dumbbell Incline Bench Press

5. Triceps Choice
   5a. Triceps Pushdown

6. Abdominals Choice
   6a. Heel Touches

Explosive Lifting Exercise Technique

1. Clean Progression

1a. Barbell Rack Clean

Exercise Objective: Develop the explosive phase of the pull and teach the athlete how to get under the bar quickly

Start Position

1. Set the bar at a height, either on boxes or in a power rack, where the thighs make contact with the bar at approximately mid-thigh (Figure 4-1)

2. Address the bar and place feet hip-width apart with toes pointed straight ahead

3. Grasp the bar with a pronated grip slightly wider than shoulder-width

4. Keep knees slightly bent and behind the toes, flex at the hips and transfer weight from the balls of the feet to the heels

5. Shoulders should be slightly in front of the bar, in line with the knees and ankles

6. Arms should be completely extended and elbows pointed out

7. Head remains in a neutral position looking forward

Figure 4-1. Start Position

Figure 4-2. Triple Extension

Figure 4-3. Catch Position

8. Take a deep breath to fill the chest with air and engage the core

Procedure

1. Explosively extend hips, knees, and ankles to achieve triple extension and accelerate bar upward (Figure 4-2)
2. Simultaneously extend onto the balls of the feet and shrug shoulders straight up
3. Keep the bar close to the body with arms extended and elbows pointed out
4. Transition feet to a squat stance and quickly pull entire body under the bar
5. Flex hips backward and sit into a quarter squat position to absorb the weight of the bar (Figure 4-3)
6. Quickly rotate elbows down and then up ahead of the bar to catch it on the front portion of the shoulders
7. Stand erect with feet flat on the ground and shoulders directly over the balls of the feet

Coaching Points

- Lower the bar in a slow and controlled manner between reps by keeping elbows slightly flexed
- Avoid pulling with the arms before attaining complete extension of the hips
- Catch the bar with elbows high, hips back, and eyes forward
- Keep elbows high in front to securely rack the bar on the front portion of the shoulders

1b. Barbell Hang Clean

Exercise Objective: Develop explosive power in the hips and legs and teach the athlete to utilize the stretch-shortening cycle

Start Position

1. Approach bar resting on the floor or platform so the shins make contact
2. Place feet hip-width apart with toes pointed straight ahead
3. Keep back flat, shoulder blades pulled together, and squat down to grasp the bar
4. Grasp the bar with a pronated grip slightly wider than shoulder-width with arms straight and elbows pointed out (Figure 4-4)
5. Head remains in a neutral position looking forward throughout the entire lift
6. Slowly extend hips and knees to elevate the bar to just above the knees
7. Keep the bar close to the body and extend hips as the bar passes the knees
8. Stand erect with shoulders, hips, and knees in alignment and the bar held at arm's length touching the top part of the thigh (Figure 4-5)

Procedure

1. Take a deep breath to fill the chest with air and engage the core
2. Keep back flat, and shoulder blades pulled together
3. Lower the bar to the top of the knees by flexing at the hips
4. In the load position, shoulders should be in front of the bar, back flat, arms extended with elbows pointed out, hips flexed, knees slightly bent (not locked out), and weight on the heels (Figure 4-6)
5. From the load position, explosively extend hips, knees, and ankles to achieve triple extension and accelerate the bar upward
6. Simultaneously extend onto the balls of the feet and shrug shoulders straight up (Figure 4-7)
7. Keep the bar close to the body with arms extended and elbows pointed out
8. Transition feet to slightly wider than hip-width, keeping them in a 30" x 36" box, and quickly pull entire body under the bar
9. Flex hips backward and sit into a quarter squat position to absorb the weight of the bar (Figure 4-8)
10. Quickly rotate elbows down and then up ahead of the bar to catch it on the front portion of the shoulders
11. Stand erect with feet flat on the ground and shoulders directly over the balls of the feet (Figure 4-9)

Coaching Points

- The purpose of the 30" x 36" box mapped out on the platform is to ensure that the explosive movement is primarily vertical (if the athlete puts too much emphasis in the horizontal or lateral directions it will be easy to observe as they will jump out of the box)
- Lower the bar in a slow and controlled manner between repetitions by keeping elbows slightly flexed
- Stand erect before each repetition
- Avoid pulling with the arms before attaining complete extension of the hips
- Catch the bar with elbows high, hips back, knees over toes, and eyes forward

Figure 4-4. Addressing the Bar

Figure 4-5. Start Position

Figure 4-6. Load Position

Figure 4-7. Triple Extension

Figure 4-8. Catch Position

Figure 4-9. Finish Position

1c. Barbell Power Clean

Exercise Objective: Develop the ability to express explosive power in the hips and legs

Start Position

1. Approach the bar resting on the floor or platform so the shins make contact
2. Place feet hip-width apart with toes pointed straight ahead
3. Keep back flat and shoulder blades pulled together, squat down to grasp the bar (Figure 4-10)
4. Grasp the bar with a pronated grip slightly wider than shoulder-width with arms straight and elbows pointed out
5. Head remains in a neutral position looking forward throughout the entire lift
6. Weight should be shifted to the heels, and the hips should be slightly higher than the knees (Figure 4-10)

Procedure

1. Lift the bar smoothly off the floor to just above the knees by slowly extending the hips and knees (keep the bar in contact with the shins)
2. The bar, knees, hips, and shoulders rise in unison with a constant back angle throughout (i.e., avoid excessive arching)
3. As the bar passes over the knees, the shoulders remain in front of the bar, arms straight with elbows pointed out, hips flexed, and knees slightly bent (Figure 4-11)
4. Explosively extend hips, knees, and ankles to achieve triple extension and accelerate the bar upward (Figure 4-12)
5. Simultaneously extend onto the balls of the feet and shrug shoulders straight up (Figure 4-12)
6. Keep bar close to the body as it accelerates and keep shoulder blades pulled together, arms straight, and elbows pointed out

Figure 4-10. Addressing the Bar

Figure 4-11. Load Position

Figure 4-12. Triple Extension

Figure 4-13. Catch Position

Figure 4-14. Finish Position

7. Transition feet to slightly wider than hip-width, keeping them in a 30" x 36" box, and quickly pull entire body under the bar
8. Flex hips backward and sit into a quarter squat position to absorb the weight of the bar
9. Quickly rotate elbows down and then up ahead of the bar to catch it on the front portion of the shoulders (Figure 4-13)
10. Stand erect with feet flat on the ground and shoulders directly over the balls of the feet (Figure 4-14)

Coaching Points

- Lower the bar in a slow and controlled manner between repetitions by keeping the elbows slightly flexed
- To lower the bar back to the platform, push hips back and slide the bar down the front of the thighs until it reaches the knees
- Sit into a quarter squat position to allow the bar to land on the thighs to aid in its deceleration
- Avoid jerking the bar off the floor; instead, pull it smoothly and under control to the top of the knees
- Avoid pulling with the arms before attaining complete extension of the hips
- Catch the bar with the hips back, elbows high, and eyes forward

2. Barbell High Pull

2a. High Pull from the Hang

Exercise Objective: Develop the ability to express explosive power in the hips and legs

Start Position

1. Approach the bar resting on the floor or platform so the shins make contact
2. Place feet hip-width apart with toes pointed straight ahead
3. Keep back flat and shoulder blades pulled together, squat down to grasp the bar
4. Grasp the bar with a pronated grip slightly wider than shoulder-width with arms straight and elbows pointed out
5. Head remains in a neutral position looking forward throughout the entire lift
6. Lift bar smoothly off the floor to just above the knees
7. Stand erect with shoulders, hips, and knees in alignment, and the bar held at arm's length on the top part of the thighs (Figure 4-15)

Procedure

1. Take a deep breath to fill the chest with air and engage the core
2. Keep back flat and shoulder blades pulled together
3. Lower the bar to the top of the knees by flexing at the hips (Figure 4-16)
4. In the load position, shoulders should be in front of the bar, back flat, arms extended with elbows pointed out, hips flexed, knees slightly bent (not locked out), and weight on the heels
5. When the bar reaches the top of the knees, immediately extend hips, knees, and ankles to achieve triple extension and accelerate the bar upward
6. Simultaneously extend onto the balls of the feet and shrug shoulders straight up
7. Keep the bar close to the body with arms straight and elbows pointed out until the body is fully extended
8. Pull the bar up to neck height by flexing the elbows out and keeping them above the bar (Figure 4-17)
9. Lower the bar in a controlled manner by keeping elbows slightly flexed, sitting into a quarter squat position, and landing the bar on the thighs

Coaching Points

- The bar should be pulled up in a straight path, close to the body
- Avoid "throwing" the head and shoulders back to complete the lift
- With heavier weights, the athlete may unload or drop the bar from the finish position (this technique may be practiced to reduce the stress and fatigue involved in lowering the bar as prescribed)
- Use rubber weightlifting plates on a weightlifting platform if this unloading method is used
- Stand erect in the start position before each repetition (Figure 4-15)
- Avoid pulling with the arms before attaining complete extension of the hips

Figure 4-15. Start Position

Figure 4-16. Load Position

Figure 4-17. Triple Extension

3. Shoulder Progression

3a. Dumbbell Shoulder Raises

Shoulder raises are a group of three exercises (front, lateral, bent-over) that can be performed together in any combination, or separately.

Front Raises

Exercise Objective: Isolate and develop strength in the anterior deltoids

Start Position

1. Stand erect with a dumbbell in each hand
2. Let arms hang in front of the thighs, and pull shoulder blades back and down
3. Position feet hip-width apart with toes pointed straight ahead
4. Slightly flex knees and engage the core to stabilize the body and prevent arching of the back (avoid rocking back and forth to complete the lift)

Procedure

1. Maintain a constant body position and raise dumbbells directly to the front until they are at shoulder level (Figure 4-18)
2. Keep palms facing the ground and lower dumbbells slowly, back to the start position

Coaching Points

- Maintain a constant head, body, and arm position throughout the entire lift
- Avoid using momentum to complete the lift

Lateral Raises

Exercise Objective: Isolate and develop strength in the lateral deltoids

Starting Position

1. Stand erect with a dumbbell in each hand
2. Let arms hang to the sides to the thighs, and pull shoulder blades back and down
3. Position feet hip-width apart with toes pointed straight ahead
4. Slightly flex knees and engage the core to stabilize the body and prevent arching of the back (avoid rocking back and forth to complete the lift)

Procedure

1. Maintain a constant body position and raise dumbbells to the sides until they are at shoulder level (Figure 4-19)
2. Keep palms facing the ground and lower dumbbells slowly, back to the start position

Figure 4-18. Front Raise

Figure 4-19. Lateral Raise

Figure 4-20. Bent-Over Raise

Coaching Points

- Maintain a constant head, body, and arm position throughout the entire lift
- Avoid arching the back to complete the lift

Bent-Over Raises

Exercise Objective: Isolate and develop strength in the posterior deltoids

Start Position

1. Stand erect with a dumbbell in each hand
2. Let arms hang to the sides to the thighs, and pull shoulder blades back and down
3. Position the feet hip-width apart with toes pointed straight ahead
4. Engage the core and push hips back to transfer weight to the heels
5. Back should be parallel with the ground
6. The dumbbells will hang in front of the body with arms extended, palms facing each other, and shoulder blades pulled back and down

Procedure

1. Keep core engaged and back parallel to the ground
2. Raise both dumbbells laterally from the shoulders until they are at shoulder level (Figure 4-20)
3. Slowly lower dumbbells to start position in a controlled motion

Coaching Points

- Keep the back parallel to the ground and maintain a flat back throughout the lift
- Avoid using momentum to complete the lift
- Concentrate on raising the dumbbells laterally from the shoulders

3b. Barbell Standing Behind the Neck Shoulder Press

Exercise Objective: Develop strength in the muscles of the shoulder girdle and teach the athlete to use the whole body to stabilize overhead loads

Start Position

1. Set the bar at a height that is comfortable for lift-off
2. Place hands evenly on the bar, slightly wider than shoulder-width, with a pronated grip
3. Position bar behind neck and comfortably across the shoulders with shoulder blades pulled together, elbows pointed down with hands directly above them (Figure 4-21)
4. Stand erect and take one or two steps back to position body in the center of the rack
5. Place feet hip-width apart, toes pointed straight ahead, and slightly flex hips and knees with the weight centered on the feet (Figure 4-21)
6. Head remains in a neutral position looking forward
7. Engage the core to stabilize the body and prevent arching the back

Procedure

1. From the start position, press the bar straight overhead by extending the arms and keeping the body stable (Figure 4-22)
2. At the top of the lift, the bar should be slightly behind the ears with elbows completely extended and in line with the shoulders, hips, and heels
3. Lower the bar to its starting position across the shoulders in a controlled manner

Figure 4-21. Start Position

Figure 4-22. Finish Position

Coaching Points

- When lowering the bar, simultaneously flex hips and knees as the bar hits the shoulders to help absorb the weight (do not allow knees to come forward over toes)
- Avoid using the lower body to complete the lift
- Keep shoulders over hips during the entire range of motion
- Keep elbows directly under hands throughout the entire lift
- Engage the core to avoid arching the back to complete the lift
- This lift may also be performed from the front of the shoulders

3c. Barbell Push Press

Exercise Objective: Develop explosive power in the hips and legs, as well as strengthen the shoulder muscles while stabilizing overhead loads

Start Position

1. Set the bar at a height that is comfortable for lift-off
2. Place hands evenly on the bar, slightly wider than shoulder-width, with a pronated grip
3. Position bar behind neck and comfortably across the shoulders with shoulder blades pulled together, elbows pointed down with hands directly above them (Figure 4-23)
4. Stand erect and take one or two steps back to position body in the center of the rack
5. Place feet hip-width apart, toes pointed straight ahead, and slightly flex hips and knees with the weight centered on the feet (Figure 4-23)
6. Head remains in a neutral position looking forward
7. Engage the core to stabilize the body and prevent arching the back

Figure 4-23. Start Position

Figure 4-24. Quarter Squat Position

Figure 4-25. Finish Position

Procedure

1. Keep back flat and shoulder blades pulled together
2. Lower into a quarter squat position by pushing hips back, flexing knees, letting the torso come forward, and transfer the weight onto the heels (Figure 4-24)
3. Explosively extend hips and knees to accelerate the bar upward
4. Drive the bar upward by extending arms completely, pressing it overhead
5. At the top of the lift, the bar should be slightly behind the ears with elbows completely extended and in line with the shoulders and hips (Figure 4-25)
6. As the bar is caught overhead, flex hips backward, keep knees behind toes, and sit into a quarter squat position
7. Extend hips and knees to stand erect
8. Lower the bar to the start position in a controlled manner

Coaching Points

- When lowering the bar, simultaneously flex hips and knees as the bar hits the shoulders to help absorb the weight (do not allow knees to come forward over toes)
- There should be no pause at the bottom of the initial countermovement quarter squat before explosively extending the weight overhead
- Keep elbows directly under hands throughout entire lift
- Engage the core to prevent arching the back
- This lift is may also be performed from the front of the shoulders

3d. Barbell Push Jerk

Exercise Objective: Develop explosive power in the hips and legs, as well as strengthen the shoulder muscles while stabilizing overhead loads

Start Position

1. Set the bar at a height that is comfortable for lift-off
2. Place hands evenly on the bar, slightly wider than shoulder-width, with a pronated grip
3. Position bar behind neck and comfortably across the shoulders with shoulder blades pulled together, elbows pointed down with hands directly above them (Figure 4-26)
4. Stand erect and take one or two steps back to position body in the center of the rack
5. Place feet hip-width apart, toes pointed straight ahead, and slightly flex hips and knees with the weight centered on the feet (Figure 4-26)
6. Head remains in a neutral position looking forward
7. Engage the core to stabilize the body and prevent arching the back

Figure 4-26. Start Position

Figure 4-27. Quarter Squat Position

Figure 4-28. Catch Position

Figure 4-29. Finish Position

Procedure

1. Keep back flat and shoulder blades pulled together
2. Lower into a quarter squat position by pushing hips back, flexing knees, letting the torso come forward, and transfer the weight onto the heels (Figure 4-27)
3. Explosively extend hips and knees and go onto the balls of the feet to accelerate the bar upward
4. Drive the bar upward with the shoulders and arms, and push the body under the bar (Figure 4-28)
5. In the catch position, the bar should be slightly behind the ears with elbows completely extended and in line with the shoulders and hips
6. Stabilize the body and step feet together so they are shoulder-width apart (Figure 4-29)
7. Lower the bar to the start position in a controlled manner

Coaching Points

- When lowering the bar, simultaneously flex hips and knees as the bar hits the shoulders to help absorb the weight (do not allow knees to come forward over toes)
- There should be no pause at the bottom of the initial countermovement quarter squat before explosively extending the weight overhead
- Keep torso upright when making the overhead catch (any forward lean will make it difficult to complete the lift)
- Drive the bar upward with the shoulders to take advantage of the power from the hips and legs
- Keep elbows directly under hands throughout the entire lift
- Engage the core to stabilize the body and prevent arching the back.
- This lift may also be performed from the front of the shoulders

4. Pulling Choice

4a. Pull-Ups

Exercise Objective: Develop strength in the muscles of the upper back, arms, and abdominals

Start Position

1. Place hands evenly on a bar slightly wider than shoulder-width with a pronated grip
2. Let body hang completely from the bar, with elbows and hips fully extended, knees slightly flexed, and ankles crossed (Figure 4-30)
3. Engage the core to stabilize the body and prevent arching of the back

Figure 4-30. Start Position

Figure 4-31. Finish Position

Procedure

1. From the start position, pull entire body up by squeezing the shoulder blades back and down, and flexing elbows
2. Continue to pull body upward until chin is over the bar (Figure 4-31)
3. Lower entire body back to the start position in a controlled manner

Coaching Points

- Avoid swinging the body or legs when pulling up
- Concentrate on squeezing the shoulder blades together to achieve a full range of motion
- Engage the core throughout the entire range of motion

4b. Standing Low Row

Exercise Objective: Develop the muscles of the upper back as well as the stabilizers of the legs and core

Start Position

1. Squat down to grasp the bar or handle and place hands evenly spaced
2. Keep chest up, back flat, and core engaged, and take a few steps back to center your body in the machine
3. Place feet hip-width apart, toes pointed straight ahead, hips and knees slightly flexed, and center weight on the feet (Figure 4-32)
4. Knees should be directly over ankles with a slight forward lean of the torso so the shoulders are directly over the knees
5. Fully extend elbows (Figure 4-32)

Procedure

1. Maintain the start position and squeeze shoulder blades back and down while flexing elbows
2. Continue to pull the handle until it touches the upper abdomen (Figure 4-33)
3. Return the bar to the start position in a slow, controlled manner

Figure 4-32. Start Position *Figure 4-33. Finish Position*

Coaching Points

- Maintain a flat back throughout the entire exercise
- Concentrate on maintaining a constant body position and pulling shoulder blades together
- Avoid using momentum to complete the lift
- Focus on achieving a full range of motion

4c. Lat Pulldown

Exercise Objective: Develop strength in the muscles of the upper back

Start Position

1. Adjust the thigh pad to anchor the body to the seat
2. Place hands evenly on the bar, slightly wider than shoulder-width, with a pronated grip
3. Fully extend arms, keep chest up, back flat, and engage the core (Figure 4-34)

Procedure

1. Keep back flat, pull shoulder blades down and back while flexing elbows
2. Pull the bar down until it touches the top of the chest (Figure 4-35)
3. Return the bar to the start position in a slow, controlled manner

Figure 4-34. Start Position *Figure 4-35. Finish Position*

Coaching Points

- Maintain a flat back position throughout the entire lift
- Avoid initiating the downward movement of the bar by leaning backward with the torso
- Concentrate on pulling elbows straight down and squeezing shoulder blades together
- Focus on achieving a full range of motion

4d. Bent-Over Row

Exercise Objective: Develop strength in the muscles of the upper back

Start Position

1. Approach the bar resting on the floor or platform and place feet hip-width apart with toes pointed straight ahead
2. Keep back flat and shoulder blades pulled together
3. Squat down to grasp the bar with a pronated grip slightly wider than shoulder-width
4. Keep arms extended and elbows pointed out (Figure 4-36)

5. Slowly extend legs to elevate the bar to just above the knees, then extend hips to stand erect

6. Keeping the back flat and knees slightly flexed, push hips backward and lower torso until it is parallel with the floor

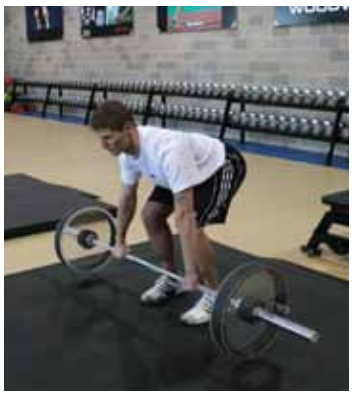

Figure 4-36. Start Position

Figure 4-37. Finish Position

Procedure

1. Maintain a torso position parallel to the floor, squeeze shoulder blades together, and flex elbows to pull them up and slightly outward

2. Pull the bar upward until it touches the upper abdomen (Figure 4-37)

3. Return the bar to the start position in a slow, controlled manner

Coaching Points

- Weight should remain on the heels of the feet with knees slightly flexed
- Maintain a flat back position throughout the entire lift
- Concentrate on squeezing the shoulder blades back and down to achieve a full range of motion
- Avoid using momentum to complete the lift

5. Biceps Choice

5a. EZ-Bar Curl

Exercise Objective: Develop strength in the biceps

Start Position

1. Grasp the bar with a supinated grip at approximately shoulder-width

2. Stand erect with feet hip-width apart with toes pointed straight ahead

3. Hold the bar at arm's length with elbows completely extended and shoulder blades pulled together (Figure 4-38)

4. Engage the core to stabilize the body and prevent rocking back and forth

Procedure

1. Maintain an erect body position and slowly pull the bar upward by flexing the elbows

2. Pull the bar up to the shoulders until elbows are completely flexed (Figure 4-39)

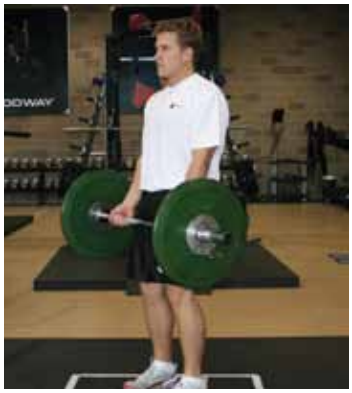

Figure 4-38. Start Position

Figure 4-39. Finish Position

3. Return the bar to the start position in a slow, controlled manner

Coaching Points

- Keep elbows positioned at the sides throughout the entire lift
- Avoid rolling shoulders forward during any part of the lift
- Avoid using momentum to complete the lift

6. Abdominals Choice

6a. Hand Planks

Exercise Objective: Develop strength, stability, and balance in the muscles of the pelvic, abdominal, back, and shoulder areas

Start Position

1. Start on all fours on a non-slip surface (Figure 4-40)

2. Hands should be directly under shoulders and knees should be directly under hips

3. Head should remain in a neutral position to keep the body in line

Procedure

1. From the start position, walk feet straight back (staying on toes) until legs reach full extension

2. Create a neutral pelvic and spine position by rolling the pelvis forward, contracting the gluteals, and pulling the belly button to the spine by contracting the inner abdominal muscles

3. Maintain a straight line from the ankles to the ears (Figure 4-41)

Figure 4-40. Start Position

Figure 4-41. Finish Position

4. Maintain this position for the designated time, or until a breakdown in technique occurs (e.g., hips pike upward, back arches, etc.)

Coaching Points

- Avoid letting hips sag and arching lower back
- Concentrate on breathing normally without releasing the abdominal contraction throughout the entire exercise
- Try holding for 20 s to start (as strength is gained and technique improves, increase the time)

6b. Elbow Planks (front and sides)

Exercise Objective: Develop strength, stability, and balance in the muscles of the pelvic, abdominal, back, and shoulder areas

Start Position

1. Start on elbows and knees on a non-slip surface
2. Elbows should be directly under shoulders and knees should be directly under hips
3. Head remains in a neutral position to keep the body in line

Procedure

1. From the start position, walk feet straight back (staying on toes) until legs are fully extended
2. Create a neutral pelvic and spine position by rolling the pelvis forward, contracting the gluteals, and pulling the belly button to the spine by contracting the inner abdominal muscles (Figure 4-42)
3. Hold this position for 20 s, then, without letting the knees or hips touch the ground, roll to one side, with the elbow directly under the shoulder, turning the arm to face forward
4. Maintain the neutral pelvic and spine position and roll to the side of the feet, lift hips, and raise the top arm straight up (Figure 4-43)
5. Hold for 20 s then return to the front elbow plank position and roll to the opposite side and hold for another 20 s
6. This should equate to 20 s for the front elbow plank and 20 s for each side elbow plank

Figure 4-42. Front Plank Position

Figure 4-43. Side Plank Position

Coaching Points

- Maintain stable body position for the designated time, or until a breakdown in technique occurs
- Avoid letting hips sag and arching lower back
- Concentrate on breathing normally without releasing the abdominal contraction throughout the entire exercise
- Increase the time as strength and technique improve
- Keep elbows directly under shoulders throughout the entire exercise

Strength Lifting Day Exercise Description
1. Leg Progression

1a. Barbell Back Squat
Exercise Objective: Develop the quadriceps, thigh adductors, gluteus maximus, and hamstrings

When done correctly, full squats strengthen the muscles, ligaments, and tendons surrounding the knee. The core muscles are developed to a large degree by keeping the torso erect. For this reason, this Manual provides detailed descriptions for the back squat.

Start Position
1. Stand under the bar with bar across the center of the shoulders
2. Ensure entire body is under the bar
3. Prior to lifting the bar, inhale to expand the lungs and hold until you have set up
4. Stand erect with the chest filled with air
5. Take one or two steps backward to set up (Figure 4-44)

Common Mistakes
- Not placing the body in center of the bar
- Not placing entire body under the bar
- Not filling the body with air and holding
- Taking more than two steps to set up

Figure 4-44. Start Position

Grip Position
1. All athletes should grip the bar with a closed, pronated grip (Figure 4-45)
2. A closer grip activates the muscles in the back
3. Taller athletes' grip will vary from medium to wide
4. Shorter athletes' grip will vary from close to medium


Figure 4-45. Grip Position

Common Mistakes
- Gripping the plates and not the bar
- Taking hands off the bar during the ascending phase
- Gripping the bar with an open grip

Bar Placement: No Significant Difference in Muscle Development between High-Bar and Low-Bar Squatting
1. High Bar Squat: The bar sits on top of the trapezius muscles near the base of the neck (increases force at the knees)
2. Low Bar Squat: The bar sits 1 – 2 in. below the deltoids (increases force at the hips)

Common Mistakes
- High-Bar: Leaning forward or rounding the back
- Low-Bar: Bar rolling down

Head and Eye Position
1. Head and eyes are positioned forward (Figure 4-46)
2. This is a natural position; keeping the cervical spine in line with the body helps maintain bodyweight distribution throughout the squat

Common Mistakes
- Titling head forward can shift weight to the balls of the feet, placing excess stress on the body, and cause rounding of the back
- Tilting head backward can shift weight to the heels of the feet, causing an improper curvature of the spine and unwanted stress on the neck and back


Figure 4-46. Head and Eye Position

Foot Position

1. Narrow stance – works quadriceps and gluteals to some extent
2. Medium stance – works quadriceps and adductors to some extent
3. Wide stance – works adductor, gluteus, and outer quadriceps
4. Keep heels on the floor
5. Point toes out slightly from neutral to 30°
6. The angle of the foot position makes no difference as long as you are comfortable with the stance

Common Mistakes

- Not finding what stance works for you
- Turning or pointing the toes inward

Abdominals

1. Strong abdominal muscles help maintain torso stability and intra-thoracic pressure throughout the squat
2. The abdominal obliques are an important muscle group when performing the squat as they help to maintain torso stability

Common Mistakes

- Not including abdominal work as part of the regular strength training routine
- Working only one section of the abdominal area (either upper or lower, or just the abdominal obliques)
- Not using a variety of abdominal/oblique exercises
- Too much hip flexion during abdominal exercises

Breathing

1. Inhale deeply to maintain intra-thoracic pressure and prevent bending forward, arching the back, and passing out
2. Helps maintain tightness throughout the squat
3. Inhale and hold prior to descent
4. Exhale near or at the top of the squat
5. Inhale and exhale at the top of the squat between repetitions

Common Mistakes

- Holding breath during entire repetitions
- Exhaling at the bottom of the squat

Torso

1. Engage the core
2. The torso should be held between 35 and 45° from vertical

Figure 4-47. Low Point of Descent

Figure 4-48. Ascent

3. Less than 35°, you are too upright
4. More than 45°, you are leaning too far forward
5. Back should be kept flat and straight

Common Mistakes

- Allowing the torso to lean too far forward
- Keeping the torso too upright
- Not squatting with a rigid torso

Descent

1. Push hips back
2. Simultaneously flex knees while pushing hips back
3. Maintain torso angle throughout lift
4. Distribute bodyweight from the balls of the feet to the heels
5. Keep knees behind the balls of the feet
6. Maintain slow, controlled descent
7. Keep shins as vertical as possible by sitting back into the squat
8. At the bottom, do not bounce, jerk, or stop the motion
9. Proper depth is achieved when mid-thigh is parallel to the floor (Figure 4-47)

Common Mistakes

- Shins not being vertical
- Rounding the back
- Dropping down too quickly into the squat (not slow and controlled)

Ascent

1. Drive feet into the floor
2. Simultaneously raise hips and shoulders
3. Push shoulders slightly back into the bar so chest remains facing outward (Figure 4-48)
4. Continue extending hips and knees
5. Maintain proper head and eye position
6. Stand erect and back into the start position

Common Mistakes

- Bouncing out of the bottom of the squat
- Raising hips too quickly out of the bottom of the squat
- Allowing the weight to shift to the toes

Without question, the squat is the single most effective leg exercise. This strength training exercise involves a large portion of the muscular system. Remember that every athlete's squat will vary based on differences in body types, length of the legs, and flexibility of the ankles. Technique will vary based on differences in stance widths, the use of heel blocks, and positioning of the bar (high or low) on the back. Coaches should instruct athletes to stabilize the torso by engaging the core. Never flex the spine (i.e., round forward) during a squat. Overall, the key to performing the squat is to do it correctly and carefully. Squats are not "bad for your knees." The fact is that if you have healthy knees, they are quite capable of handling even the heaviest weight that your body can tolerate (2,4,5).

1b. Barbell Front Squat

Exercise Objective: Develop the quadriceps, thigh adductors, gluteals, and hamstrings

When done correctly, front squats build the muscles, ligaments, and tendons surrounding the knee. This exercise is great for athletes who have problems keeping erect during back squats. If an erect position is not maintained during this lift, the bar will roll forward.

Start Position

1. Set the bar at a height that is comfortable for lift-off
2. Step under the bar with the knees slightly bent
3. Place the bar comfortably on the front of the shoulders in one of two positions:

- Clean Style: Place hands on the bar slightly wider than shoulder-width and rotate elbows up so they are high in front of the bar (Figure 4-49)
- Cross-Arm Style: Cross arms in front of shoulders and place hands on top of the bar with elbows high in front (Figure 4-50)

4. Align hips vertically with shoulders
5. Inhale to expand the lungs and hold until you are set up
6. Lift the bar off the rack by extending knees (Figure 4-51)
7. Step backward using as few steps as possible, and position the feet so they are shoulder-width apart with toes pointed straight ahead in a comfortable foot position (Figure 4-52)

Figure 4-49. Clean Style Grip

Figure 4-50. Cross-Arm Style Grip

Procedure

1. Focus head and eyes straight ahead, take a deep breath to fill the chest with air, and engage the core
2. In a slow, controlled motion, simultaneously push hips back, flex knees, and allow the torso to come forward slightly
3. Distribute bodyweight from the balls of the feet to the heels
4. At the bottom, do not bounce, jerk, or stop the squat (Figure 4-53)
5. Drive through the floor (keeping the weight back on the heels), and extend hips and knees
6. Raise hips and shoulders simultaneously to keep back flat and head neutral
7. Exhale near the top of the squat and fully extend knees and hips to return to start position

Coaching Points

- Do not bounce out of the bottom position
- Keep knees pointed out, aligned with feet, and behind toes throughout entire lift
- Pick a spot on the wall and focus on it throughout the entire lift

Figure 4-51. Lift-Off

Figure 4-52. Start Position

Figure 4-53. Bottom Squat Position

1c. Barbell Clean Deadlift

Exercise Objective: Learn how to lift the bar off the ground properly and develop strength in the muscles of the legs, hips, back, and torso stabilizers

Start Position

1. Approach the bar resting on the floor or platform so the shins make contact
2. Place feet hip-width apart with toes pointed straight ahead
3. Keep back flat and shoulder blades pulled together, squat down to grasp the bar
4. Grasp the bar with a pronated grip slightly wider than shoulder-width with arms straight and elbows pointed out
5. Head remains in a neutral position looking forward throughout the entire lift
6. Weight should be shifted to the heels, and the hips should be slightly higher than the knees
7. Take a deep breath to fill the chest with air and engage the core (Figure 4-54)

Procedure

1. Lift the bar smoothly off the floor to just above the knees by slowly extending the hips and knees (keep the bar in contact with the shins)
2. Raise the bar, knees, hips, and shoulders in unison with a constant back angle throughout (i.e., avoid excessive arching)
3. As the bar passes over the knees, the shoulders remain in front of the bar, arms straight with elbows pointed out, hips flexed, and knees slightly bent
4. Extend hips forward and engage the core to establish erect position
5. As a fully erect body position is established, shoulders, hips, knees, and ankles should be in alignment (Figure 4-55)
6. Return the bar to the platform in a slow, controlled manner, maintaining a straight back
7. The bar should slide down the thighs as you flex primarily at the hips until it passes over the knees
8. Then, squat down by simultaneously pushing hips back and flexing knees with weight on the heels

Coaching Points

- Maintain a constant back angle during the initial lift-off (the shoulders, hips, knees, and bar should all move together as one unit)
- Do not jerk the bar off the floor; pull it smoothly and under control
- The bar should remain in contact with the legs throughout the entire lift

Figure 4-54. Start Position

Figure 4-55. Finish Position

2. Barbell Romanian Deadlift (RDL)

Exercise Objective: Develop strength in the hamstrings, gluteals, and torso stabilizers

Start Position

1. Grasp the bar with a pronated grip slightly wider than shoulder-width
2. Stand in an erect position with feet shoulder-width apart, toes pointed straight ahead, and knees slightly flexed
3. Arms should be fully extended with elbows pointed out, and the bar resting against the thighs
4. Keep chest high by pulling shoulder blades together
5. Engage the core to maintain a straight back (Figure 4-56)

Procedure

1. Slowly push hips backward, let the bar slide down the thighs, and transfer weight onto the heels
2. Maintain a flat back and continue descent until the bar reaches the top of the knees (Figure 4-57)
3. Extend hips forward (by pulling with hamstrings), contract gluteals, and transfer weight back to the center of the feet to return to an erect position (Figure 4-58)

Coaching Points

- Maintain the starting back, chest, and knee positions throughout the entire range of motion
- Keep the shoulder blades pulled together throughout the entire lift
- The bar should remain in contact with the legs throughout the entire lift

3. Single-Leg Choice

3a. Forward Step Lunge

Exercise Objective: Isolate a single leg and develop strength in the muscles of the hips, legs, and core

Start Position

1. Stand in an erect position with dumbbells at sides, shoulder blades pulled back and down, arms straight, and palms facing in
2. Position feet hip-width apart with toes pointed straight ahead

Procedure

1. Take an exaggerated step forward keeping feet hip-width apart with toes pointed straight ahead (Figure 4-59)
2. Sit hips down until the front thigh is parallel with the floor
3. The torso should come forward to a 35 – 45° angle with back flat and straight (Figure 4-60)
4. Maintain balance and push through the heel of the front foot to return to the start position

Coaching Points

- Make sure that hips and shoulders remain square to the direction facing throughout the entire lift
- Keep weight on the front heel and keep back heel pointed to the sky to prevent it from rolling to the side
- Do not allow the front knee to go forward past the toes

3b. Walking Lunge

Exercise Objective: Develop strength in the muscles of the hips, legs, and core

Start Position

1. Stand in an erect position with dumbbells at sides, shoulder blades pulled back and down, arms straight, and palms facing in
2. Position feet hip-width apart with toes pointed straight ahead (Figure 4-61)

Figure 4-56. Start Position

Figure 4-57. Load Position

Figure 4-58. Finish Position

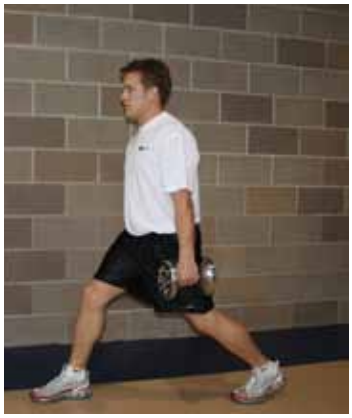

Figure 4-59. Start Position

Figure 4-60. Finish Position

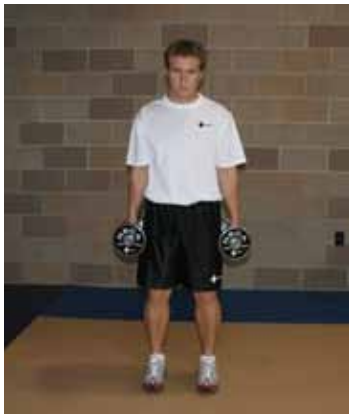

Figure 4-61. Start Position

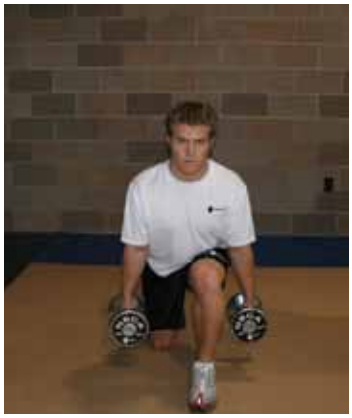

Figure 4-62. Finish Position

Procedure

1. Take an exaggerated step forward with one leg, keeping toes pointed straight ahead
2. Sit hips and knee down until the front thigh is parallel with the floor (Figure 4-62)
3. The torso should come forward to a 35 – 45 ° angle with the back flat and straight
4. Maintain balance as you push off with the back leg and step all the way through to the next lunge

Coaching Points

- Make sure that hips and shoulders remain square to the direction facing throughout the entire lift
- Keep weight on the front heel and keep back heel pointed to the sky to prevent it from rolling to the side
- Do not allow the front knee to go forward past the toes
- Avoid taking a middle step for balance as you step through to the next rep

4. Pushing Progression

4a. Barbell Bench Press

Exercise Objective: Develop strength in the muscles of the pectorals, shoulders, and triceps

Start Position

1. Lie flat on the bench in a five-point body contact position with eyes directly under the bar
2. Grasp the bar evenly with a closed, pronated grip with hands slightly wider than shoulder-width
3. Lift the bar from the hooks and position it directly above shoulders with elbows fully extended (Figure 4-63)

Procedure

1. Take a deep breath to fill the chest with air and engage the core to prevent the back from arching
2. Lower the bar slowly and under control, allowing it to touch the chest (Figure 4-64)
3. Keep wrists rigid and directly above elbows
4. Drive the weight explosively off the chest by extending elbows
5. Exhale as you near the top of the lift

Figure 4-63. Highest Point

Figure 4-64. Lowest Point

Coaching Points

- The movement of the bar should be down and slightly forward, and up and slightly back
- The most common error is to let the bar come off the chest moving toward the legs (the bar must come straight up and back off the chest for maximum force)

- Wrists should be in line with elbows with thumbs wrapped around the bar throughout the entire lift
- The lower back should remain in contact with the bench throughout the entire lift (do not arch the back or raise the chest to meet the bar)
- Avoid bouncing the bar off the chest

4b. Barbell Incline Bench Press

Exercise Objective: Develop strength in the upper pectorals, shoulders, and triceps

Start Position

1. Lie flat on the inclined bench in a five-point body contact position with eyes directly under the bar
2. Grasp the bar evenly with a closed, pronated grip with hands slightly wider than shoulder-width
3. Lift the bar from the hooks and position it directly above shoulders with elbows fully extended (Figure 4-65)

Procedure

1. Take a deep breath to fill the chest with air and engage the core to prevent the back from arching
2. Lower the bar slowly and under control, allowing it to touch the top of the chest (Figure 4-66)
3. Keep wrists rigid and directly above elbows
4. Drive the weight explosively off the chest by extending elbows
5. Exhale as you near the top of the lift

Figure 4-65. Highest Point

Figure 4-66. Lowest Point

Coaching Points

- The movement of the bar should be down and slightly forward, and up and slightly back
- The most common error is to let the bar come off the chest moving toward the legs (the bar must come straight up and back off the chest for maximum force)
- Wrists should be in line with elbows and thumbs wrapped around the bar throughout the entire lift
- The lower back should remain in contact with the bench throughout the entire lift (do not arch the back or raise the chest to meet the bar)
- Avoid bouncing the bar off the chest

4c. Dumbbell Bench Press

Exercise Objective: Develop strength and stability in the pectorals, shoulders, and triceps

Start Position

1. Grasp a dumbbell in each hand with a closed grip and sit on the bench
2. Lie flat on the bench in a five-point body contact position with arms extended (Figure 4-67)

Procedure

1. Take a deep breath to fill the chest with air and engage the core to prevent the back from arching
2. Lower the dumbbells slowly and under control keeping hands over shoulders until the dumbbells reach chest level (Figure 4-68)
3. Drive the weight off the chest extending elbows
4. Exhale as you near the top of the lift

Figure 4-67. Start Position

Figure 4-68. Finish Position

Coaching Points

- Wrists should be in line with elbows, and forearms perpendicular to the ground
- The lower back should remain in contact with the bench throughout the entire lift (do not arch the back or raise the chest to complete the lift)

4d. Dumbbell Incline Bench Press

Exercise Objective: Develop strength and stability in the upper pectorals, shoulders, and triceps

Start Position

1. Grasp a dumbbell in each hand with a closed grip and sit on the bench
2. Lie flat on the inclined bench in a five-point body contact position with arms extended (Figure 4-69)

Procedure

1. Inhale, taking a deep breath to fill the chest with air, and engage the core to prevent the back from arching to complete the lift
2. Lower the dumbbells slowly and under control keeping the upper arms 45° to the torso (Figure 4-70)
3. Drive the weight off the chest extending the elbows to return the dumbbells to the starting position
4. Exhale as you near the top of the lift

Figure 4-69. Start Position

Figure 4-70. Finish Position

Coaching Points

- Wrists should be in line with elbows
- The most common error is letting the dumbbells and hands go wider than the elbows (i.e., the forearms should not go wider than perpendicular to the ground)
- The lower back should remain in contact with the bench throughout the entire lift (do not arch the back or raise the chest to complete the lift)

5. Triceps Choice

5a. Triceps Pushdown

Exercise Objective: Isolate and develop strength in the triceps

Starting Position

1. Position hands on the pulldown bar about 6 in. apart in an overhand grip
2. Stand with feet flat on the floor, hip-width apart, toes pointed straight ahead, and knees slightly flexed
3. Engage the core to stabilize the body and prevent the back from arching

Procedure

1. Keep shoulder blades pulled together and elbows positioned at the sides until there is a 90° angle at the elbows (Figure 4-71)
2. Maintain an erect body position and push the bar down to full elbow extension (Figure 4-72)

Coaching Points

- Avoid letting shoulders roll forward during any part of the lift
- Avoid using momentum to complete the lift

Figure 4-71. 90° Elbow Angle

Figure 4-72. End Position

6. Abdominals Choice

6a. Heel Touches

Exercise Objective: Develop strength in the abdominal muscles

Start Position

1. Lie on the floor face up with arms straight at the sides, and palms flat
2. Bend knees keeping feet flat on the floor and pressing lower back into the floor

Procedure

1. Pull chest toward thighs, lifting scapula off the ground, and contract abdominal muscles (Figure 4-73)
2. Hands should slide along the ground close to the body until they make contact with the heels (Figure 4-74)
3. Hold position for 1 s and slowly return back to the start position, pause, and repeat for the desired repetitions
4. For the obliques, bring the right shoulder toward the right heel by sliding the right hand along the ground until it touches the heel
5. Slowly return to the start position, and repeat on the left side

Coaching Points

- Avoid pulling head forward throughout the exercise
- Avoid lifting the lower back off the ground

Figure 4-73. Start Position

Figure 4-74. Reaching Position

Conclusion

Exercise technique forms the foundational knowledge and skill to allow the coach to supervise strength training and conditioning programs effectively. Proper technique must be taught to both the athlete as well as the spotter(s) to ensure safe and effective movements. Prior to beginning a strength training program, these techniques should be taught to all athletes.

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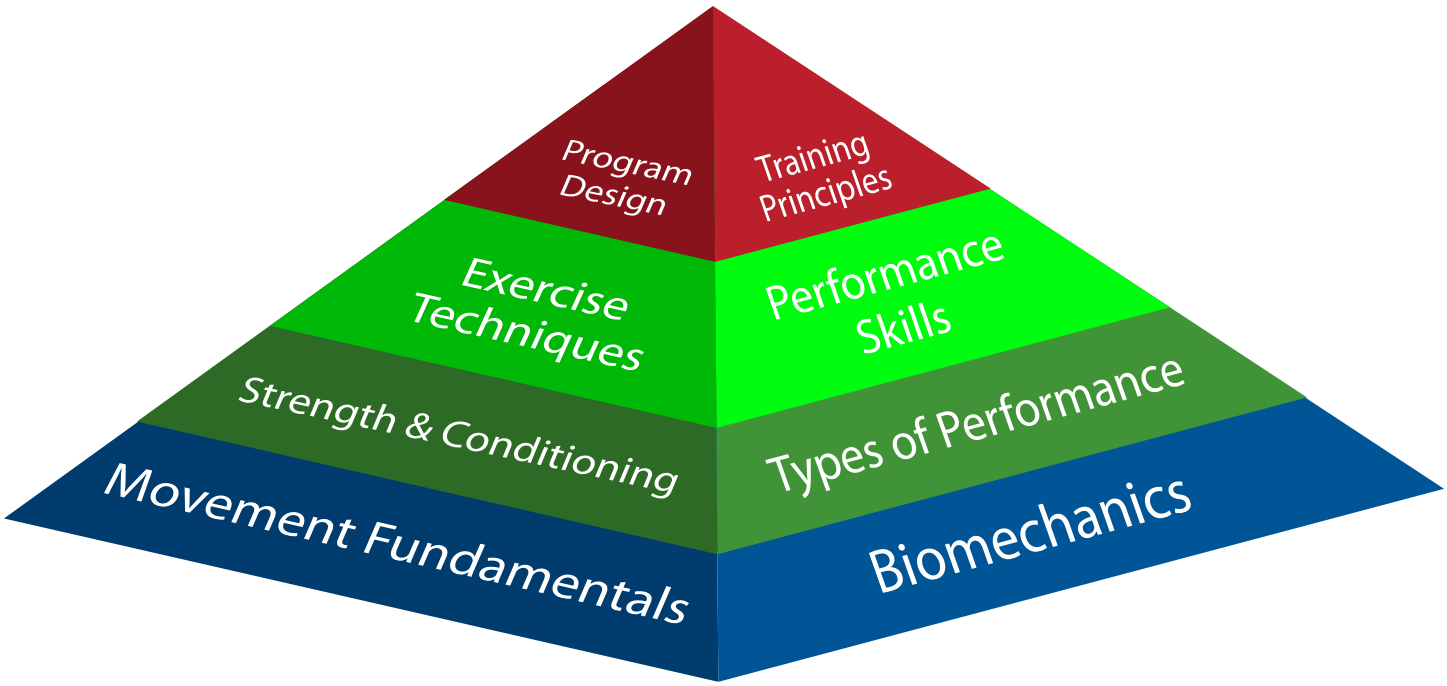

Performance Pyramid

CHAPTER FIVE
SPEED AND AGILITY TRAINING

There are many different methods of training used to train athletes for improvement in sport performance. Each of these methods serves a purpose and can target certain physiological characteristics. It is very important for strength training and conditioning coaches to understand that these different methods of training all have different purposes. As described previously, when designing and implementing strength and conditioning programs, strength training and conditioning coaches need to have an objective for the training session and training cycle. This will ensure that programs target the physiological characteristics they are designed to target. The special methods of training reviewed in this chapter will allow for a greater understanding of different methods that can be implemented within strength training and conditioning programs to illicit improvements in performance through speed and agility training.

Introducing Plyometrics

A popular type of training exercise is plyometric training (2,3,19,20,32). This type of training uses jumping exercises to involve the neuromuscular system in rapid force development and improved use of tissue elasticity to improve power, rate of force development, and the ability to absorb force. A simple jumping exercise can be classified as a plyometric exercise if it involves an eccentric muscle action (lengthening of the muscle tissue), amortization phase (phase between eccentric and concentric muscle actions), and a concentric muscle action (shortening of the muscle tissue). These three components allow athletes to utilize the musculoskeletal system to produce greater force following the eccentric muscle action. For example, a countermovement jump involves a quick lowering of the body to produce eccentric tension in the relevant musculature which is then followed by a transition from down to up, the amortization phase, and then the athlete develops concentric or shortening tension in the relevant muscles as he/she performs the "up" phase of the jump.

Plyometric training is very stressful, but the stress comes from the mechanical impact demands placed on relevant tissues and the ability of the nervous system to respond rapidly to these quickly applied forces. It is imperative that the musculoskeletal system is given time to adapt to the demands of a plyometric training program (6,7,8). Plyometric exercise sessions should begin with a general warm-up, dynamic stretching, and specific warm-up movements. The specific warm-up for plyometric training should consist of low-intensity, dynamic movements. During the warm-up, the athlete gradually progresses to actual plyometric or rebound types of exercises.

Plyometric exercise is not inherently dangerous; however, developing an adequate base of strength and power should be seen as a prerequisite for serious plyometric training. Low-intensity plyometrics, such as running, leaping, hopping, and so forth, can be used with novice athletes. However, drop jumps, shock training (dropping from heights greater than 1 m, and then landing and jumping again) should be reserved for advanced athletes. Landing surfaces, proper footwear, number of repetitions, base strength, and speed of execution all interact in plyometric training and affect the intensity, volume, and/or injury potential of the exercise.

Plyometrics are merely a part of an overall strength training and conditioning program that includes strength, speed, agility, aerobic and anaerobic training, flexibility training, and proper nutrition. Plyometrics have a purpose, which is usually described as power and speed training, but plyometrics are not a panacea (9,13,21,24,28).

Plyometrics

Virtually all of the things required during athletic events involve one's ability to exert force in a rapid manner. This ability to exert force can be in the form of jumping, hopping, and changes of direction (1). Improving one's ability to exert force in a rapid manner can have a positive influence on sports performance. Prior to improving one's ability to exert force rapidly, it is important that athletes can absorb force during various movements. Improving absorption of force involves an adequate strength base, and strong and elastic connective tissue.

The Stretch-Shortening Cycle

A common mistake is to confuse plyometrics (the exercise the athlete performs) with the stretch-shortening cycle (the mechanism underlying the tissue response). The stretch-shortening cycle involves the tissue response to the three phases

Phase	Action	Physiological Event
I—Eccentric	Stretch of the agonist muscle	• Elastic energy is stored in the series elastic component • Muscle spindles are stimulated
II—Amortization	Pause between phases I and III	• Type Ia afferent nerves synapse with alpha motor neurons. • Alpha moto neurons transmit signals to agonist muscle group.
III—Concentric	Shortening of agonist muscle fibers	• Elastic energy is released from the series elastic component • Alpha motor neurons stimulate the agonist muscle group

Figure 5-1. Stretch-Shortening Cycle Phases

of a plyometric exercise as described above. Figure 5-1 shows the three phases of the stretch-shortening cycle along with the underlying physiology that accompanies each phase.

Deceleration and Jump Training for Novice Athletes

Conventional resistance training should be used prior to plyometrics in order to promote general strength gains and connective tissue development (10,11). One of the other methods used to promote general strength and connective tissue development is deceleration/jump training. This type of training does not involve high levels of orthopedic demands, and thus reduces the likelihood of injury. These exercises involve an emphasis on landing mechanics. Putting a large emphasis on landing mechanics also allows for the development of eccentric strength in a dynamic environment. The key to this type of training is to promote dynamic eccentric strength and the landing mechanics of each exercise. Coaches can use jumps in place (drills that involve jumping and landing in the same spot), multiple hops, and jumps that cover distance. For all of these types of jumps, emphasis should be on the landing portion of the jump, and one's ability to decelerate and avoid reaching the extreme range of motion limit of the joints. One of the major distinctions between plyometric training and traditional strength training and conditioning is that plyometric training targets the nervous system more than the muscular system. The nervous system is trained to respond rapidly and without hesitation. Factors that influence the intensity of plyometric exercises are shown in Figure 5-2.

Speed and Agility

Two methods of training that have been utilized for many years are speed and agility training. Speed and agility training usually involves moving at high rates of speed. Speed training involves running and other rapid movements (4,15,18,22,29). There are different types of speed:

Reactive Speed: The ability to react to a stimulus in the shortest possible time (reactive speed involves both simple and choice reactions)

Active Speed: The ability to move quickly and precisely during short duration activities of less than 6 s (active speed involves noncyclic movements)

Frequency Speed: The ability to run, walk, row, climb, swim, and so forth involving cyclic movement activities

Complex Speed: The ability to holistically combine reactivity, perception, spatial relationships, and so forth to produce movements that are coordinated and goal directed, and involves primarily noncyclic activities (29)

Agility training combines moving at high speeds with rapid changes of direction. Agility training is commonly used to mimic competitive situations and improve the ability of athletes to simulate the movement and perceptual demands of the sport. This method of training usually involves movement patterns that target multiple changes of direction over the course of an activity. In many cases, speed training and agility training are performed together (i.e., within the same training session or within the same training cycle). Speed and agility methods of training involve high-intensity work and it is imperative that strength training and conditioning coaches monitor rest periods and volume to decrease the chance of injury during the course of a training session. Utilizing speed and agility training can improve the transfer of performance from the accumulation effect of the training sessions to competitive situations (4,5).

Linear Speed

One of the key elements of a conditioning program is ensuring the athletes move as efficiently and effectively as possible. In relation to speed, it is essential that an effective sprinting technique be stressed from day one. The length of each step (step length, SL) and the number of steps taken over a specific distance (step frequency, SF) determine the speed or velocity of an athlete (velocity = SL x SF) (16).

In most sports, the key factor in linear speed is not the top speed achieved, but the ability to accelerate (i.e., the first 10 yards) (25,30,31). Acceleration refers to the rate of change in velocity over time. Therefore, athletes need to be able to reach maximum velocity in as little time as possible. During the first 10 yards from

Factor	Effect
Points of contact	The ground reaction force during single-leg lower body plyometric places more stress on an extremity's muscles, connective tissues, and joints than during double-leg plyometric drills
Speed	Greater speed increases the intensity of the drill
Height of the drill	The higher the body's center of gravity, the greater the force on landing
Bodyweight	The greater the athlete's bodyweight, the more stress is placed on the muscles, connective tissues, and joints. External weight (in the form of weight vests, ankle weights, and wrist weights) can be added to the body to increase a drill's intensity

Figure 5-2. Plyometric Intensity Factors

the start, step length will be relatively small with a high step frequency (3). As force can only be applied while the foot is in contact with the ground, the more time the foot is on the ground, the greater amount of force can be produced through each step. As the athlete reaches maximum velocity (by 30 – 40 yards), step length will likely increase while step frequency will likely decrease (16). In sports, athletes may be required to accelerate from a static position or from a rolling start where they may already be walking or jogging prior to the sprint. Therefore, both of these forms of acceleration should be addressed in speed and agility training.

Agility

The term "agility" encompasses a wide range of movements and abilities that athletes are required to perform throughout competition. Agility movements can be defined as rapid, whole-body movements that require single or multiple changes in velocity (i.e., acceleration or deceleration) or direction (i.e., vertical, lateral, or horizontal) in response to an external stimulus (e.g., opponent movements, location of the ball, etc.) (14,26,27). From this definition, it is clear that reactive decision-making, technique, and physical capabilities all contribute to the success of an agility performance; therefore, agility training programs should include all three of these aspects.

While some training approaches are beneficial for optimal gains in agility performance (i.e., interval training), others such as aerobic conditioning focus on opposing energy systems (oxidative versus phosphagen) and muscle fibers (slow twitch versus fast twitch) than that required for rapid and explosive movements in agility. Coaches should limit high-mileage running (e.g., distance running) for athletes during the base lifting phase and for athletes that are not required to perform aerobically during competition. By including distance running in anaerobic agility programs, strength gains may be compromised, training intensity may decrease due to athletes pacing themselves (as a result of limited rest during training sessions), and the potential for overuse injuries will likely increase. Above all, agility training should be performed in an environment and manner that simulates the conditions and demands of the competition as closely as possible. If the athletes are regularly required to perform lateral cuts followed by short bursts of speed in games or matches, then these movement sequences should be replicated in training. In contrast, if athletes are not required to transition from backpedaling to forward sprinting in their sport, then there is no need to include these tasks as regular elements in the training program.

Interval Training

Interval training is a series of high-intensity, short duration exercises or drills followed by a period of rest. The ratio of this work-to-rest interval is typically 1-to-10 (which is applicable to most power-based sports). This means if the drill lasts 5 s, the athlete should then be given 50 s to recover before performing another drill. Rather than having all athletes in a single group run at the same time, rest cycles can be easily built into drills by dividing the athletes into two smaller groups. This allows one group to perform the drill while the other rests. It is important to make sure that the resting group is still given their full 50 s of rest before performing the drill again (i.e., the resting group will not be starting the drill immediately following the previous group's completion). The intensity within each drill can be increased to challenge the performance of the athletes. Having athletes race each other is an easy way to increase the intensity of the drill.

A common training error of coaches is making the rest interval too short. For example, when athletes are required to jog or run to the next station with no recovery between drills, athletes tend to pace themselves and decrease the intensity so they are able to complete the workout. Athletes should be giving their best effort for each performance, which means adequate rest and hydration between sets and drills is required.

Components of Agility

There are many factors that contribute to the overall success of a given agility performance. Fortunately, these qualities can be grouped into four main categories: 1) perceptual/decision-making factors; 2) technical factors; 3) physical factors; and 4) anthropometric factors (body shape and size) (Figure 5-3) (17). The following section will briefly describe the importance of each component to agility performance and the trainability of each.

Perceptual Decision-Making Factors

The perceptual/decision-making component relies on the ability of the athlete to recognize specific cues from the situation, and react in a timely and appropriate manner. Decision-making is a difficult quality to train in an athlete due to constantly varying scenarios and circumstances in sports. However, routinely familiarizing players with situations they are likely to encounter in competition will aid in the development of the ability to recognize familiar cues, and anticipate subsequent movements and help determine how to react to such scenarios in competition. While most agility drills do not incorporate a reactive/decision-making component, this perceptual element can easily be integrated into many drills through audio tones (e.g., whistle blow), visual stimuli (e.g., light or color indicators), or the inclusion of additional players (e.g., opponents or teammates).

Technical Factors

The development of proper technique is crucial to the success of many team and individual sports. The same is true for the efficient and effective execution of agility drills. Beginning at the developmental level, proper technique in all aspects of the sport should be emphasized. As athletes progress to more advanced competition and skill levels of the sport, the techniques that were learned early will begin to become autonomous, allowing athletes to shift their focus to other aspects of the sport. As illustrated in Figure 5-3, depending on the specific requirements of the sport, technical characteristics may include body positioning, stride adjustments, foot placement, and joint and body segment sequencing throughout different phases of each movement (17). As the movements performed in the sport should be replicated as much as possible in training sessions, these technical characteristics should also be emphasized in all drills.

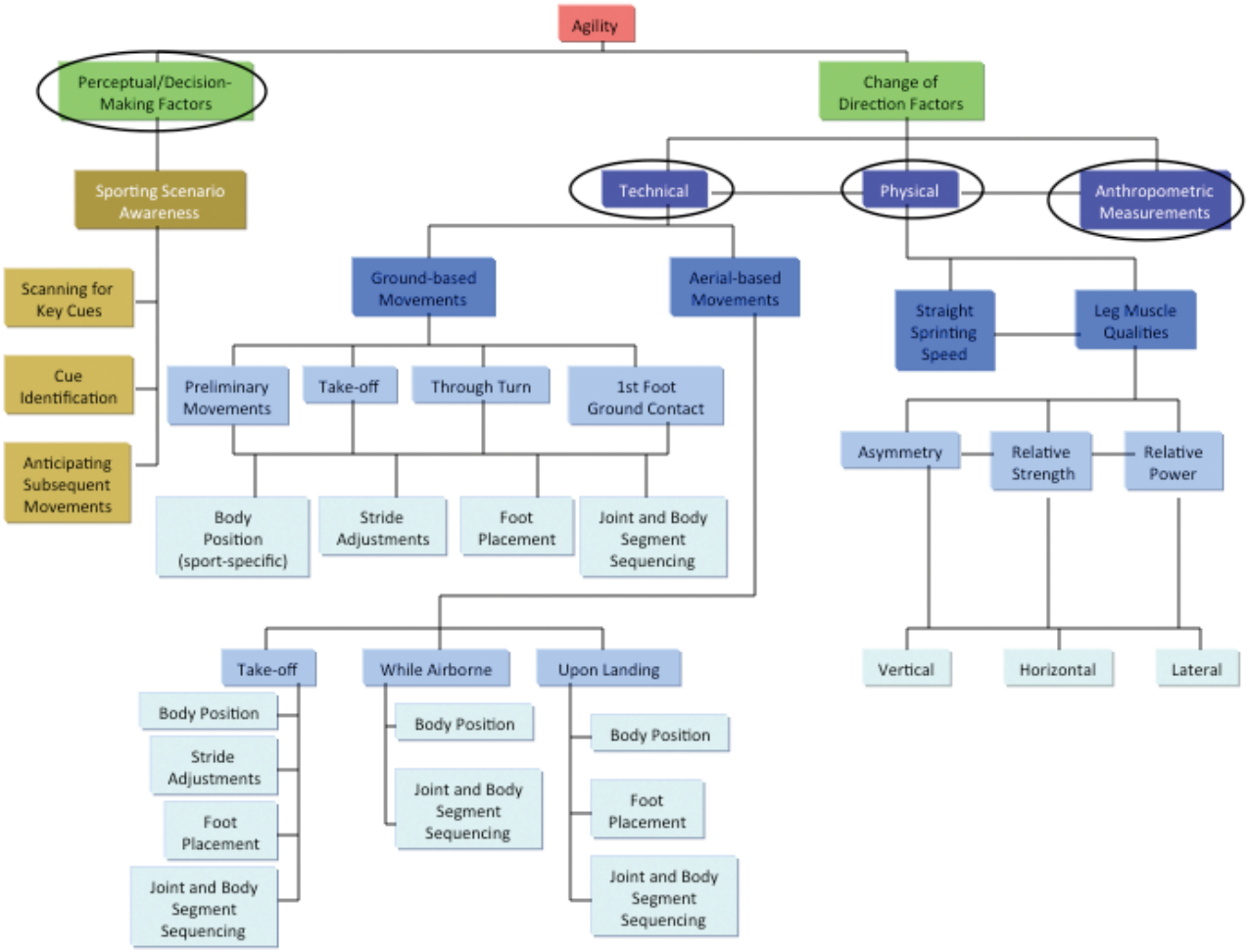

Figure 5-3. Key Contributing Components of Agility (with the four main categories circled) (17)

Athletes from a variety of different sports are required to perform jumps in various directions. While the techniques employed during the approach and take-off phases of a jump are important for attaining maximal height, distances, positioning on the field/court, the techniques used when landing are even more important when trying to minimize the risk of injury.

Noncontact anterior cruciate ligament (ACL) injuries are common among athletes, particularly when landing from a jump. Females sustain noncontact ACL injuries 2 – 8 times more often than males (12,23). This is often attributed to a wider pelvis and increased Q-angle (Figure 5-4) associated with females when compared to males. Increased leg stiffness upon landing coupled with decreased strength in the thigh musculature when compared to males is also likely to contribute to the higher incidence of noncontact ACL injuries in female athletes (23). These anatomical differences and strength deficits typically cause the knees to come together upon landing (valgus knee position) (Figure 5-5), which increases the strain on the ligaments and muscles surrounding the knee.

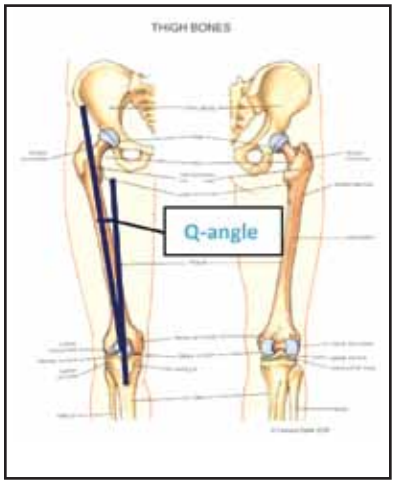

Figure 5-4. The Q-angle

Figure 5-5. Valgus Knee Alignment Upon Landing

It is important to emphasize proper landing technique to athletes regardless of skill level. Joint stiffness upon landing (i.e., limited flexion at the hips, knees, and ankles upon impact) will require the large ground reaction forces to be absorbed by only one or two joints (primarily the knee). Landing on the balls of the feet and immediately flexing the hips, knees, and ankles upon impact will help dissipate the large ground reaction forces over several joints and accompanying muscles, and will likely result in decreased strain on the knees. It is also important to emphasize proper lower body alignment upon landing. The hips, knees, and ankles should create a straight line when viewed from the front (Figure 5-6) throughout the absorption phase of jump landing. This form should also be emphasized when performing a countermovement (rapid, shallow squat) prior to a jump. While some athletes may still incur ACL injuries, emphasizing proper landing mechanics and strengthening the thigh muscles will assist in minimizing the potential for such injuries.

Figure 5-6. Proper Knee Alignment Upon Landing

Physical Factors

Many sports require athletes to perform explosive movements (e.g., jumps, sprints, cuts, etc.) throughout competition. These movements require both strength and power. Therefore, building a solid foundation of strength and power in each athlete is important for maximal performances in agility. Directly related to strength and power, the development of speed (Figure 5-3) in athletes is also important when accelerating out of a turn, from a static start, and so forth (17). As such, immediately following a 4-week base lifting phase, two weeks of speed training with a focus on technique (e.g., arm action, posture, step length, stride frequency, etc.) and overall acceleration performance should be included in the training program prior to the addition of agility drills.

Anthropometric Factors

The overall size and shape of the athlete will also affect agility performance. For example, an athlete with long legs (e.g., basketball center) will naturally have a longer step length than an athlete with shorter legs (e.g., soccer midfielder). When accelerating out of a sharp change of direction, a high step frequency and short step length will allow the athlete to accelerate faster (increased ground contact time). The basketball center will need additional time to reposition his/her longer legs between each step. Therefore, the soccer midfielder will likely have a faster performance time for the first 2 – 3 strides out of a sharp turn. Other factors such as body mass, torso length, and joint flexibility will also have advantages and disadvantages in sports. Some athletes may need to alter their technique in order to capitalize on their natural anthropometric characteristics (17).

Agility Training Drills and Programming

Knowing when to incorporate agility training into a strength training and conditioning program is important for optimal gains in performance. Programming should begin with four weeks of lifting four times per week with no additional running. Beginning on Week 5, speed drills should be added twice per week on nonconsecutive explosive days (see the end of this chapter for sample speed programs). Agility drills can be added to the program on the strength days beginning on Week 7 (see the end of this chapter for sample agility programs). These two strength days should be opposite to the explosive days, making four running days per week.

As with any training program, all exercises and skills should be progressive in nature. The first time athletes perform a new drill, they will not be familiar with the movement. A significant amount of attention by the athletes will be required to perform the drill. Once the athletes have become familiar with the drill (familiarity will vary depending on the difficulty of the drill) they will know some key aspects of the movement, but attention will still be needed when performing the drill. When practiced extensively, the athletes will develop better knowledge of the movement and will be able to perform the drill with less conscious attention to the specific movement patterns. At this point, additional challenges (e.g., more complex movement patterns, catching a ball, etc.) may be incorporated into the drill to increase the difficulty. It is important to allow athletes to progress through all three phases of development before increasing the complexity of the drill for optimal performance gains.

The following information pertains to standard techniques for basic agility training drills and some of their variations. Many strength training and conditioning programs regularly use these foundational drills. Everyone using these drills should have a sound understanding of how each of these drills and their variations are performed to optimize individual techniques. Performance technique for each drill listed below appears in the remainder of this chapter. Examples of agility training programs are provided at the end of this chapter.

Warm-Up Drills

1. High Knees – 10 yards down and back
2. Heel-Ups – 10 yards down and back
3. Forward Lunge with Elbow to Instep – 10 yards
4. Side Lunge with Squat – 4 each side
5. High Knee Foreleg Extension – 10 yards down slow, 10 yards back quick

Speed Drills

1. Build-Ups – 40 yards
2. Form Starts
3. Position Starts
4. Flying 10s
5. Power Skips (for height)
6. Power Skips (for distance)
7. Flying 20s
8. Harness Routine
9. Flying 30s
10. Bag Jumps
11. Hollow Sprints

Agility Drills

1. Rope or Ladder Routine
   - 1a. Every Hole
   - 1b. Every Other Hole
   - 1c. Lateral Step
2. Bag Routine
   - 2a. Change of Direction
   - 2b. Shuffle
   - 2c. Forward and Backpedal
3. Line Jump Routine
   - 3a. Single Bunny Hop
   - 3b. Double Bunny Hop
   - 3c. Scissors
   - 3d. Ali shuffle
4. Pro-Agility
5. Nebraska Agility
6. Three-Cone Drill
7. Four-Corner Drill
8. Sprint Ladder
9. Shuffle Ladder
10. Backpedal Ladder

Landing Drills

1. Drop Jump
2. Vertical Jump
3. Tuck Jump
4. 180 Degree Jump
5. Broad Jump with Vertical Jump
6. Depth Jump
7. Box Shuffle Step
8. Double Box Shuffle Step
9. Lateral Box Jump

Warm-Up Drills

1. High Knees – 10 yards down and back

Exercise Objective: Develop lower body muscle strength, power, and increased range of motion of the hips

Procedure

1. Forcefully drive knee upward (Figure 5-7)
2. Fully extend opposite leg as driving knee is lifted
3. Maintain a flat back with a slight forward lean of the torso
4. Drive arms aggressively in opposite direction of knee drive

Figure 5-7. High Knees

Figure 5-8. Heel-Ups

Coaching Points

- Take short, quick steps (the athlete should achieve at least 30 steps over 10 yards)
- Avoid leaning back
- Thigh should be parallel to the ground at the highest point of the movement
- Keep head and neck relaxed throughout the movement

2. Heel-Ups – 10 yards down and back

Exercise Objective: Develop hamstring strength and range of motion of the hips

Procedure

1. Swing heel up toward buttocks with each step (Figure 5-8)
2. Knee of swinging leg should remain in line with the body (not flexing or extending at the hip)
3. Maintain a flat back with a slight forward lean of the torso
4. Move arms in opposition to legs but keep shoulders relaxed (no driving action of the arms)

Coaching Points

- Take short, quick steps
- Avoid leaning back
- Weight should remain on the forefoot throughout the movement
- Keep head, neck, and arms relaxed throughout the movement

3. Forward Lunge with Elbow to Instep – 10 yards

Exercise Objective: Develop strength and range of motion of the hips

Procedure

1. Take a large step forward with the left foot (Figure 5-9a)
2. Bring torso down toward front knee (using the right hand to help balance if needed) (Figure 5-9b)
3. Bring left elbow towards inside of left foot (Figure 5-9c) and hold for 3 s
4. Push off with left foot and bring right leg forward past left leg, and repeat movement on right side of the body

Coaching Points

- Keep front foot pointed forward and feet hip-width apart
- When bringing the torso down, the knee should remain directly above the ankle
- No additional steps should be taken when transitioning from the left to right side

4. Side Lunge with Squat – 4 each side

Exercise Objective: Develop strength and range of motion of the hips

Procedure

1. Begin with feet shoulder-width apart with knees and hips slightly flexed
2. Take a large step to the left, keeping both feet facing forward
3. Push hips back, shift weight onto left leg, and flex left knee and hip (right leg remains straight) (Figure 5-10a)
4. Hold position for 3 s

Figure 5-9a. Forward Lunge

Figure 5-9b. Bring Torso Toward Front Knee

Figure 5-9c. Bring Elbow Toward Instep

5. Stand up through left leg by keeping weight on left leg and brining right leg back to shoulder-width

6. Lower into a squat, keeping weight on heels (Figure 5-10b)

7. Return to start position

Coaching Points

- When shifting weight onto left leg, the knee should remain directly above the ankle
- Keep right foot flat on the ground while shifting weight to left leg

Figure 5-10a. Side Lunge Position

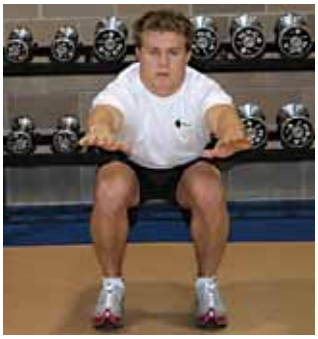

Figure 5-10b. Squat Position

5. High Knee Foreleg Extension – 10 yards down slow, 10 yards back fast

Exercise Objective: Develop strength and range of motion of the hips and knees

Procedure

1. Perform a small skip by driving left knee up and extending onto toes of right foot (Figure 5-11a)

2. At the highest point of the skip, extend left knee until entire leg is parallel to the ground (Figure 5-11b)

3. Keep right knee extended and drive left leg down toward the ground

Coaching Points

- Maintain a slight forward lean throughout
- The thigh should reach parallel to the ground before extending the foreleg
- Try to make the movement rhythmic

Figure 5-11a. Driving the Knee Upward

Figure 5-11b. Knee Extension

Speed Drills

1. Build-Ups – 40 yards

Exercise Objective: Develop proper stride length and stride frequency

Procedure

1. Begin jogging from a standing start
2. Gradually build up speed so that maximum velocity is attained by 40 yards (Figure 5-12)
3. Gradually slow the pace over the remaining 20 yards

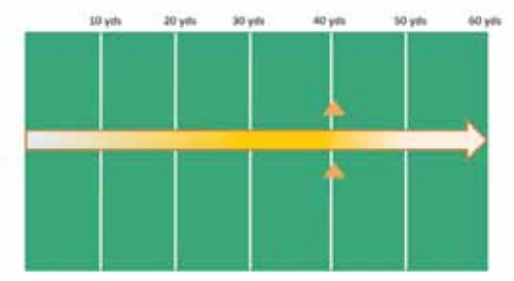

Figure 5-12. 40-Yard Build-Up

Coaching Points

- Avoid running at full speed after 40 yards
- Make sure proper sprinting technique is employed throughout the drill

2. Form Starts

Exercise Objective: Develop proper stride length, stride frequency, and body position from a static start

Procedure

1. Place one foot directly behind the designated start line
2. Place other foot 6 – 12 in. behind heel of front foot and 2 – 4 in. to the inside of front foot (Figure 5-13)
3. The hand opposite to the front foot is placed just behind the start line (usually on fingertips)
4. The other arm is extended behind body with a bend at the elbow
5. Hips should be higher than shoulders
6. A slight forward lean is used, which can cause the shoulders to cross over the start line
7. Eyes should be focused 2 – 3 ft in front of the start line

Figure 5-13. Form Start

Coaching Points

- Push off with both feet at the start of the sprint
- Maintain a forward lean with head down for the first 10 yards, then gradually become more erect through the next 10 yards
- This start can be used for any sprinting distance of interest during the training session

3. Position Starts

Exercise Objective: Develop proper stride length, stride frequency, and body position from a static start

Procedure

1. Begin in the Athletic Stance (Figure 5-14) with hips, knees, and ankles slightly flexed, and hands in front of the body
2. On cue, explode out of this stance into the required direction and distance as specified by the coach or drill

Coaching Points

- Remain in the athletic stance until the cue is given
- The initial step out of the stance should be powerful and explosive

Figure 5-14. Athletic Stance

4. Flying 10s

Exercise Objective: Develop proper stride length and stride frequency

Procedure

1. Begin jogging at half speed, increasing speed with each stride for the first 30 yards so maximal velocity is attained by the 30-yard mark (Figure 5-15)

2. Continue to sprint at maximum velocity for 10 yards before decelerating gradually

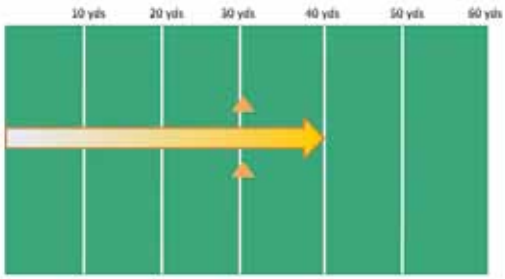

Figure 5-15. Flying 10s

Coaching Points

- A maximal sprint should be performed for the entire 10 yards
- Make sure proper sprinting technique is employed throughout the drill

5. Power Skips (for height)

Exercise Objective: Develop explosive power in the lower body

Figure 5-16. Power Skips for Height

Procedure

1. Perform a high skip by driving the left knee up, maintaining a 90° angle at the knee, landing on the take-off leg (the extended leg)

2. Try to attain maximal height during every skip (Figure 5-16)

3. Drive arms aggressively in opposition to the legs

Coaching Points

- The take-off leg should reach full extension at the ankle, knee, and hip for every skip
- The goal should be to skip as high as possible, not as far as possible

6. Power Skips (for distance)

Exercise Objective: Develop explosive power in the lower body

Procedure

1. Perform a high skip by driving the left knee forward and upward, maintaining a 90° angle at the knee, landing on the take-off leg (the extended leg)

2. Try to attain maximal distance during every skip (Figure 5-17)

3. Drive arms aggressively in opposition to the legs

Figure 5-17. Power Skips for Distance

Coaching Points

- The take-off leg should reach full extension at the ankle, knee, and hip for every skip
- The goal should be to skip as far as possible, not as high as possible

7. Flying 20s

Exercise Objective: Develop proper stride length and stride frequency

Procedure

1. Begin jogging at half speed, increasing speed with each stride for the first 30 yards so maximal velocity is attained by the 30-yard mark (Figure 5-18)

2. Continue to sprint at maximum velocity for 20 yards before decelerating gradually

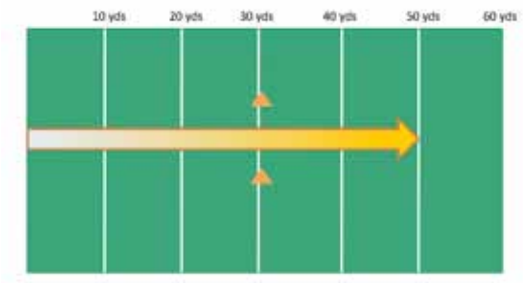

Figure 5-18. Flying 20s

Coaching Points

- A maximal sprint should be performed for the entire 20 yards
- Make sure proper sprinting technique is employed throughout the drill

8. Harness Routine

Exercise Objective: Develop proper body positioning during acceleration phase and minimize the time needed to attain maximum velocity

Procedure

1. Attach harness around waist with handles or slack in the back (Figure 5-19)

2. Attach back of harness to stationary object or have coach hold

3. Sprint in place with the following technique:

   A. Drive lead leg upwards so thigh is parallel to ground
   B. Fully extend trail leg at ankle, knee, and hip
   C. Drive arms aggressively in opposition to the legs
   D. Elbows should flex to 90° on forward arm swings and fully extend on backward arm swings
   E. Arms should remain parallel to the body (i.e., not crossing over in front of the chest)
   F. A slight forward lean into the harness is used throughout the drill

4. After sprinting in place for 10 s, the same technique should be used with the harness for the remaining tasks (i.e., 10-yard sprint, 10-yard jog/10-yard sprint) to complete the repetition

Figure 5-19. Sprinting with a Harness

Coaching Points

- Maintain proper body lean and posture throughout each task
- Enforce appropriate rest intervals throughout the drill

**NOTE: One repetition includes sprinting in place, sprinting 10 yards, jogging 10 yards followed immediately by sprinting 10 yards (an area with 50 – 60 yards of flat running surface is needed)*

9. Flying 30s

Exercise Objective: Develop appropriate stride length and stride frequency

Procedure

1. Begin jogging at half speed, increasing speed with each stride for the first 30 yards so maximal velocity is attained by the 30-yard mark (Figure 5-20)

2. Continue to sprint at maximum velocity for 30 yards before decelerating gradually

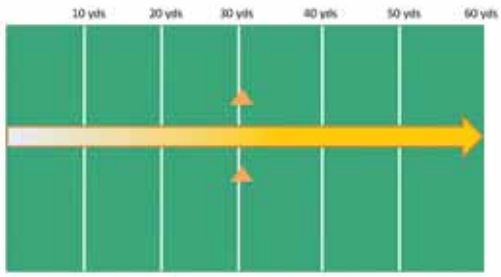

Figure 5-20. Flying 30s

Coaching Points

- A maximal sprint should be performed for the entire 30 yard sprint
- Make sure proper sprinting technique is employed throughout the drill

10. Bag Jumps

Exercise Objective: Develop explosive power and acceleration

Figure 5-21. Bag Jump Tuck Form

Procedure

1. A series of bags (approximately 24 in. high) are laid out in a line on the ground with approximately 24 in. between bags
2. Jump over the first bag, tucking both knees in toward the chest (Figure 5-21)
3. Drive both arms upward when exploding off of the ground to assist in reaching optimal jump height
4. Upon landing, immediately explode upward over the next bag in the series
5. Sprint 5 yards following the final bag jump

Coaching Points

- Minimize time on the ground by quickly exploding into the next bag jump
- Avoid taking additional steps between bags
- Make sure both feet are brought over the bags and not around the sides

11. Hollow Sprints

Exercise Objective: Develop proper stride length and stride frequency, as well as explosive power

Procedure

1. Perform the following intervals consecutively without stopping (Figure 5-22):
   A. Jog for 10 yards
   B. Sprint for 10 yards
   C. Jog for 10 yards
   D. Sprint for 10 yards
   E. Jog for 10 yards
2. This drill can also be performed using 20-yard increments (100 yards total for the drill) and 30-yard increments (150 yards total for the drill)

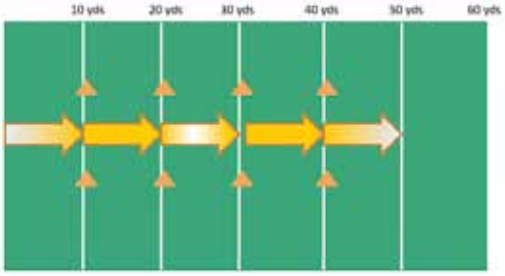

Figure 5-22. Hollow Sprints (10-yard increments shown)

Coaching Points

- Smoothly transition between running speeds
- When decelerating to a slower speed, sit into a shallow (three quarter) squat as opposed to sticking the chest out
- Sprint at full speed for the entire designated distance before decelerating

Agility Drills

1. Rope or Ladder Routine

Exercise Objective: Develop range of motion of the hips, knees, and ankles, as well as coordination and balance

1a. Every Hole

Procedure

1. Run forward, stepping into every hole with each foot (Figure 5-23)
2. Drive knees upward for each step
3. Drive arms aggressively in opposition to the legs
4. A slight forward lean is used throughout the drill

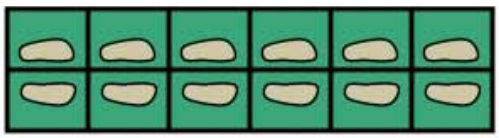

Figure 5-23. Rope or Ladder Routine – Every Hole

Coaching Points

- The right foot hits every hole on the right side; the left foot hits every hole on the left side
- Keep head up with eyes focused straight ahead (avoid looking down)

1b. Every Other Hole

Procedure

1. Run forward, stepping into every other hole with each foot (Figure 5-24)
2. Drive knees upward for each step
3. Drive arms aggressively in opposition to the legs
4. A slight forward lean is used throughout the drill

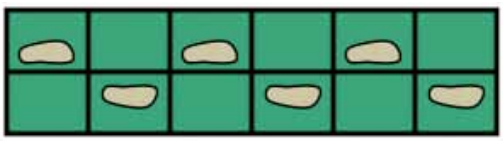

Figure 5-24. Rope or Ladder Routine – Every Other Hole

Coaching Points

- The right foot hits every other hole on the right side; the left foot hits every other hole on the left side
- Keep head up with eyes focused straight ahead (avoid looking down)

1c. Lateral Step

Procedure

1. Run laterally, stepping into every hole with each foot (Figure 5-25)
2. Use only one side of the ladder per direction
3. Drive knees upward for each step
4. Drive arms aggressively in opposition to the legs
5. A slight forward lean is used throughout the drill

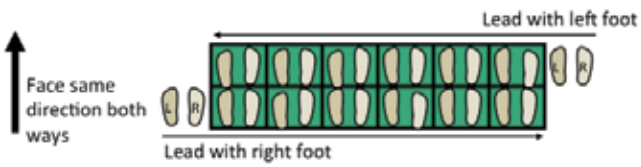

Figure 5-25. Rope or Ladder Routine – Lateral Step

Coaching Points

- Face the same direction for each leading foot
- Keep head up with eyes focused straight ahead

2. Bag Routine

Exercise Objective: Develop range of motion of the hips, knees, and ankles, as well as coordination and balance when accelerating, decelerating, and changing directions rapidly

2a. Change of Direction

Procedure

1. Position bags 5 yards apart
2. Beginning at either the right or left bag, run forward to the far side of the first bag (Figure 5-26)
3. Use the outside foot to plant and run forward toward the far side of the next bag (continue this weaving pattern through the three bags)
4. Finish the drill by sprinting 5 yards

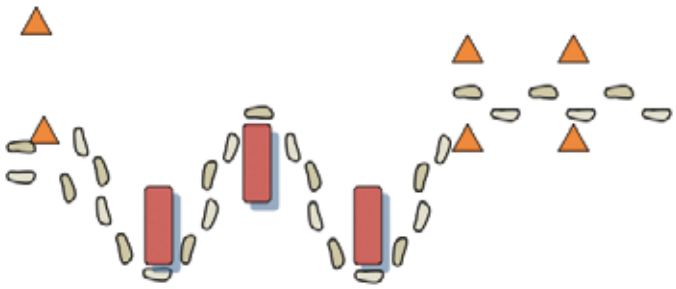

Figure 5-26. Bag Routine – Change of Direction

Coaching Points

- Drive knees upward for each step
- Drive arms aggressively in opposition to the legs
- A slight forward lean is used throughout the drill
- Take only one step around each bag

2b. Shuffle

Procedure

1. Position bags 5 yards apart
2. Beginning at either the right or left bag, shuffle diagonally to the far side of the first bag (Figure 5-27)
3. Use the outside foot to plant and explode diagonally toward the far side of the next bag (continue this weaving pattern through the three bags)
4. Finish the drill by sprinting 5 yards

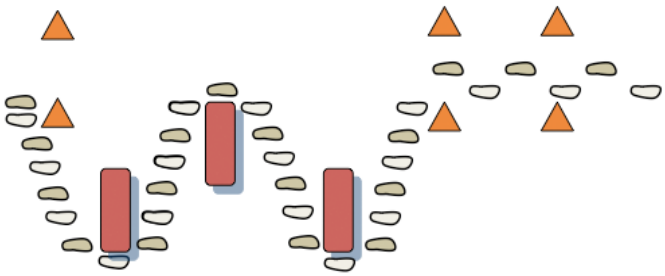

Figure 5-27. Bag Routine – Shuffle

Coaching Points

- Stay low throughout the drill
- Avoid using a cross-over step
- Take only one step around each bag

2c. Forward and Backpedal

Procedure

1. Beginning at either the right or left bag in the athletic position (upright torso, slight flexion of the ankles, knees and hips, head up and hands away from the body)
2. On cue, backpedal to the far end of the first bag (Figure 5-28)
3. Transition into a forward sprint at the far end of the next bag (continue this pattern through the remaining bags)
4. Finish the drill by sprinting 5 yards

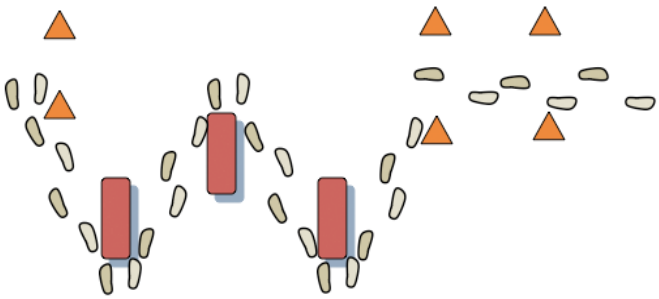

Figure 5-28. Bag Routine – Forward and Backpedal

Coaching Points

- Stay low throughout the drill
- Keep weight on the balls of the feet when backpedaling
- Avoid looking back for the bags
- Take only one step around each bag

3. Line Jump Routine

Exercise Objective: Develop range of motion of the ankles, as well as lower body strength, coordination, and balance when changing directions rapidly

3a. Single Bunny Hop

Procedure

1. Stand at a straight line on a field or court
2. Jump back and forth on one foot over the line, moving forward (Figure 5-29)
3. Switch feet at the midway point without stopping

Figure 5-29. Line Jump Routine – Single Bunny Hop

Coaching Points

- Stay as close to the line as possible
- Keep head up with eyes focused straight ahead
- This drill can also be performed moving backwards

3b. Double Bunny Hop

Procedure

1. Stand with both feet to one side of a straight line on a field or court
2. Moving forward, jump back and forth over the line with both feet (Figure 5-30)

Figure 5-30. Line Jump Routine – Double Bunny Hop

Coaching Points

- Stay as close to the line as possible
- Keep head up with eyes focused straight ahead
- This drill can also be performed moving backwards

3c. Scissors

Procedure

1. Stand with one foot on each side of a straight line on a field or court

2. Moving forward, shuffle step down the line (Figure 5-31)

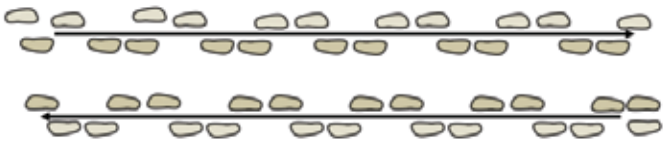

Figure 5-31. Line Jump Routine – Scissors

Coaching Points

- Stay as close to the line as possible
- Keep head up with eyes focused straight ahead

3d. Ali Shuffle

Procedure

1. Stand with one foot on either side of a line on a field or court (toes of the right foot to the line and the heel of the left foot to the line) (Figure 5-32)

2. Moving laterally down the line, switch feet while jumping in the air (the right foot will now be on the far side of the line with the heel nearest the line, and the left foot will now be on the near side with toes to the line)

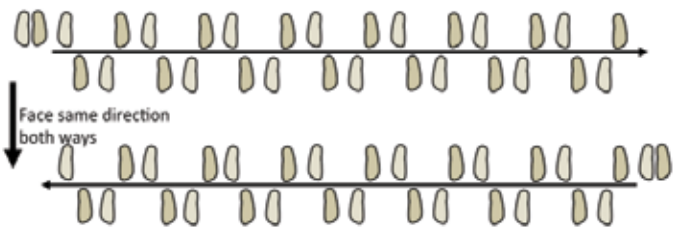

Figure 5-32. Line Jump Routine – Ali Shuffle

Coaching Points

- Stay low to the ground while jumping
- Keep head up with eyes focused straight ahead
- Shuffle to the right and then to the left

Figure 5-33a. Starting Position for the Pro-Agility Drill

4. Pro-Agility

Exercise Objective: Improve reaction time, coordination, balance, and acceleration when changing directions rapidly

Procedure

1. Begin in the athletic stance, straddling the middle line (Figure 5-33a)

2. When ready, sprint to the right line and touch it with the right hand

3. Push off laterally, sprint back across the middle line to the left line, and touch it with the left hand

4. Push off laterally and sprint back through the middle line (Figure 5-33b)

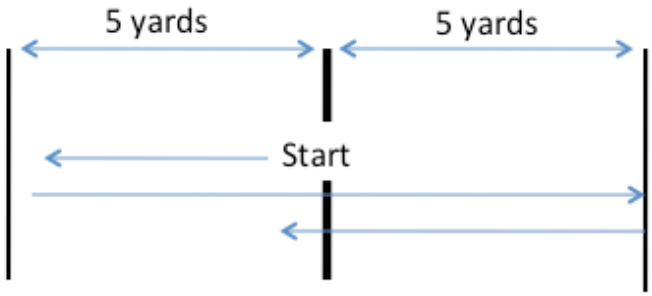

Figure 5-33b. Pro-Agility Drill

Coaching Points

- Stay low when changing directions
- Make sure to touch the lines with the corresponding hand before changing directions (do not just touch the line with foot)

5. Nebraska Agility

Exercise Objective: Improve coordination, balance, and acceleration when changing directions rapidly

Procedure

1. Begin in the Form Start position (Figure 5-13) at the starting line (Figure 5-34)

2. When ready, sprint forward to the cone and plant left foot to complete a 180° change of direction to the right

3. Sprint forward back to the starting line and plant right foot to complete a 180° change of direction to the left

4. Sprint forward 5 yards and touch the line with both hands; then backpedal across the starting line

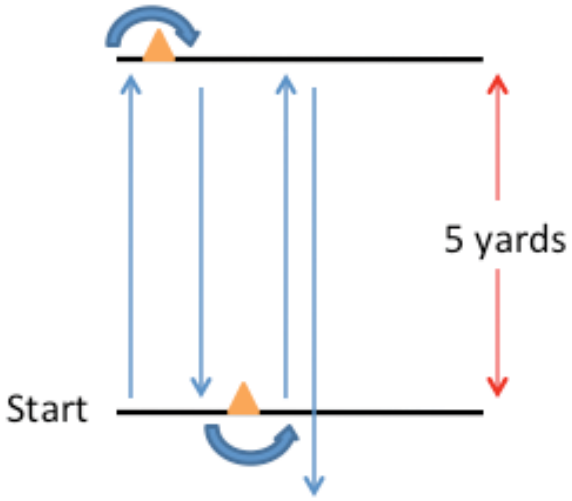

Figure 5-34. Nebraska Agility Drill

Coaching Points

- Stay low when changing directions and backpedaling
- Avoid using more than one step to change directions around the cones
- Make sure to touch the line with both hands before backpedaling

6. Three-Cone Drill

Exercise Objective: Improve coordination, balance, acceleration, and deceleration when changing directions rapidly

Procedure

1. Begin in the Form Start position (Figure 5-13) at the starting line (Figure 5-35)
2. When ready, sprint forward to the cone and plant right foot to complete a 90° change of direction to the left
3. Sprint forward to the far side of the next cone; plant left foot to complete a 180° change of direction to the right
4. Sprint forward back to the second cone and plant left foot to complete a 90° change of direction to the right
5. Sprint past the first cone to finish
6. Complete this drill in the opposite direction as well (i.e., right turn around the first cone, etc.)

Coaching Points

- Stay low when changing directions
- Avoid using more than one step to change directions around the cones
- Keep head and eyes up; avoid looking for the cones

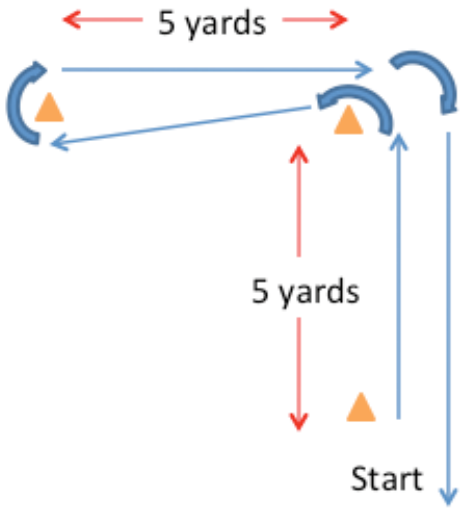

Figure 5-35. Three-Cone Drill

7. Four-Corner Drill

Exercise Objective: Improve coordination, balance, acceleration, and deceleration when changing directions rapidly

Procedure

1. Begin in the Form Start position (Figure 5-13) at the starting line (Figure 5-36)
2. When ready, sprint forward to the cone and plant right foot to complete a 90° change of direction to the left
3. Sprint forward to the next cone and plant right foot to complete a 90° change of direction to the left
4. Sprint forward to the next cone and plant right foot to complete a 90° change of direction to the left
5. Sprint past the first cone to finish
6. Complete this drill in the opposite direction as well (i.e., plant with left foot to complete right turns around all cones)
7. This drill can also be performed using a sprint-shuffle-backpedal-shuffle pattern and a backpedal-shuffle-sprint-shuffle pattern

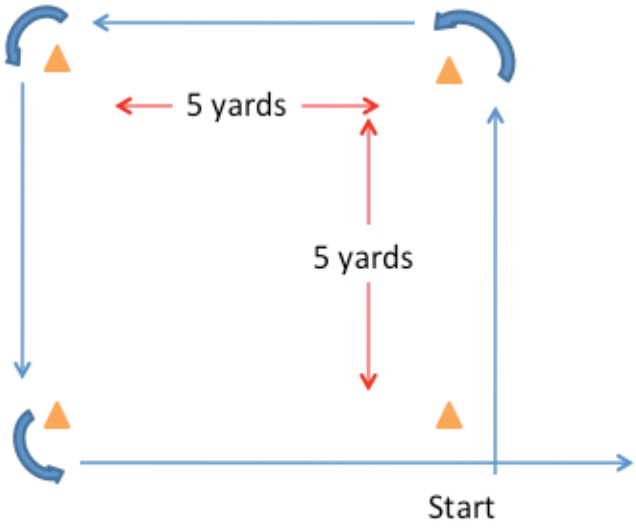

Figure 5-36. Four-Corner Drill

Coaching Points

- Stay low when changing directions
- Avoid using more than one step to change directions around the cones
- Keep head and eyes up; avoid looking for the cones

8. Sprint Ladder

Exercise Objective: Improve coordination, balance, acceleration, and deceleration when changing directions rapidly

Procedure

1. Begin in the Form Start position (Figure 5-13) at the starting line
2. When ready, sprint forward to the first line (5 yards) and touch it with the right hand (Figure 5-37)
3. Turn and sprint back to the starting line and touch it with the left hand
4. Turn and sprint to the second line (10 yards) and touch it with the right hand
5. Turn and sprint back to the starting line and touch it with the left hand
6. Turn and sprint to the first line again (5 yards), touch it with the right hand, then turn and sprint past the starting line
7. Perform this drill using the following distances: 10 yards – 5 yards – 10 yards, 5 yards – 5 yards – 5 yards, 5 yards – 10 yards – 15 yards, and 15 yards – 10 yards – 5 yards

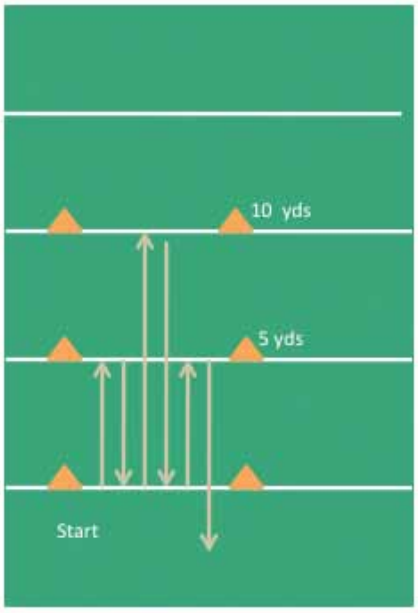

Figure 5-37. Sprint Ladder

Coaching Points

- Stay low when changing directions
- Avoid using more than one step to change directions
- Keep turns sharp – avoid running in a circular pattern when turning

9. Shuffle Ladder

Exercise Objective: Improve coordination, balance, and strength in the adductors and abductors

Procedure

1. Begin in the Athletic Stance (Figure 5-14) straddling the starting line
2. When ready, shuffle to the first line (5 yards) and touch it with the outside hand (i.e., if facing left, touch the line with the right hand) (Figure 5-38)
3. Shuffle back to the starting line and touch it with the outside hand
4. Shuffle to the second line (10 yards) and touch it with the outside hand
5. Shuffle back to the starting line and touch it with the outside hand
6. Shuffle to the first line again (5 yards), touch it with the outside hand then shuffle past the starting line
7. Perform this drill facing both the right and the left using the following distances: 10 yards – 5 yards – 10 yards, 5 yards – 5 yards – 5 yards, 5 yards – 10 yards – 15 yards, and 15 yards – 10 yards – 5 yards

Figure 5-38. Touching the Line with the Outside Hand

Coaching Points

- Stay low when shuffling
- Touch the line with the outside hand

10. Backpedal Ladder

Exercise Objective: Improve coordination, balance, acceleration, and deceleration ability when changing directions rapidly

Procedure

1. Begin in the Athletic Stance (Figure 5-14) facing away from the starting line
2. When ready, backpedal to the first line (5 yards) and touch it with either foot
3. Turn and backpedal back to the starting line and touch it with both hands
4. Turn and backpedal to the second line (10 yards) and touch it with either foot
5. Turn and backpedal back to the starting line and touch it with both hands
6. Turn and backpedal to the first line again (5 yards), touch it with either foot, then turn and backpedal past the starting line
7. Perform this drill using the following distances: 10 yards – 5 yards – 10 yards, 5 yards – 5 yards – 5 yards, 5 yards – 10 yards – 15 yards, and 15 yards – 10 yards – 5 yards

Coaching Points

- Stay low when backpedaling
- Avoid using more than one step to change directions

Landing Drills

1. Drop Jump

Exercise Objective: Develop proper landing technique for absorbing large impact forces

Procedure

1. Stand on a box (12 – 24 in. tall) with feet hip-width apart and toes pointed forward (Figure 5-39a)
2. Step off the box and land on the balls of both feet simultaneously
3. Flex hips, knees, and ankles immediately upon impact (Figure 5-39b)
4. Hold this flexed position for 5 s

Figure 5-39a. Start Position

Figure 5-39b. Landing Position

Coaching Points

- Avoid jumping off the box
- The landing should be soft and quiet
- Knees should be directly over ankles throughout the landing (avoid letting knees come together upon impact)

Figure 5-40. Vertical Jump

2. Vertical Jump

Exercise Objective: Develop explosive power

Procedure

1. Stand with feet hip-width apart and toes pointed forward
2. Lower 4 – 6 in. (i.e., countermovement) and immediately extend hips, knees, and ankles while driving both arms upward, jumping as high as possible (Figure 5-40)
3. Land softly by flexing hips, knees, and ankles upon impact

Coaching Points

- Avoid taking any steps before the jump
- There should be no pause between lowering and extending
- The landing should be soft and quiet
- The knees should be directly over the ankles throughout the landing (avoid letting the knees come together upon impact)

3. Tuck Jump

Figure 5-41. Tuck Jump

Exercise Objective: Develop explosive power, and develop proper landing technique for absorbing large impact forces

Procedure

1. Stand with feet hip-width apart and toes pointed forward
2. Lower 4 – 6 in. (i.e., countermovement) and immediately extend hips, knees, and ankles
3. While airborne, bring both knees into the chest (Figure 5-41)
4. Land softly by flexing hips, knees, and ankles upon impact

Coaching Points

- Avoid taking any steps before the jump
- There should be no pause between lowering and extending
- The landing should be soft and quiet
- Knees should be directly over ankles throughout the landing (avoid letting the knees come together upon impact)

4. 180 Degree Jump

Exercise Objective: Develop explosive power, and develop proper landing technique for absorbing large impact forces

Procedure

1. Stand with feet hip-width apart and toes pointed forward
2. Lower 4 – 6 in. (i.e., countermovement) (Figure 5-42a) and immediately extend hips, knees, and ankles while driving both arms upward
3. While airborne, rotate 180° to face the opposite direction (Figure 5-42b)
4. Land softly by flexing hips, knees, and ankles upon impact (Figure 5-42c)

Coaching Points

- Avoid taking any steps before the jump
- There should be no pause between lowering and extending
- The landing should be soft and quiet
- Knees should be directly over ankles throughout the landing (avoid letting the knees come together upon impact)

Figure 5-42a. Countermovement Phase of the 180° Jump

Figure 5-42b. Aerial Turn for 180° Jump

Figure 5-42c. 180° Jump Landing

5. Broad Jump with Vertical Jump

Exercise Objective: Develop explosive power, and develop proper landing technique for absorbing large impact forces

Procedure

1. Stand with feet hip-width apart and toes pointed forward
2. Lower 4 – 6 in. (i.e., countermovement) while bringing both arms back behind the body (Figure 5-43a)
3. Immediately extend hips, knees, and ankles while driving both arms up and forward, (jumping forward at 45°) (Figure 5-43b)
4. Bring both legs forward to land with both feet ahead of hips (Figure 5-43c)
5. Repeat the broad jump (forward jump) three times, and then perform one vertical jump for maximum height (Figure 5-43d)

Coaching Points

- Avoid taking any steps between jumps
- There should be no pause between lowering and extending
- The landing should be soft and quiet
- Knees should be directly over ankles throughout the landing (avoid letting the knees come together upon impact)

Figure 5-43a. Countermovement Phase of the Broad Jump

Figure 5-43b. Broad Jump Takeoff

Figure 5-43c. Broad Jump Landing

Figure 5-43d. Vertical Jump following Broad Jump

6. Depth Jump

Exercise Objective: Develop explosive power, and develop proper landing technique for absorbing large impact forces

Procedure

1. Begin standing on a box (12 – 24 in. tall) with feet hip-width apart and toes pointed forward (Figure 5-44a)
2. Step off the box and land on the balls of both feet simultaneously
3. Flex hips, knees, and ankles immediately upon impact (Figure 5-44b)
4. Rapidly extend hips, knees, and ankles while driving both arms upward, jumping as high as possible (Figure 5-44c)

Figure 5-44a. Depth Jump Start Position

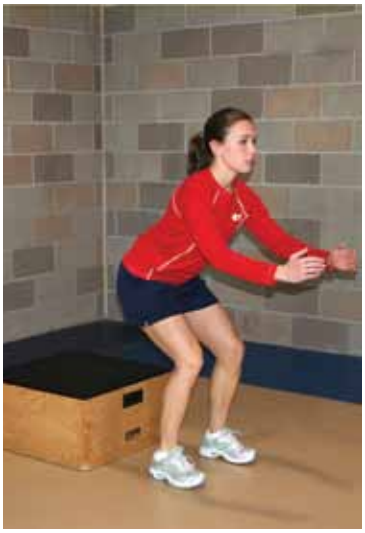

Figure 5-44b. Depth Jump Countermovement

Figure 5-44c. Vertical Jump Portion

Coaching Points

- Avoid jumping off the box
- Avoid pausing between the landing and vertical jump
- The landing should be soft and quiet
- Knees should be directly over ankles throughout the landing (avoid letting the knees come together upon impact)

7. Box Shuffle Step

Exercise Objective: Develop explosive lateral power

Procedure

1. Stand with the left foot on a box (12 – 24 in. tall) with feet hip-width apart and toes pointed forward (Figure 5-45a)
2. Jump up and over the box (Figure 5-45b) with the right foot landing on the far side of the top of the box and the left foot landing on the ground (Figure 5-45c)
3. Shuffle up and over the box from side to side continuously for the designated time (e.g., 20 s)

Coaching Points

- Avoid pausing between the landings
- The landing should be soft and quiet
- Stay low throughout drill

8. Double Box Shuffle Step

Exercise Objective: Develop explosive lateral power

Procedure

1. Stand to the right side of a box (12 – 24 in. tall) with feet hip-width and toes pointed forward (Figure 5-46a)
2. Jump up onto the box, landing with the left foot (Figure 5-46b)
3. Switch feet on top of the box, so the right foot is now on the box and the left leg is free (Figure 5-46c)
4. Lower the left foot down to the ground (Figure 5-46d)
5. Jump up and over the box from side to side continuously for the designated time (e.g., 20 s)

Figure 5-45a. Box Shuffle Step Start Position

Figure 5-45b. Box Shuffle Step Jump

Figure 5-45c. Box Shuffle Step Landing

Figure 5-46a. Double Box Shuffle Step Takeoff

Figure 5-46b. Double Box Shuffle Step First Contact

Figure 5-46c. Double Box Shuffle Step Second Contact

Figure 5-46d. Double Box Shuffle Step Landing

Coaching Points

- Avoid pausing between the landings
- The landings should be soft and quiet
- Stay low throughout drill

9. Lateral Box Jump

Exercise Objective: Develop explosive lateral power

Procedure

1. Stand to one side of a box (12 – 24 in. tall) with feet hip-width and toes pointed forward (Figure 5-47a)
2. Jump up onto the box with both feet (Figure 5-47b)
3. Jump off of the box, landing on the other side with both feet (Figure 5-47c)
4. Jump up and over the box from side to side continuously for the designated time (e.g., 20 s)

Coaching Points

- Avoid pausing between the landings
- The landing should be soft and quiet
- Stay low throughout drill

Figure 5-47a. Lateral Box Jump Start Position

Figure 5-47b. Landing on the Box

Figure 5-47c. Lateral Box Jump Landing (far side)

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Sample Program for Agility Drills Weeks 5-12

Week 5		
Drill	**Day 1 Reps (LIGHT)**	**Day 2 Reps (HEAVY)**
Build-Ups	2	4
Form Starts	4	4
Position Starts	4	4
2 minute water break		
Flying 10s	2	3
Power Skips (height)	2	2
Power Skips (distance)	2	2
Total reps	**16**	**19**

Week 6		
Drill	**Day 1 Reps (LIGHT)**	**Day 2 Reps (HEAVY)**
Build-Ups	3	4
Form Starts	4	4
Position Starts	4	4
2 minute water break		
Flying 10s	3	4
Power Skips (height)	2	3
Power Skips (distance)	2	3
Total reps	**18**	**22**

Week 7		
Drill	**Day 1 Reps (LIGHT)**	**Day 2 Reps (HEAVY)**
Build-Ups	4	4
Form Starts	4	4
Position Starts	4	4
2 minute water break		
Flying 20s	2	3
Power Skips (height)	2	2
2 minute water break		
Power Skips (distance)	2	2
Harness Routine	1	2
Total reps	**21**	**25**

Week 8		
Drill	**Day 1 Reps (LIGHT)**	**Day 2 Reps (HEAVY)**
Build-Ups	4	4
Form Starts	4	4
Position Starts	4	4
2 minute water break		
Flying 20s	2	4
Power Skips (height)	2	3
2 minute water break		
Power Skips (distance)	2	3
Harness Routine	2	2
Total reps	**24**	**28**

Week 9		
Drill	**Day 1 Reps (LIGHT)**	**Day 2 Reps (HEAVY)**
Build-Ups	4	4
Form Starts	4	4
Position Starts	4	4
2 minute water break		
Flying 30s	2	3
Bag Jumps	2	4
2 minute water break		
Harness Routine	2	6
Total reps	**22**	**25**

Week 10		
Drill	**Day 1 Reps (LIGHT)**	**Day 2 Reps (HEAVY)**
Build-Ups	4	4
Form Starts	4	4
Position Starts	4	4
2 minute water break		
Flying 30s	2	4
Bag Jumps	3	4
2 minute water break		
Harness Routine	2	3
Total reps	**23**	**29**

Week 11		
Drill	**Day 1 Reps (LIGHT)**	**Day 2 Reps (HEAVY)**
Build-Ups	4	4
Form Starts	4	4
Position Starts	4	4
2 minute water break		
Flying 30s	3	4
Bag Jumps	3	4
2 minute water break		
Harness Routine	2	3
Total reps	**24**	**29**

Week 12		
Drill	**Day 1 Reps (LIGHT)**	**Day 2 Reps (HEAVY)**
Build-Ups	4	4
Form Starts	4	4
Position Starts	4	4
2 minute water break		
Flying 30s	4	4
Bag Jumps	3	4
2 minute water break		
Harness Routine	2	4
Total reps	**25**	**32**

Sample Program for Speed Drills Weeks 7-12

Week 7		
Drill	**Day 1 Reps (HEAVY)**	**Day 2 Reps (LIGHT)**
Rope or Ladder Routine (a, b, and c)	1 each	1 each
Bag Routine (a, b, and c)	1 each	1 each
Line Jump Routine (a, b, c, and d)	1 each	1 each
2 minute water break		
Pro-Agility	4 (2 left, 2 right)	2 (1 left, 1 right)
Three-Cone Drill	4 (2 left, 2 right)	4 (2 left, 2 right)
2 minute water break		
Sprint Ladder	4 (1 x a, 1 x b, 1 x c, and 1 x d)	2 (1 x a and 1 x b)
Total reps	**22**	**18**

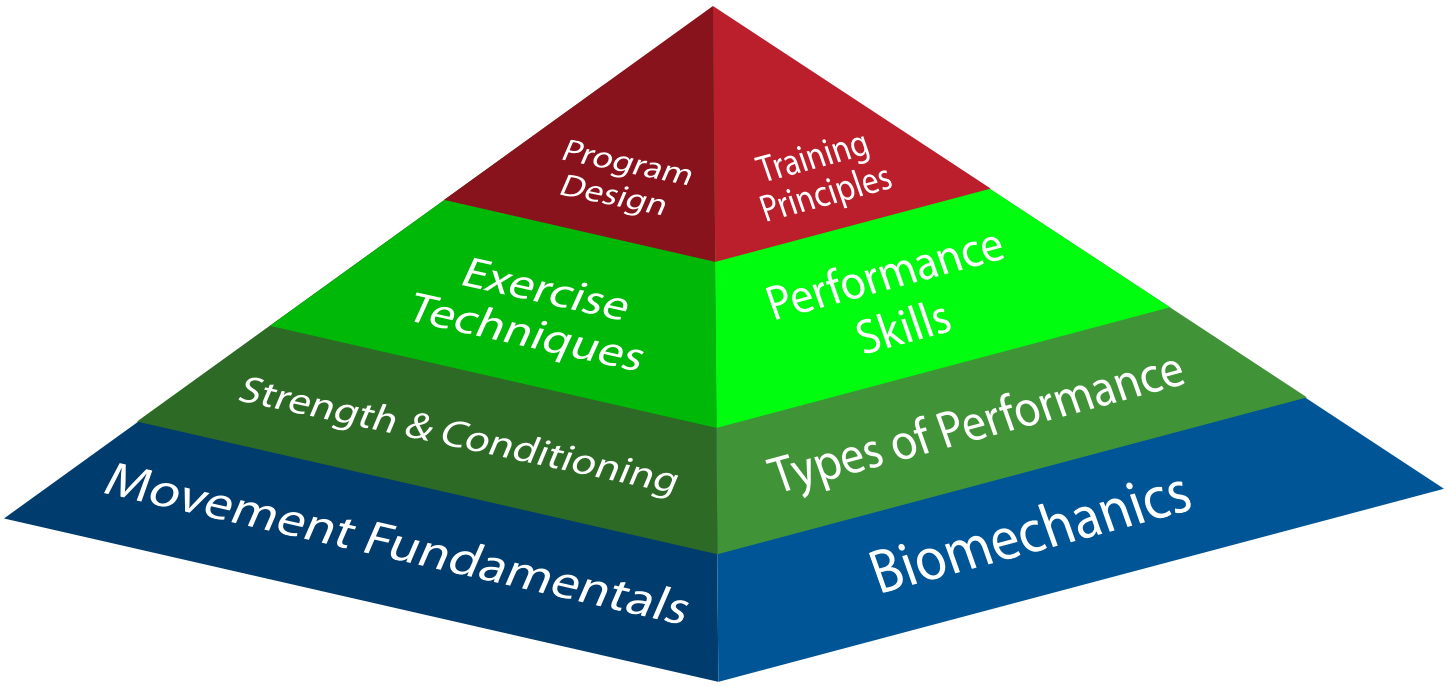
Week 8		
Drill	**Day 1 Reps (HEAVY)**	**Day 2 Reps (LIGHT)**
Rope or Ladder Routine (a, b, and c)	1 each	1 each
Bag Routine (a, b, and c)	1 each	1 each
Line Jump Routine (a, b, c, and d)	1 each	1 each
2 minute water break		
Pro-Agility	4 (2 left, 2 right)	3 (2 left, 1 right)
Three-Cone Drill	6 (3 left, 3 right)	4 (2 left, 2 right)
2 minute water break		
Sprint Ladder	6 (2 x a, 2 x b, 1 x d, and 1 x e)	4 (1 x a, 1 x b, 1 x d, and 1 x e)
Total reps	**26**	**21**

Week 9		
Drill	**Day 1 Reps (HEAVY)**	**Day 2 Reps (LIGHT)**
Rope or Ladder Routine (a, b, and c)	1 each	1 each
Bag Routine (a, b, and c)	1 each	1 each
Line Jump Routine (a, b, c, and d)	1 each	1 each
2 minute water break		
Pro-Agility	4 (2 left, 2 right)	2 (1 left, 1 right)
Nebraska Agility	4	2
Three-Cone Drill	4 (2 left, 2 right)	4 (2 left, 2 right)
2 minute water break		
Sprint Ladder	2 (1 x d and 1 x e)	2 (a and b)
Shuffle Ladder	2 (1 x a and 1 x b)	2 (1 x c and 1 x d)
Backpedal Ladder	2 (1 x a and 1 x b)	2 (1 x d and 1 x e)
Total reps	**28**	**24**

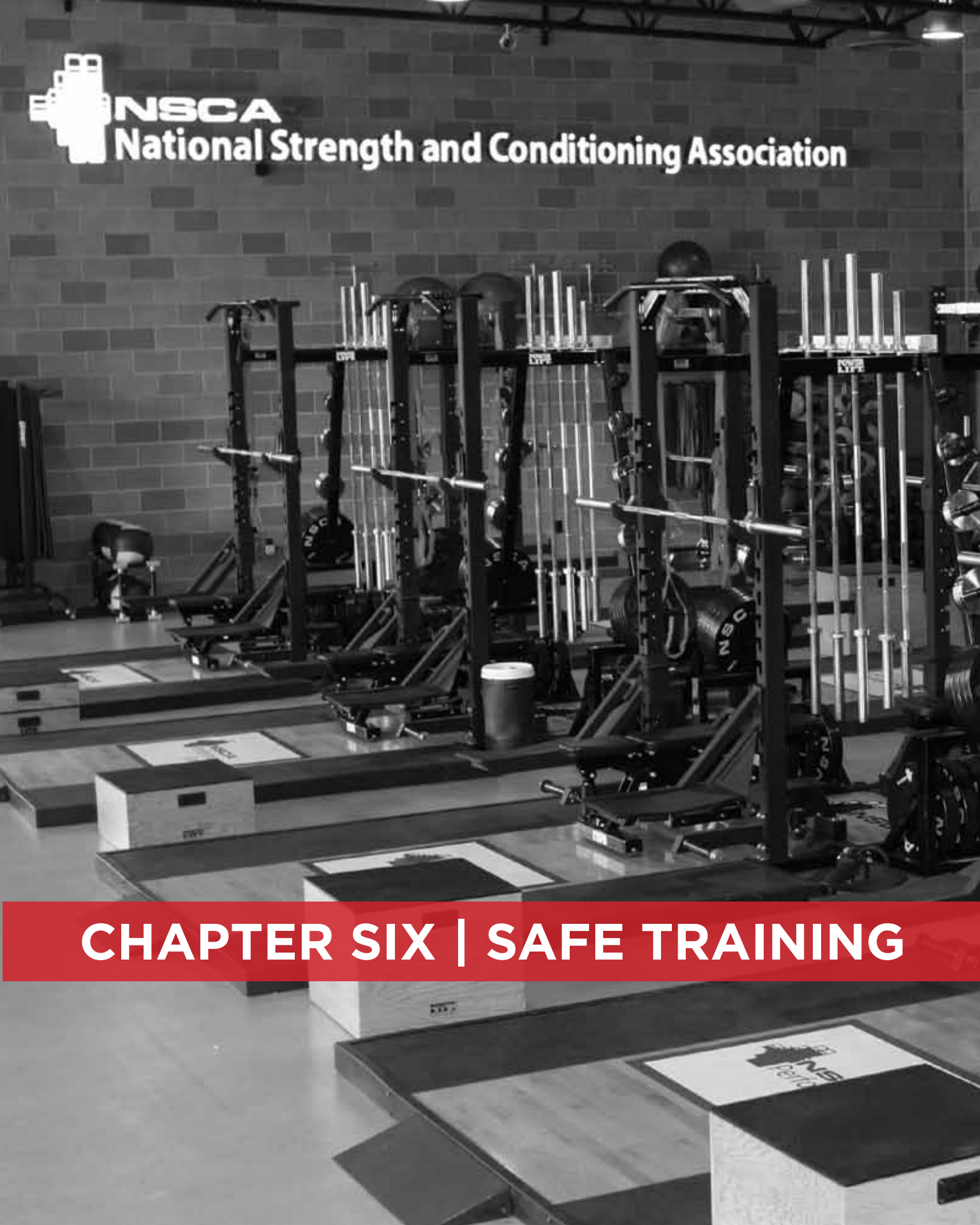
Week 10		
Drill	**Day 1 Reps (HEAVY)**	**Day 2 Reps (LIGHT)**
Rope or Ladder Routine (a, b, and c)	1 each	1 each
Bag Routine (a, b, and c)	1 each	1 each
Line Jump Routine (a, b, c, and d)	1 each	1 each
2 minute water break		
Nebraska Agility	4	2
Three-Cone Drill	6 (3 left, 3 right)	4 (2 left, 2 right)
2 minute water break		
Sprint Ladder	5 (1 x a, 1 x b, 1 x c, 1 x d, and 1 x e)	2 (1 x d and 1 x e)
Shuffle Ladder	3 (1 x a, 1 x d, and 1 x e)	4 (2 x a and 2 x b)
Backpedal Ladder	3 (1 x a, 1 x d, and 1 x e)	4 (2 x a and 2 x b)
Total reps	**31**	**26**

Week 11		
Drill	**Day 1 Reps (HEAVY)**	**Day 2 Reps (LIGHT)**
Rope or Ladder Routine (a, b, and c)	1 each	1 each
Bag Routine (a, b, and c)	1 each	1 each
Line Jump Routine (a, b, c, and d)	1 each	1 each
2 minute water break		
Nebraska Agility	4	2
Three-Cone Drill	6 (3 left, 3 right)	4 (2 left, 2 right)
2 minute water break		
Four-Corner Drill	6 (3 left, 3 right)	4 (2 left and 2 right)
Sprint Ladder	2 (1 x a and 1 x b)	3 (1 x a, 1 x c, and 1 x d)
Backpedal Ladder	2 (1 x d and 1 x e)	3 (1 x a, 1 x b, and 1 x c)
Total reps	**30**	**26**

Week 12		
Drill	**Day 1 Reps (HEAVY)**	**Day 2 Reps (LIGHT)**
Rope or Ladder Routine (a, b, and c)	1 each	1 each
Bag Routine (a, b, and c)	1 each	1 each
Line Jump Routine (a, b, c, and d)	1 each	1 each
2 minute water break		
Pro-Agility	4 (2 left, 2 right)	3 (1 left, 2 right)
Three-Cone Drill	4 (2 left, 2 right)	4 (2 left, 2 right)
Four-Corner Drill	6 (3 left, 3 right)	4 (2 left, 2 right)
2 minute water break		
Sprint Ladder	5 (1 x a, b, c, d, and e)	4 (1 x a, 1 x b, 1 x d, and 1 x e)
Backpedal Ladder	5 (2 x a, 2 x d, and 1 x c)	3 (1 x a, 1 x b, and 1 x c)
Total reps	**34**	**28**



Performance Pyramid



CHAPTER SIX | SAFE TRAINING

Safe training involves "risk management," which is the modern term for ensuring that programs, policies, procedures, personnel, and other factors are selected and act in the safest manner possible. Risk management is the modern term because absolute safety remains unachievable; thus, the coach must "manage" risk such that the probability of injury is low. "Injury prevention" is also a common term for safe training in that the obvious goal is to prevent injury. However, modern understanding of safety programs and their implementation involves management more than an implied guarantee of prevention. Therefore, the following information should be used to develop and implement sound strength training and conditioning programs, and facility policies and procedures, to manage risk effectively and help ensure a safe training environment.

Waivers and Informed Consent/Assent

1. Informed consent requirements now permeate many activities from school field trips to serious medical procedures. Every athlete should be made fully aware of the risks involved in the activity and formally (in writing) agree to undertake those risks.

2. Consent is a term used for people of legal age who are able to sign a legally binding contract. Assent refers to the agreement of the underage participant to take part in the activities and signifies that the underage participant understands the risks involved. Underage athletes will also require the consent of their parent or legal guardian.

3. "Technically, informed consent is a contract." Both parties in the contract must understand the agreement they are making. These types of contracts cannot legally bind minors, because of their immaturity. In order for minors to be involved, their parents and/or guardians must agree to the contents of the document. Informed consent should always be obtained in writing (45).

4. Informed consent is achieved by acknowledging risk, developing a document that details these risks, presenting the document, and ensuring complete understanding of the risks by all parties (45).

5. Although informed consent is a contract, it is not an agreement to be injured (45). Nor does informed consent imply that lawsuits are impossible. The informed consent document indicates that the athlete has agreed to participate based on understanding the risks involved.

6. At some point the athlete, parent/guardian must sign the informed consent document and thereby agree to participate or allow the underage child to participate in the activity. The signing of the document indicates that both parties are aware of the risks and choose to participate in spite of the risks. These documents must remain in a file in the event the participant is ever injured. No one should be allowed to participate without an informed consent document on file (45).

7. Allow time and provide opportunities for participants and parents/guardians to ask questions. It is a mistake to simply hand out the documents, request signatures, and then collect them.

Pre-Participation Screening and Clearance

A physical examination is imperative for all athletes prior to participating in strength training and conditioning programs. This should include a comprehensive health and immunization history as well as a relevant physical exam, part of which includes an orthopedic evaluation (12,13,19,30). Some type of cardiovascular screening is also recommended (3,13,18,20). Strength training and conditioning coaches do not need a copy of the results, but must require a signed statement verifying proof of medical clearance for athletes to participate.

Warnings

1. Warn in advance of all potential hazards in the strength training and conditioning facility.

2. Document that parents were warned of the hazards of participation before beginning. This usually occurs via the consent/assent document.

3. "Failure to Warn" is an almost universal allegation in sports lawsuits. These allegations are almost impossible to defend against and no proof of negligence or wrongdoing is required (45).

4. Warnings are necessary because the athlete is usually the least informed party in the physical activity. Thus, the coach or supervisor carries the burden of providing the warning(s).

5. Warnings Guidelines:

- Warnings should be written and cover the full range of potential risks involved
- Warnings should indicate the hazards and the potential harm that may result from participation
- Warnings should be understandable by the layperson
- Warnings should be specific to the particular activity
- Warnings should not assume that anything is obvious to the athlete or his/her parents/guardians
- Warnings must cover all aspects of the activity from skills, to transportation, to locker rooms, and so forth
- Warnings should include the potential consequences and severity of injuries, both short- and long-term
- Warnings should define and explain terms such as quadriplegia, sickle cell trait, sudden cardiac death, concussion, hypertrophic cardiac myopathy, paraplegia, paralysis, disability, musculoskeletal injury, sprain, strain, arthritis, pathogen, HIV-AIDS, and overuse

- Warnings should include all safety rules and policies
- Warnings should include information about the role of parents, siblings, and significant others
- Verbal and written warnings should be documented and provided consistently and often (25)
- Written records should include warning dates and times, content, and who received the warnings
- Warnings signage should be plentiful, easy to read, and attention should be drawn to the signage whenever appropriate (updates and new policies should be written and provided to all athletes and significant others)
- Warnings are commonly delivered during orientation meetings or initial tours of the facility
- Do not describe warnings as something like, "Well, we have to do this warning stuff, but don't worry, you're perfectly safe." Take warnings seriously, provide them often, and ensure that people understand and appreciate the warnings (33)

Supervision

Supervision is defined as "overseeing the activities of participants," (45). Estimates have indicated that approximately 80% of athletic injuries involve a lapse in supervision and/or instruction (5,6,37). One of the primary tasks of supervision is to ensure that safety practices are implemented by all concerned (7,8). In short, supervision is designed to prevent injuries due to inappropriate behaviors such as horseplay, daredevil-type stunts, and inattentiveness (31,32).

There are two basic types of supervision, direct and indirect, based on proximity and involvement of the supervisor (23,27,28,38). Direct supervision involves closer contact and direction of the athlete(s) such as in teaching. Usually skill instruction and spotting involve direct supervision. Indirect supervision is common for observing activities in the weight room, but the supervisor is less close to the athletes. In situations when the skills of the activities are well learned, and the athletes are fully competent at performing on their own, then indirect supervision is all that is necessary to maintain vigilant protection of the athletes.

Supervision is an "elastic" concept implying that an experienced strength training and conditioning coach will move easily from direct to indirect supervision, and back, as the situation or the participant's needs dictate. However, anyone charged with either type of supervision should station him/herself to see all of the activities under his/her jurisdiction. As such, the supervisor should be able to see and stop all activity whenever circumstances dictate (41). Supervision is required as long as athletes are in the facility and sometimes when they are moving from one area of a larger facility to the weight room and back (9). The strength training and conditioning coach should know that his/her responsibility extends to ensuring that athletes moving from one facility to another are supervised at all times. Be aware that in school settings you may need to collect students at their classroom and return them to their classroom. Do not expect that students, especially young students, will get safely from one place, or building, to another without competent supervision in place (9).

Gender sensitive supervision – The strength training and conditioning coach may be supervising and/or instructing athletes of both genders simultaneously. Obviously, locker room and restroom facilities should be supervised carefully when an instructor or supervisor of the opposite gender must intervene. If possible, have supervisors of both genders present during strength training and conditioning activities.

Stranded participants – Perhaps too often, young participants arrive at the facility via a parent or non-custodial parent (e.g., the parent who drove the carpool). However, if an athlete's ride home is late when training is completed, supervisors should never be alone with a single youngster in the facility; this is particularly true when the youngster is of the opposite gender. If this should occur, the supervisor should notify local police and have the child picked up by a police officer and transported to the local police station from where pick up of the youngster occurs. Parents/guardians should be aware of this policy from the outset, so that they understand the scope, depth, and duration of the supervisor's responsibilities. A list of non-custodial parents, relatives, and others who are permitted to transport a youngster should be kept in the facility and non-approved people should not be allowed to transport a youngster without expressed parental or guardian permission. Pre-planning for these types of problems via participation forms can save a great deal of indecision and liability exposure.

Emergency supervision – Emergency plans should be developed and practiced for critical local emergencies such as a serious injury, weather-related threats, and others. Policies and procedures for unusual and threatening situations should be developed, written, communicated to all involved, and practiced. Emergencies may occur when an athlete becomes seriously injured or ill and the supervisor must attend to the injury or illness while awaiting emergency transport. In this type of situation, develop a plan for ensuring the supervision and safety of the other athletes so that they are not unsupervised.

Matching opponents – Strength training and conditioning athletes should be paired or grouped such that they have similar physical characteristics. Partner exercises along with competitive races or other activities can be powerful motivators for training. However, pairing an athlete that is physically more mature with an athlete that is physically less mature can invite problems. A less mature athlete may not even be able to lift the weight needed by the partner performing a selected exercise. Be sensitive to keeping athletes of similar characteristics together so that they can easily assist each other in spotting, moving weights, racking and unracking the bar, and so forth.

Facility

Location

- Ideally, strength training and conditioning rooms should be located on the ground floor with an easily accessible entrance for moving large pieces of equipment in or out

Access

- The room should have clear, unobstructed doors and pathways both inside and out
- All door or floor-to-floor level thresholds should be flush, level, and even
- All exits must be clearly marked, never obstructed, and visible from any location within the facility (special signage for the visually impaired is also required)
- During closed hours, unsupervised access to the room should be prohibited

Ceiling

- Ceiling height should be a minimum of 12 – 14 ft (this height includes other items such as lighting, pipes, fans, and signage)
- If medicine ball training is going to be included, ensure adequate ceiling height and solid walls

Flooring

- The two most common materials for flooring are carpet and various types of rubber flooring
- If carpet is used in the aerobic or warm-up area, it should be treated with antifungal, antiseptic, and antibacterial agents
- In places where free weights touch the ground, facilities should have rubber flooring; otherwise, carpet is recommended for sound and aesthetics
- Provide a firm but resilient floor for plyometric exercises and turf for sprint and agility work

Lighting

- A weight room should be lit to 75 – 100 foot candles (806 – 1,076 lux), and at least 50 foot candles (538 lux) at floor level
- In comparison, a coach's office is often lighted at approximately 50 foot candles
- Lighting should not produce marked shadows

Windows

- Windows should be located a minimum of 20 in. above the floor to protect from rolling bars and plates that could break them
- The floor plan should not have the spotters and lifters near or contacting windows to prevent collision and breakage

Temperature

- The recommended temperature for a facility is 68 – 78°F, (68 – 72°F for summer months and 72 – 78°F for winter months)
- Zone heating is recommended due to its ability to regulate temperatures based on the number of athletes in the room at any one time

Sound

- Music is often used as a motivator while training and the volume should never exceed 90dB

Electrical

- Grounded outlets (GFCI) should be used at all times throughout the room and plenty of outlets should be installed to accommodate all electronic equipment (cleaning machines also need access to electrical outlets)

Signage

- Signage can assist athletes in emergency procedures, operational policies, rules, and safety guidelines

Other considerations

- Drinking fountains should be placed throughout the facility with easy access (however, drinking fountains should not hinder traffic flow or cause a distraction)
- Restrooms for both males and females should be clearly marked and located close to the weight room or in the entrance of the weight room
- Telephones are needed in the strength training and conditioning office for normal use as well as in case of emergencies (an additional line can be placed in the weight room for emergency purposes only)
- Telephones should be located 4 ft off the ground to accommodate athletes with disabilities

In addition to the previous list, there are a few caveats for the safe implementation of a strength training and conditioning program. First, strength training and conditioning activities should be planned, and the required number of qualified staff should be present. Second, recommended guidelines should be followed during peak usage times for minimum average floor space allowance per participant (100 ft^2), coach-to-athlete ratios (1:10 junior high school, 1:15 high school, 1:20 college), and number of participants per barbell or training station (up to 3). In ideal circumstances, this corresponds to one strength training and conditioning coach per 3 – 4 training stations and/or 1,000 ft^2 (junior high school); 5 training stations and/or 1,500 ft^2 (high school); or 6 – 7 training stations and/or 2,000 ft^2 (college), respectively. Professional discretion may adjust these guidelines with respect to the practical considerations discussed above.

Performance Safety Team

Modern strength training and conditioning has become a complex professional area with branches that interact with virtually all facets of sports and exercise activities. The literature, consensus statements, position statements, and personal opinions sometimes vary widely and require interpretation by specialist professionals for implementation by the strength training and conditioning coach. Most sports medicine and science specialists will likely agree with the fact that it is almost impossible for them to keep up with the newest literature in their own academic areas. Thus, a coach is unlikely to know what specialists know, and should learn to ask questions and involve specialists in areas of concern that arise in their coaching and athletes (10,15,17,22,24, 26,29,35,39,43,45,46). The performance safety team will also assist the coach in staying up-to-date with the latest trends and discoveries in strength training and conditioning, and the science that underlies the practice. The coach and/or program should seek the following specialists to help:

- Team physician
- Team athletic trainer
- Nutritionist/Dietitian
- Team psychologist/counselor
- Student or other manager
- Others, as needed

Preventing Sudden Death

The Inter-Association Task Force for Preventing Sudden Death in Collegiate Conditioning Sessions published 10 recommendations in January 2012 for the best practices in preventing sudden death. These recommendations were endorsed by the National Strength and Conditioning Association, American College of Sports Medicine, American Medical Society for Sports Medicine, American Osteopathic Academy of Sports Medicine, Canadian Athletic Therapists' Association, Collegiate Strength and Conditioning Coaches Association, and National Athletic Trainers' Association, to name a few. The following are 10 recommendations for preventing sudden death in collegiate conditioning sessions (14):

1. Acclimatize Progressively for Utmost Safety
2. Introduce New Conditioning Activities Gradually
3. Do Not Use Exercise and Conditioning Activities as Punishment
4. Ensure Proper Education, Experience, and Credentialing of Strength Training and Conditioning Coaches
    A. Education
    B. Experience
    C. Credentials
5. Provide Appropriate Medical Coverage
6. Develop and Practice Emergency Action Plan
7. Be Cognizant of Medical Conditions
    A. Exertional sickling and SCT-related concerns
    B. Exertional heat stroke
    C. Cardiac conditions
8. Administer Strength and Conditioning Programs
9. Partner with Recognized Professional Organizations
10. Provide Adequate Continuing Education for the Entire Coaching and Medical Teams

Special Considerations

Recent evidence and medical opinion have arisen to identify several important threats to athlete health of which everyone in athletics should be aware. These threats include sickle cell trait, sudden cardiac death, concussion, exertional rhabdomyolysis, and hyperthermia.

Sickle Cell Trait

Sickle cell trait refers to the change in shape of red blood cells from their typical, rounded frisbee-like shape to a sickle shape ("sickle" refers to the quarter moon shape of the red blood cell) (1,2,4). Sickle cell trait can be fatal. Athletes with sickle cell trait should be allowed to participate in sports. Sickle cell trait diagnosis should have been made at birth, and records of this disease, or simply notification of its presence, should be available to the strength training and conditioning coach. Complications from sickle cell trait occur in many competitive sports. Athletes with this condition will show moderate fatigue, but can still talk and move (1,2,4). If they are suffering from the condition, they will likely have ischemic (lack of oxygen making it to body tissues) pain and muscle weakness (1,2,4). Heat, altitude exposure, asthma, and dehydration may be contributors to the condition even when the exercise is mild. Evidence has shown that incidents occur in hard training rather than games, but the cause or causes of athlete collapse are not yet known. Recommendations include:

1. Slow build-up of exercise intensity
2. Allow athlete to set own pace
3. Provide adequate rest, and when in doubt rest
4. Exclude athletes from pre-season screening fitness tests
5. Stop activity if pain, unusual muscular weakness, or shortness of breath occurs
6. Stay hydrated, stay cool
7. Avoid high caffeine and energy drinks
8. Manage asthma

9. Beware of exercise at higher altitudes, and under high environmental pressures (e.g., scuba diving)
10. Abstain from training when ill
11. Stay in shape year round so that sudden increases in fitness are unnecessary
12. Do not hesitate to seek medical help

Sudden Cardiac Death

Although sudden cardiac death is rare, the devastating consequences obviously merit focused attention. Sudden cardiac death is considered a non-traumatic and unexpected death due to cardiac causes within one hour of symptoms onset (30). Hypertrophic cardiomyopathy is the main cause of sudden cardiac death accounting for 48% of recorded deaths in a sample of 134 athletes, although 17 different causes have been identified (30,36). Unfortunately, most athletes who suffer sudden cardiac death have no symptoms before death and no history of family or personal cardiac problems. Moreover, pre-participation screening using electrocardiography and echocardiography identify only a small percentage of athletes who may have serious cardiac conditions. Thus, the cost of the screening may not be economically feasible given the relatively small positive findings among a very large population of athletes.

Concussion

A concussion is a brain injury caused by a blow to the head that results in shaking, or otherwise traumatizing, the brain. The brain, housed inside the skull, is surrounded by and floats in cerebrospinal fluid. Concussions, although always a part of contact sports, appear to be trending upward based on epidemiological data (11). Concussions do not have to be present with unconsciousness, and most people will fully recover from a concussion. Some serious concussions and concussive events that happen repeatedly may require surgery. Concussions are serious and can be trauma of such significance that the injury affects the athlete for the rest of his/her life (16,42,44,47). Symptoms of a concussion include:

- Unconsciousness
- Unclear thinking
- Inability to concentrate
- Forgetfulness
- Headache
- Blurred vision
- Nausea and vomiting
- Dizziness
- Light sensitivity
- Ataxia (balance problems)
- Agitation
- Inability to sleep

If an athlete suffers a concussion, the athlete should be removed from play for the entire day. The seriousness of this type of head injury cannot be judged by a layperson. Appearance of any of the symptoms listed above should merit a medical examination. The athlete should be removed from all sport participation until cleared by a physician.

Exertional Rhabdomyolysis

Exertional rhabdomyolysis is the degeneration or destruction of muscle tissue because of excessive and unaccustomed exercise. Rhabdomyolysis has been seen in emergency medical settings due to circumstances such as suspension syndrome when someone is held aloft for period of minutes to hours while blood flow to and from the legs is cut off due to a harness or rope acting like a tourniquet. In strength training and conditioning settings, exertional rhabdomyolysis is caused by excessive exercise (21,34,40). The best treatment for rhabdomyolysis is prevention. Guidelines to avoid rhabdomyolysis include:

1. Do not begin training programs with excessive and intense exercise (instead, build training loads progressively)
2. Separate freshmen from upper classmen due to varying fitness levels
3. Maintain adequate hydration
4. Feelings of dizziness should be taken seriously by reducing training intensity
5. Train progressively and use delayed onset muscle soreness (DOMS) as a clue that training may be too difficult for the athletes

Symptoms include:

- Pain in the muscle(s), and on exertion
- Muscle weakness and swelling
- Myoglobin in the urine (myoglobin turns the urine a brown color)
- Other muscle cell proteins and enzymes are found in the blood
- Increased amount of large proteins in the blood (can lead to kidney failure and death)

Hyperthermia

Hyperthermia means overheating. Hyperthermia is a potentially fatal condition, most often seen in football during pre-season training during the latter summer months when outside temperatures are hot, accompanied by high humidity. Heat injury can range from mild heat cramps to heat stroke. Unfortunately, a number of athletes have died from heat stroke during training. Heat stroke is completely preventable, though. Recommendations for avoiding heat-related performance problems include:

1. Encourage and even enforce frequent rest periods in hot and humid environments
2. Encourage maintenance of hydration by frequent drink breaks (thirst is a poor indicator of dehydration—encourage fluid intake before the athlete is thirsty)
3. Urine color can be a helpful tool in gauging hydration (dark yellow or brown urine indicates dehydration—urine should be light yellow in color or clear)
4. Compare pre-practice weight with after practice weight and try to replace about 1.5 times the weight difference (i.e., loss) in fluids following practice
5. Acclimatize to the high heat and humidity by progressing training very slowly
6. Use the cooler parts of the day to train
7. Wear light clothing and light colors
8. Do not be afraid to stop training if the environment is prohibitive for safety

Factors include:

- Environmental temperature
- Environmental wind direction and speed (wind is a potential cooling agent)
- Environmental humidity (greater than 60% can be problematic, especially when combined with high temperatures)
- Dark clothing tends to absorb heat from the sun
- Fitness and acclimatization
- Age (children do not adapt to high heat and humidity as rapidly as adults)
- Hydration (the athlete must remain hydrated throughout training)
- Over-fat (fat is an insulating tissue and athletes who are over-fat are more predisposed to heat injury than leaner athletes)
- Sickle cell trait is aggravated by hot environments

In closing this chapter, always keep the best interest of the athlete foremost in your mind. Training decisions should always proceed from a safety premise. Remember, that sensible strength training and conditioning is injury prevention. However, like all great things, strength training and conditioning can be abused and thereby obtain the opposite of safety. Well-designed training, well-instructed and well-supervised athletes do not tend to be injured or suffer from overtraining. When in doubt, rest. When training, be ever vigilant and observant of technique errors. Be sure to pay attention to detail so that the small errors, that by themselves may not merit much attention, do not lead to bigger errors.

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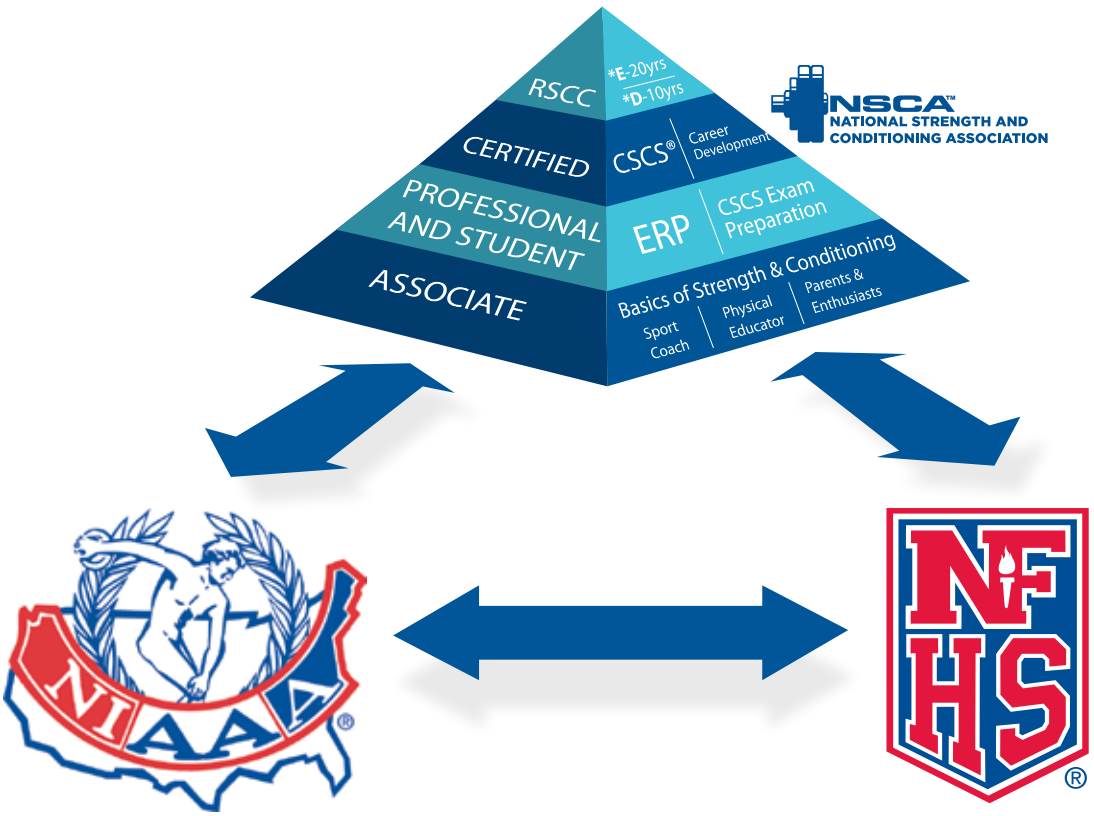

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