Year Round Cardiovascular Conditioning Program for Division 1 Baseball Players

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This program has been designed with the intent of maximizing the talent and ability of the college baseball player by efficient and knowledgeable preparation for competition. The goal of this project is to develop a strength and conditioning program that prepares the athlete both mentally and physically to peak ultimately for competition in the months of March through May. With a proper balance of shock and regeneration cycles, and an adequate transition phase, the psyche of the athlete should be prepared to maintain concentration and motivation, gain confidence, and crave competition. Additionally, the goal of this program physically, is to reduce the risk of injury and facilitate tactical ability (and ultimately success) through endurance, speed, strength, and flexibility training.

This program is designed for the collegiate level, male baseball player. The typical age of this athlete ranges from eighteen to twenty-two, placing him in the final stages, or completion, of puberty and physical maturation. In following this protocol, specific considerations should be made for those athletes with personal or family medical history. The collegiate level Division 1 athlete must be capable of handling the physical and mental stress of a demanding competitive season that includes as many as three games a weekend and lots of time on the road. In order to monitor the health of the athlete throughout participation, a pre-participation physical is necessary to medically clear the athlete, as well as obtain baseline values for height, weight, blood pressure, pulse rate, and musculoskelatal (ligamentous) stability. Previous medical history of illness and surgery should be identified as well as any family history of heart disease, stroke, or sudden death. Allergies and medications should be brought to attention of the athletic trainer as well. The team physician should perform the exam, and proper documentation should be kept on file for future reference.

While some injuries in baseball can be acute such as fracture and shoulder dislocation, most injuries stem from overuse and include: bicipital tendonitis, rotator cuff strains, impingement syndrome, bursitis, Little Leaguer's Elbow, medial epicondylitis, MCL sprains/rupture, wrist flexor strains, and finger pathology (tendon rupture). Specifically, some catchers may experience patello-femoral joint irritation at the knee as a result of continued squat to stance positioning. Pitchers, along with experiencing rotator pathology, increase stress and risk of injury to the extended hip of the stance leg and the knee of the lead leg when pitching off the mound. Endurance to reduce muscle fatigue, proper biomechanics, strength training, and flexibility training will all contribute to reducing incidences of these injuries.

In regards to energy requirements, baseball utilizes primarily the ATP-Creatine Phosphate (CP) Cycle, which provides energy for high intensity, short physical exertions of one to fifteen seconds, typical for a sprint around the bases, or a run in from the outfield to make a catch, or field the ball. Energy is derived from the high-energy, Creatine-Phosphate found in the muscle. Specific conditioning through short, intense bouts of exercise will increase the efficiency of this energy system.[5] Along with the ability to provide sufficient means of energy for competition, the cardiovascular system must be trained to meet the oxygen demands of the muscles to ensure metabolic function.

Good technique will increase power and velocity for both hitting and throwing the baseball, as well as reduce the risk of injury by properly distributing the stress of these activities. Proper coordination of the body in the kinetic chain allows for the generation of momentum to strike or release the ball followed by a deceleration of the body. The biomechanics of hitting a baseball include a weight shift to the back foot and generation of a "trunk coil" by rotating the arms, shoulders and then hip segments in a clockwise direction (for right-handed batter). In stepping forward with the front leg and extending the left knee and right hip, the hips rotate in a counter clockwise rotation that creates momentum that passes through and builds upon the counter clockwise rotation of each subsequent link (shoulders, arms, and bat) until contact with the ball is made.[7] The body then slows itself through the eccentric contraction and distribution of energy through the larger muscle groups.[7] The components of a pitch are performed with similar mechanical rationale to the striking of the ball. In the wind up, flexing the hip of the lead leg shifts the weight to the back foot while the trunk is rotated to ninety degrees, which loads the body. Next, the stance knee is flexed and the lead leg begins its motion toward the plate shifting his weight forward. Once the stride is complete, the trunk initiates rotation and extension, which is complemented with flexion at the elbow and maximum external rotation of the shoulder (cocking). Acceleration of the arm begins with internal rotation of the humerous and elbow extension, and ends with the release of the ball. The arm decelerates with continued elbow extension and shoulder internal rotation. Extension of the lead leg, hip flexion, shoulder adduction, horizontal adduction, elbow flexion, and forearm supination are motions of the follow through which dissipate the stress of the pitching motion.[3]

For optimal power hitting the ball, strength in the entire body is required including the upper and lower extremity. Of course strength is necessary in the upper extremity for outfielders to field the ball distances of 200 ft., and for a pitcher to repeatedly throw 75 to 80 mph pitches across the plate. Leg strength is a component of the momentum that transmits from the bat to the ball, and furthermore provides the athlete with the power necessary to run the bases. Also increasing in popularity is the concept of core strengthening of the trunk. This includes strengthening muscles of the abdomen, primarily the obliques which are critical for the twisting motion needed to load the trunk and has helped even the smallest athletes develop the power needed to knock a ball out of the ball park. While strength training for power is important, strength training for joint stability is also important. Plyometric exercise helps to facilitate neuromuscular coordination that allows for the muscles in the shoulder to fire efficiently and explosively. Performed with high reps and low loads, enhanced endurance of the stabilizers will help protect the joint from fatigue that opens the door for injury. Strength training, if done properly, can also be used to facilitate flexibility gains. To increase muscle flexibility, all lifts should be worked through the entire range of motion, and attention should focus on eccentric development of the muscle contraction. Physiologically it is understood that "excessive stress and tension of negative work (eccentric work) produces a greater stretch of the involved fibers, resulting in enhanced flexibility."[1] As long as these considerations are made the theory that lifting decreases range of motion is proven wrong.

In addition to biomechanics, strength, and endurance, flexibility is also crucial in the conditioning process. The general goal of flexibility includes an increase of the athlete's range of joint motion, which consequently increases skilled agility and lowers the risk of injury. According to Alter, "an increase in range of motion permits one to exert muscle forces over greater distances and longer periods of time," which prevents the mechanical breakdown leading to injury, and also increasing momentum and power that are useful in running, batting, and throwing.[1] Understanding how to assess flexibility combined with the knowledge of specific techniques and stretches used to increase flexibility will result in gains in the athlete's ROM, and ultimately success.

Flexibility can be assessed through goniometric measurements, which provide a value for joint mobility comparison. Normal measurements for the upper extremity are as follows: shoulder abduction (180 degrees), shoulder flexion/extension (180 degrees/ 50 degrees), shoulder internal and external rotation (90 degrees each), elbow flexion/extension (160 degrees/ 0 - -5 degrees), wrist flexion/extension (90 degrees/70 degrees), forearm supination/pronation (90 degrees each).[6] A baseline bilateral comparison of these measurements is recommended for each athlete in event of injury leading to impaired range of motion. A study by Cook in 1987 noted that baseball pitchers will have excessive, or greater than normal, joint motion in their throwing shoulder (increased external rotation and decreased internal rotation).[1] In these cases stretching should be exercised only to normal limits, and not to the athlete's end range, to avoid over-stretching the ligaments and joint capsule resulting in instability. Such hypermobility may result in "impaired proprioception, increased risk of joint trauma (such as sprains), recurrent dislocation, effusions, and premature osteoarthrosis."[1] Also noteworthy is the increase in hip flexion of pitcher's lead leg and increased hip internal rotation their stance leg. [1]

Once the athlete's flexibility has been assessed, modifications can be made to maintain or increase his levels of flexibility. Three stretching techniques exist including static, ballistic, and proprioceptive neuromuscular facilitation (PNF). Static stretching requires that the muscle be stretched until slight discomfort is felt, and then held for fifteen seconds.[2] This is repeated three times with an increase in flexibility each time. Ballistic stretching is a more sport-specific stretching technique that uses quick, bouncing motions that stretch the muscle. Caution must be exercised so that the quick motions do not exceed the muscle's extensibility limits making it susceptible to small micro-tears. (A good warm-up is advised before attempting this method) The final method of stretching, PNF, considers current knowledge of the muscle's myotatic reflex and Golgi tendon organs (GTOs) in order to obtain increased ROM by alternating muscle contraction and relaxation. A muscle stretch causes muscle spindles found in the muscle to send messages to the spinal cord, which cause the muscle to reflexively contract to protect the joint structure. If the stretch lasts longer than six seconds, the GTOs will fire sending a message to the spinal cord that causes the muscle to then relax safely into extension.[6] Three types of PNF stretches have been developed based on this understanding: contract-relax (CR), hold-relax (HR), and slow reversal-hold-relax (SRHR). In CR, the antagonist muscle is actively, isotonically contracted against the resistance of the athletic trainer and then relaxed allowing the athletic trainer to passively stretch further into the ROM. HR uses a isometric contraction of the muscle being stretched against resistance followed by a passive stretch of the muscle. SRHR requires an isotonic contraction of the agonist, followed by an isometric contraction of the antagonist. The contraction of the agonist causes the antagonist to relax and stretch.[6] Both Static and PNF stretching techniques have been recommended for increasing joint flexibility.[6] These stretches are implemented into the annual conditioning program.

The macro cycle is broken into phases in relation to the actual competitive season. These phases include the preparatory (general and specific), competitive, and transition phases. Developing or maintaining flexibility is determined by phase. The goal of the general preparatory period is to gain overall body flexibility through static stretching of all major muscle groups. For increase in range of motion, stretching should be performed five to six times a week.[2] Major muscle groups include the external and internal shoulder rotators, low back, hamstrings, quads, and the gastrocnemius and soleus (calf muscles). Pictures with detailed instruction on completion of these stretches are found in appendix 1. As the athlete enters into the specific preparatory phase he should continue static stretches to increase flexibility while incorporating PNF stretching into the routine. Sport specific stretches for the upper extremity are included to facilitate the anterior and inferior joint capsule of the shoulder, the scapular stabilizers, rotator cuff, deltoid, pectoralis major, rhomboids, and trapezius (appendix 1). Wrist flexors and finger stretches are integral as well. Stretching should be performed both in warm up, to prevent injury, and in cool-down, to facilitate flexibility gains and reduce delayed onset muscle soreness. Optimal flexibility should be achieved by the commencement of the competition phase, and maintained throughout competition with continued static and PNF stretching before and after activity. Ballistic stretching may be implemented as a precursor to sport activity (properly warm-up first). Pitchers may also consider using the Fauls shoulder stretching method into their routine on a daily or as needed basis. An article from the fall 1981 issue of <u>Athletic Training</u> details these stretches with pictures and instruction (appendix 1).[4] The post-season, transition phase includes a return to the general flexibility program that entails static stretching of major muscle groups three to five times a week. This maintains a healthy base that allows for a smooth move back into competition. A chart found in appendix 2 has the monthly breakdown of the macrocycle.

There are several safety considerations when stretching. A proper warm-up and cool-down should accompany all physical activities. A light jog or activity that causes a light sweat will increase body temperature. This will result in numerous flexibility benefits which include: increased collagen and elastin (non-contractile components of muscle and tendon) extensibility, enhancing the GTOs' ability to fire by facilitated nerve conduction[6], decreased viscosity of the muscle, as well as decreased muscle tension.[1] Because of the high temperatures of the muscle after activity, the cool-down is an excellent time to stretch for flexibility increase. Other safety considerations are as follows. Stretch through discomfort and tightness but not through pain. As previously mentioned, avoid over stretching joint capsules and surrounding ligaments. Use caution when stretching the low back and neck to avoid disk injury. And finally, continue to breath normally throughout the stretch.[2]

By completing a year round flexibility program one should experience gains in their range of motion and overall flexibility. Of course, this requires that the athlete perform the stretching activities with proper technique, safely, and according to the schedule developed. By enhancing flexibility, the athlete should be able to avoid many of the injuries that hinder his ability, and ultimately lead to a more successful baseball career.

Weight training is a beneficial way to develop the muscular strength and endurance required for every pitcher, batter, and fielder. Weight training, as a form of progressive resistive exercise (PRE), employs the use of free weights and equipment that provide resistive loads to the muscles as they are shortened or lengthened. This change in muscle length and joint position, which results from a force being applied against an external resistance, is referred to as an isotonic contraction. The concentric, isotonic contraction occurs when the force produced by the muscle exceeds the resistance applied externally, causing the muscle to shorten. Typically, this is the exertional, upward motion. The complement to the concentric contraction is the eccentric contraction, which is characterized by a lengthening of the muscle as the external force exceeds the force produced by the muscle. The eccentric contraction usually occurs while moving the weight back to the starting position.

In addition to isotonic contractions, isometric and isokinetic contractions can be used to gain muscular strength. Each of the three bring their own pros and cons. The PRE method of isotonic contraction is beneficial in that the resistive equipment is relatively inexpensive, and transportable. If done correctly, these contractions provide strength gains through the joint's entire range of motion(ROM). However, the strength gains are not equal through the entire ROM, as the amount of weight applied is only the amount that can be overcome by the weakest point of the muscle (typically the end ranges of motion), leaving the potential of the strongest portion of the muscle unmet. There is also a risk of injury if balance or control is lost while performing the exercise. [8]

Isometric contractions are more commonly used in the early stages of rehabilitation. The contraction produces no change of motion or joint position as the force created is unable to overcome the external resistance. Because a solid object such as a wall or table can be used as the source of resistance, isometrics are inexpensive and can be performed almost anywhere. At the same time, strength is only achieved in one point of the ROM maximally, and the contractions are time consuming, producing little strength appreciation. [8]

Isokinetic contractions are most efficient in increasing strength of the entire muscle. Machines such as the Biodex and Cybex apply a varying resistance that accommodates the strength of the muscle at the particular location in the ROM. While the resistance changes, the speed of the motion remains constant through the joint's ROM.[1] This method of strength development creates total strength gains in the muscle, provides performance feedback, and protects the athlete from injury by controlling the joint motion. [8] Drawbacks to such equipment are the high cost to purchase and maintain the machinery.[8] In evaluating each of these three techniques, isotonic resistance training appears to be the most cost effective and beneficial method for developing the muscular strength, power, and endurance needed to facilitate baseball performance.

Muscle strength is necessary to perform even the most basic physical activity, and is defined as "the maximum force or tension generated by a muscle(or muscle groups)."[1] In order to appreciate how strength is built, it is important to have an anatomical and physiological understanding of skeletal muscle. In general, each muscle is composed of numerous muscle fibers that contain many contractile units called sarcomeres. The energy system employed by the muscle tissue will determine the type of muscle contraction produced. Type I fibers are known as the slow twitch fibers. Cellular production of energy in these fibers occurs aerobically, and allows the muscle to continue activity long after energy stores have been depleted. This feature makes type 1 the optimal fiber type for performing any endurance activity lasting over one minute.[1] Conversely, the type II fibers are collectively referred to as the fast twitch fibers, and are used for short, quick spurts of activity, that are powered by anaerobic metabolic pathways. [1] The fast twitch muscles are further divided into the type II a, and type II b categories. Type II a fibers are used for bouts of exercise lasting fifteen to sixty seconds, while the "true" fast twitch, type IIb fibers initiate the contractions for activities less than fifteen seconds in duration. [1] The physical demands of each particular sport will determine which fiber type is predominantly employed in play, and consequently, which muscle fibers will be targeted in strength training. This training concept is correlated to the specificity principle that states that specific training will produce specific outcomes. Therefore, in addition to training the type II a fibers which are predominantly employed in baseball, the strength program should target the, muscle groups and movement patterns used in the sport.

With specificity in mind, it is important to stress the fact that the strength and conditioning program should be designed with the intent of increasing baseball performance, not weight lifting performance. Many male athletes develop an attitude that bulk is better, when excess hypertrophy can actually be detrimental, causing altered biomechanics that lower baseball performance and increasing the risk of injury.[9] Studies show that lifting high amounts of weight at low speed will cause a reduction in movement speeds, including bat swing and pitching velocity. Acceleration of the arm is slowed due to the extra mass that must be mobilized.[10] Furthermore, the excess muscle in the rotator cuff may increase the chance of pinching the supraspinatus muscle under the acromion of the scapula, predisposing the athlete to Impingement Syndrome. [10] With these points in mind, the strength program is designed to incorporate lifts of lower weight, faster speeds, and in similar planes of motion to facilitate the muscular demands on the baseball field.

While weight training, it is important to follow a number of safety considerations: proper warm up and cool down, using the correct equipment and technique, and the use of a spotter. As with flexibility training, a proper warm up is necessary to prepare the muscles for activity. A five to ten minute run on a treadmill or stationary bike, and a good, stretch of the arms, legs, and trunk (may use the general stretch in appendix one) should increase circulation to the muscles sufficient to increase warming of the muscle tissue, enhancing its extensibility, and reducing the risk of injury. Begin each lift by warming up with a few reps of low weight. The workout should finish with a cool down jog/walk and stretch to assist in the removal the lactic acid from the muscles and into circulation. It is the lactic acid, created from the eccentric muscle contractions, that is responsible for delayed onset muscle soreness (DOMS) after the workout .[1]

In the weight room, the athlete must be conscious of the equipment and others around them. The lifting area should be spacious and organized to avoid backing into others. All plates and weights are to be obtained and replaced in their appropriate location to avoid tripping. Furthermore, all equipment should be inspected before use. Never risk using faulty equipment that could break, causing injury. The weight plates should be safely secured by locks and collars that permit no movement on the central bar. All free weights should be prepared with an appropriate, and equal amount of weight on each side. The chains, cables, and padding of every weight machine should be in good condition allowing for fluid movement. Weight machines should be adjusted to fit the athlete, ensuring proper joint alignment with the axis of the machine. [8]

Proper technique allows for the most effective lift, and more importantly, ensures proper mechanics to avoid injury. The correct grip and stance, lifting motion, and breathing patterns, are all components necessary for perfect technique. For safety reasons, the thumb should always lock the grip around the bar, with a underhand grip used for pulling lifts, and an overhand grip for pushing. [8] Varying the width of grip from narrow to wide will target different muscles. For instance, the wide grip on a bench press facilitates the pectoral muscles more than the narrow grip, which uses more of the triceps. Balance can be maintained by keeping the weight close to the body, and by maintaining the proper stance. [8] The grip should be balanced and just wider than shoulder width apart. Feet should be spaced shoulder width apart, and flat on the floor with toes pointing straight ahead or slightly outward. The athlete's head should be up, looking ahead, and his back should be flat. [8]

The dynamic nature of sport requires strength of the entire muscle from its origin, through its belly, and into its insertion. While we recognize that isotonic contractions through the entire joint range of motion will not produce strength gains that are equally distributed in the muscle, the lift must be performed through the ROM to train the entire muscle to meet the performance demands of baseball.

Correct breathing patterns are also necessary to counteract the Valsalva effect which inhibits the return of blood to the heart, lowering arterial blood pressure, and causing dizziness and possibly fainting. During maximal exertions, forced exhalation against a closed glottis creates the Valsalva maneuver. [1] During the exertional motion, one's breath should be expelled to prevent the sharp rise in intrathecal pressure that inhibits blood flow. Air should then be inspired as the muscles are relaxed, and the weight is lowered. Finally a spotter is needed to protect the athlete. While the spotter must avoid obstructing the athlete's lift, he must also be in a position to immediately assume the weight of the bar if needed. [8]

Strength development is incorporated into the macro-cycle with different objectives for each of the three phases (preparatory, competitive, and transition), and their sub-phases. The general preparatory phase consists of a six week, anatomical adaptation program, and a twelve week, maximum strength program. The specific preparatory phase incorporates a six-week program to convert the strength gained in the previous phase into power. As the competitive season begins, the strength program transitions into a maintenance phase for approximately five weeks, and then moves into a six week cessation period that coincides with the taper. The transition phase of the post-season includes a sixteen-week regeneration phase used to help the body recover from competition, and utilize muscles that were neglected due to their small role in baseball performance.

Exercises for the adaptation phase are primarily multi-jointed activities that prepare the entire body for training. Because a strong aerobic base is needed before any aerobic advancements are made, the slow twitch muscle fibers must be developed first by lifting to gain muscular endurance, or the ability to complete repeated and resisted contractions over a relatively long period of time. [5] This is achieved by lifting higher repetitions per set and lower amounts of weight. Three sets, or groupings of repetitions alternated with a rest period of thirty seconds, are recommended at this time. [11] Each set should consist of eight to twelve repetitions, with each repetition representing one eccentric and concentric movement. The weight should only be forty to sixty percent of the individual's one-repetition maximum (1-RM), which is defined as the amount of weight the athlete can lift only one time. [1] Typically the bench press is used to determine the 1-RM for the upper body, and the leg press for the lower body. [8] An individual's 1-RM is established through trial and error, and begins with an estimation of the amount of weight the athlete can lift one time on the aforementioned machine. Success or failure to correctly complete the lift determines whether weight is increased or decreased (usually in five kilograms increments). [1] One to five minutes should be permitted between each attempt to help avoid fatigue which could produce an assessment lower than his potential 1-RM score. [1] The goal is to determine the 1-RM in three to five attempts.[8]

Just as the goal of the adaptation program was to develop muscular endurance, the goal of the maximum strength program is to develop increases in muscular strength. To achieve this goal, two principles in regard to strength training should be kept in mind. The first is the idea that "an exercise overload specific to the activity must be applied to enhance physiologic improvement and bring about a training response". [1] In other words, to see strength gains the weight must be increased as the body adapts, or becomes stronger. Overload can be achieved by increasing any combination of intensity, duration, or frequency of the activity. For example, the number of repetitions recommended during the maximum strength phase is six to eight per set at ninety percent of the 1-RM. (A decrease in the number of reps and an increase in weight from the adaptation phase.) As the athlete becomes stronger and can perform eight repetitions, he or she should increase the weight (intensity) and decrease the number of repetitions(frequency) back down to six. Duration is altered by increasing or decreasing the recovery time from two to five minutes between sets. [11] The second concept, the progression principle, reminds individuals that progressive resistance exercise (PRE) is a gradual process. For example, the net strength increase in upper body strength is the result of slowly increasing weight two to five pounds at a time, and does not occur all at once. (However, increases in strength are more noticeable in the early stages of training, do to enhancement in the nerves ability to recruit, fire, and synchronize the firing of the muscles' motor units. [5]) It is also understood, that the eccentric contraction, or the lengthening of the muscle while under tension, is more effective than the concentric contraction in gaining strength. [1] Thus, the lowering of the weight back to the starting position should be performed in a slow, controlled manner; typically four seconds to the concentric contraction's time of two seconds. [8]

As the macro-cycle transitions into the specific preparation phase in mid-January, the strength program switches to the six, conversion phase. In accordance with the specificity principle already mentioned, the goal at this time is to convert the strength of the bodies core, arms, and legs into muscle power that can be used to strike the ball at bat and explode around the bases, or quickly accelerate the arm to release the ball. Power is the product of force and velocity, and is trained ballistically by throwing and catching medicine balls for the upper body, jumping for the lower body, and practicing with modified equipment (over and under-weighted bats and balls). Ballistic training "refers to acceleration and high velocity with actual projection into free space;" similar to pitching and hitting which require the body to continue to increase speed until the ball is released from hand or struck by the bat. [10] Studies have shown that with the fitness base provided in the previous phases of training, ballistic training will increase throwing velocity and base running speed. [10] To retain the strength achieved in the previous phase, some low rep/high weight exercises are continued.

When the competitive season begins in late February, the strength program adopts a maintenance program that lasts approximately five weeks. The baseball players lift three times a week, and must allow 24 to 48 hours for muscle recovery before the game. The program includes only five exercises that work multiple muscle groups and maintain levels of strength.

The cessation phase coincides with the commencement of conference games, and lasts six weeks, or through mid-May. The goal of this phase is to facilitate the taper toward the final competition. This break from strength training allows for all energy expenditure to be conserved and used at the season's climax (playoffs).

Finally, the end of the competitive season leads to the commencement of the sixteen-week regeneration phase. Overall, the goal of this time of active rest is used to remove fatigue, replenish energy, and rehabilitate injuries incurred though the season.[8] A very basic lifting program is created to increase strength in muscles that were overlooked in the specific baseball training, and to rehab any musculoskeletal injuries incurred through the season. The program should be modified every six weeks to avoid adaptation and boredom. At this time other physical activities (swimming, running, karate, golf, etc.) are encouraged to maintain strength and fitness while preventing burnout.

In understanding the basic kinematics involved in baseball, exercises can be selected to enhance these motions. A strong lower body and trunk is probably the most important factor in generating force while at bat and throwing the ball.[10] The hip extension followed by trunk coiling, transmits energy from the legs through the trunk and upper body to the bat or ball. Forward and side lunges, squats, hang cleans, power pulls, jammer explosions, jammer rotations, and box jumps, all require quick extension of the hip by the hamstrings and gluteus maximus. The hamstring curl, the glut-ham raise, and back extensions target the hamstrings and low back musculature. Exercises to strengthen the core are key. Abdominals can be trained with traditional crunches (crunch, and reverse crunch), crunches on the physioball to challenge the core stabilizers, or with a medicine ball. Because of the twisting motion in hitting and pitching, the obliques should be trained with side and twisting crunches, standing trunk rotations and Russian twists with a medicine ball, and the jammer rotations.

For correct upper body mechanics, the scapular stabilizers must have muscular strength and endurance to maintain proper contact with the humerous. Seated and bent over rows target the rhomboids. The latissimus dorsi is trained with the lat pull down and the trapezius with the shrugging component of the power pull. The rotator cuff is comprised of the arms internal and external rotators, which are trained with resistive tubing and medicine ball throws and catches. Elastic tubing can be tied to a pole and used as resistance for the arm while training internal and external rotation of the humerous. These exercises can be performed with the arm at zero degrees or at ninety degrees(which requires more scapular stabilization). Self-toss with a six to ten pound medicine ball, a bench toss with a two pound medicine ball to a partner, and a medicine ball toss into a plyoback strengthen the rotator cuff ballisticaly (see Appendix 3).[11] Eccentric training is essential because the shoulder musculature must perform quick eccentric contractions to decelerate the arm on follow through.[5] The catch and follow through motion of the medicine ball train the eccentric muscles. The pectoralis major (adductor and internal rotator) should be strengthened with bench flys, and the deltoid (abductor and internal and external rotator) with three way shoulder raises.

The bench press with alternating dumb bell press, jammer explosions, and jammer rotations all require the arm to extend through rapid contraction of the triceps muscles. This extension is also part of both the throwing and batting mechanics. It is noted that the alternating dumb bell press is favored over the bench press as it allows greater range of motion, and requires increased firing of shoulder stabilizers.[10] The jammer exercises are performed on the Ground Base Jammer. The explosion requires an "explosion" from a sitting position to a position extended hips and arms above head. The jammer rotation mimics the motion of a baseball pitch and swing by standing sideways in the machine and forcefully extending the hips, while simultaneously twisting the trunk and forcing the back arm into extension.[12]

Strong wrists and grip strength are trained by attaching a weighted plate with a rope to a bar. Wrist flexion and extension are used to wind the rope up and down around the bar. Wrist rotations and curls also isolate the wrist musculature. The power pull requires a wrist flexing component, while the hang clean uses wrist hyperextension as the elbows move under the bar to rack the weight across the shoulders. Appendix 3 has pictures of these exercises, and lists where they are incorporated into the macrocycle, based on their function and the strength goals in that phase.

Preparatory Phase

	General Prep		Specific Prep
Date	9/15 – 10/15		10/16 – 1/15
Strength Phase	Anatomical Adaptation	Maximum Strength	Conversion
Exercise	Squat Bench Press Lunges Lat Pull-Down Seated Row Hamstring Curls Back Extensions 3-Way Shoulder Raise Tricep Kickbacks Shoulder Shrugs Hammer Wrist Rotation Crunches (crunch, reverse, side, & twist)	Squat Jammer Rotations Glut-Ham Raise Jammer Explosions Hang Clean Power Pull Alt. Dumb bell press Bent-Over Row Bench Fly Seated Rear Deltoid Raise Wrist Curls Crunches on Physioball	Box Jumps Medicine Ball Throws - supine self toss - partner toss -plyoback - over shoulder catch Resistive Tubing IR/ER - 0 degrees - 90 degrees Weighted Baseballs and Bats Squat Jammer Rotations Abdominals w/ Medicine ball - standing trunk rotations - Russian Twist
Sets Reps recovery	4 8-12 30sec.	2 6-8 2-5 min.	3 8-12 1-2 min.

Competitive Phase

Date	Maintenence 2/23 – 3/30	Cessation 3/31-5/13
Exercise	Jammer Explosions Medicine Ball Throws Resistive Tubing Back Extensions Abdominals	
Sets Reps Recovery	3 8-12 1 min.	

Transition Phase

Date	Regeneration Phase 5/14 –9/14
Exercise	Leg Press / Calf Raise Bench Press Hamstring Curls Military Press Leg Extensions Lat Pull Down Easy Bar Curls Tricep Extensions Abdominals
Sets Reps Recovery	3 8-12 1-2 min.

While flexibility and strength are necessary for baseball performance, the athlete's cardiovascular system must be conditioned as well. This involves training the heart (and associated vasculature) and lungs to meet the body's demand for essential nutrients, and removal of waste products during physical activity. The heart functions to pump blood, oxygenated in the lungs to the working cells of the body and to bring blood carrying carbon dioxide waste to the lungs, for removal from the body. As the muscles' workload and intensity increases the demand for oxygen increases. This is because of oxygen's role in the energy production process. Depending on the type of activity the body will employ one of three energy systems.

Activities of short duration and higher intensity require little oxygen because the energy utilized is typically already present in the body's skeletal muscle and liver, stored in the form of the high-energy phosphates, Creatine phosphate (CP) and Adenosine triphosphate (ATP). This type of activity is considered anaerobic because the presence of oxygen is not imperative for the creation of energy. However, the body can only store enough energy to sustain maximum activity for approximately fifteen seconds. This anaerobic system is referred to as the ATP-CP energy system, and is most commonly used in baseball to provide the necessary energy to strike the ball, advance around the bases, and to field the ball. Each of these activities are brief in duration, but require maximal output.

The short-term energy system, known as fast glycolysis (or lactic acid cycle) is also an anaerobic process that produces energy for all-out activity that continues past the first fifteen seconds and through the first three minutes of physical exertion. Being anaerobic in nature, this system will also function without oxygen, but produces lactic acid in the active muscles and blood. Fast glycolysis is typically activated because there is not enough oxygen to run the third, long-term aerobic energy system. This occurs early in the activity before a steady state is reached or later on in the activity when the aerobic system can no longer meet the energy demands placed on it alone.

When all reserves have been used, the body must create energy by rebuilding its high energy phosphates. This occurs through a series of chemical (redox) reactions that require oxygen to phosphorylate (add a high-energy phosphate bond) to Creatine (C) and adenosine diphosphate (ADP) making CP and ATP. When oxygen is used to fuel the activity, it is considered aerobic. This aerobic, long-term system creates energy to meet the demands of the muscles being worked for several minutes. As the intensity of the activity increases the athlete's oxygen uptake will increase until reaching what is known as the Maximum Oxygen Uptake (VO2 max), or the maximum oxygen consumption. At this point the body will not take in any more oxygen even if the intensity of activity increases.[8] A steady state is reached where the body produces energy equal to the muscle's requirements to maintain function. Working above one's steady state requires more energy than can be produced aerobically, compromising the system and resulting in the recruitment of the glycolytic system and the creation of lactic acid. This lactic acid accumulates and is responsible for muscle exhaustion.

Studies have shown that trained individuals will reach their VO2 max more efficiently (faster and with a lower oxygen debt).[1] These trained individuals will also be capable of maintaining this production/consumption balance for longer periods of time and at higher intensities before switching back into glycolysis or stopping activity altogether. Consequently, this individual will consume greater quantities of oxygen and rely on anaerobic metabolism less, increasing the body's ability to make ATP and sustain activity. [1]

It is interesting to note that slow-twitch muscle fibers used in endurance activities (lower intensity and longer duration) have concentrations of the enzyme Lactate dehydrogenase (LDH) that enhance the muscles choice to convert lactic acid to pyruvic acid which can be more readily used for energy production aerobically. [1] Fast-twitch muscles are used in more intense activity, however they have levels of LDH that favor the production of lactic acid. This means that athletes with a predominance of fast-twitch muscle fibers, or are involved in activities that require the use of the fast-twitch fibers, will fatigue faster and produce more lactic acid which is responsible for DOMS (delayed onset muscle soreness).

Just as the lungs accommodate an increase in oxygen consumption, the heart works to increase the circulation (cardiac output) of more oxygenated blood through the system. Mathematically, the cardiac output is determined by multiplying the heart rate (beats per minute) by the stroke volume (amount of blood ejected in one contraction in ml). HR x SV = CO. Because the heart is a muscle, training will increase the organ's size, allowing for more blood to be pumped with each beat, consequently increasing its stroke volume. This means that less work is required to supply the same amount of blood, reducing the individual's resting heart rate. When exercise is initiated, a conditioned athlete will be able to increase his or her stroke volume and heart rate, where as an untrained individual only compensates for the increased demand by elevating his or her heart rate. [1]

In order to attain most efficient energy production and utilization, each baseball player must adopt a cardiovascular conditioning program to increase his VO2 max and cardiac output. As mentioned in the strength portion of the paper, to increase one's fitness the body must be subjected to increasing physical demands. To overload the body cardiovascularly, the intensity, duration, frequency of the activity can be adjusted. This is achieved by increasing the workload from submaximal to maximal, increasing the time, and decreasing the rest period between subsequent work activities. The SAID principle necessitates these overloads to the system. The SAID principle claims that the body will undergo specific adaptations to imposed demands. The stepwise progression of overload and adaptation increases the cardiovascular fitness of the athlete, increasing his or her VO2 max, and his or her ability to reach that plateau more efficiently with less oxygen debt.

The key to the SAID principle is that the effects of training will be specific to the type of demands/stressors placed on the body. For example, lifting weights will increase strength but do little in improving cardiovascular fitness. Therefor, aerobic activity is required to train the aerobic energy system and anaerobic activity is required to train the anaerobic, ATP-CP and fast-glycolysis energy systems. Note that aerobic activity requires continuous rhythmic activity such as a long jog, where anaerobic activity includes short intense bursts of activity such as sprints. The individual demands of the sport will then determine the extent to which the system is trained. Baseball conditioning will therefor focus on sprinting, and short duration, maximal intensity activities.

To train the CP-ATP energy system an endurance base is required as foundation to build on. Slow-twitch fibers are used regardless of exercise intensity while fast-twitch muscle fibers are used only in high intensity and maximum power efforts.[8] Moreover, this base will lower the systems dependence on the lactic acid producing energy systems.[8] Consequently the General Prep phase in September and October should consist of a good deal of endurance training which would include runs of 25 to 30 minutes in duration, or interval training that include longer distance runs at a slower pace but with shorter recovery between runs.

Entering the specific prep in mid-October requires a transition from endurance training to one that continues to add more anaerobic activity as the competitive season nears. Sprinting or intervals that requires near maximal speed, shorter distances, and longer rests in between sprints should be more frequent while still devoting some time to endurance work.

In-season training requires the maintenance of the athlete's level of fitness while simultaneously keeping the body well rested for competition. This is achieved by reducing the amount of time conditioning by utilizing less frequent, but more intense, workouts. As long as the intensity is maintained, a reduction in training for up to fifteen weeks will not adversely alter the athlete's fitness.[8] These high intensity practices should be coordinated with the competition schedule to allow maximal time to recover for the next game.

During the off-season, the body should be given time to rest and rejuvenate. However, it is important not to sacrifice the base that has been built. It is much easier to peak again if the base can be maintained. Unfortunately, the principle of reversibility states that one's fitness level can depreciate in half the amount of time it took to build. In order to avoid burnout and condition other muscles that may have been neglected in training for baseball, other aerobic activities should be adopted such as roller blading, biking, or swimming. (A year-round break down of activities are found in Appendix 4.)

While it is necessary to continually increase the demands placed on the body in training to reap the rewards of better performance, over-training and burn-out can be deleterious. Over-training is defined as "a pathological state of training when work recovery ratio is overlooked, and the athlete is exposed to high intensity training when in a state of fatigue."[8] This fatigue may be the result of training faults, the athlete's lifestyle, social environment, or health. Coaches, Athletic Trainers, and athletes must be aware of the symptoms of over-training including: apathy, lethargy, sleep disturbance, muscle pain and soreness, mood changes, gastrointestinal disturbances, loss of appetite, and weight loss.[13] In regards to the cardiovascular system, there may be an elevation in resting heart rate and blood pressure, and a slower than typical recovery for physical/exertional activities.[13] While all of these symptoms may have other sources, a careful look at the training program should be made if these signs do appear. If over training is the case, the workloads should be temporarily reduced in intensity, duration, and or frequency. These athletes could benefit from some time off or a change in training pattern or activities. Changes may also need to be made to the athlete's sleep cycle, diet, caffeine/alcohol consumption, living conditions, and his family, peer, and professional relationships.

A number of safety precautions are necessary with cardiovascular training. Because the heart and lungs are so important and placed under considerable amounts of stress during maximal or prolonged exertion, it is important to have a medical exam prior to the initiation of an exercise program. A family history of cardiovascular disease or sudden death should be mentioned to the physician. Conditions such as high blood pressure, heart murmur, cardiovascular disease, or Marfan's syndrome could affect the heart's ability to meet the demands of increased activity and ultimately be fatal. In the majority of these cases, exercise will not be discouraged but caution is advised. The doctor may give modifications for the exercise program, or prescribe medication to compensate for the condition.

Furthermore, the heart operates within a safe zone that is determined individually by baseline assessments of heart rate and blood pressure. Resting heart rate ranges from 60 to 80 beats per minute and will increase with physical exertion. During maximal intensity workouts, the heart rate should not exceed the individual's maximum heart rate, which is determined by subtracting the individual's age from 220 beats per minute. For example a 22 year old senior on the baseball team would have a maximum heart rate of 198 bpm (220-22 = 198). To ensure that the athlete is not exceeding his maximum heart rate, frequent monitoring should be interspersed within the workout and during the recovery from activity. If the athlete does exceed his maximum heart rate, experiences chest pain, or has a prolonged recovery to resting heart rate following activity, the activity should be stopped and modifications should be made to the conditioning program as the athlete's current level of fitness is not able to meet the cardiovascular demands safely. Adaptations to the program may include more rest between activity, decreasing the intensity, or lowering the time/length of the activity.

To improve aerobic capacity the activity must be intense enough for the heart to work at 50 -74% of its maximum heart rate for a duration of 40-50 minutes. If activity is shortened, the intensity must increase to raise the target heart rate (the number of beats per minute desired for a healthy overload). Conditioning for 20-30 minutes demands a target heart rate of 75-84% of the maximum heart rate, while 15-20 minute duration requires 85% of the maximum heart rate or higher. [8]

Resting blood pressure value is an important reference that helps to assess the stress placed on the heart and associated vasculature. When compared to untrained individuals, a trained athlete will experience greater gains in blood pressure during activity, followed by a faster recovery to resting blood pressure levels post activity. Once again, the workout must be modified if an increase in resting blood pressure is noted.

Again the importance of a proper warm-up and cool-down is stressed. A five-minute jog around the perimeter of the field, or track will prepare the heart and lungs for the impending workout. A light sweat is a good indication that the body is properly warmed. In addition to preparing the mind for activity, the body is prepped physiologically in a number of ways. First, the muscles of the body will act more fluidly because of lowered viscous resistance in active muscles. Additionally, increased body temperature better allows hemoglobin (oxygen transporting molecules in the blood) to release oxygen to working muscles. Finally, the warm-up will dilate the vascular structures in the active muscle/body tissues allowing for increased blood flow, allowing for more efficient use of larger amounts of the body. [1] A cool-down is just as important for safety. The heart must gradually decrease activity from maximal demand to resting as opposed to abrupt changes in cardiovascular demand. Upright activity such as running could result in a tendency of the blood to pool in the lower extremity causing swelling in the lower extremities. The jog to walk progression for approximately five minutes after activity will help redistribute the blood through the body. This redistribution will also help remove any lactic acid accumulated in the muscles during exercise, and circulate it to the liver where it can be converted back to pyruvic acid in a system known as the Cori Cycle. [1] In addition to the conversion into a chemical now capable of creating energy, the transformation to pyruvic acid will decrease the symptoms of DOMS because of the lowered levels of lactic acid and metabolic waste build-up in the muscle tissue.

Correct equipment is also necessary to prevent injury. Many of the stress related and overuse injuries can be prevented with simple changes in shoes or running surfaces. Athletic shoes are designed for different performance needs. Running shoes are designed to support the foot and absorb much of the repeated force and shock of the feet repeatedly striking the ground. Therefor it is advised that running shoes be worn for all endurance activities, high force activities (i.e., plyometrics), and for long series of sprinting. While shoes may appear to be in good condition externally, the internal cushion and support will break down, reducing the effectiveness of the shoes in preventing injuries such as stress fractures, shin splints, and even injuries to the knee and hip. To avoid such injury, it is recommended that running shoes be replaced about every four months or 300 miles. Baseball spikes, on the other hand, are designed with the intent of providing the athlete with better traction on the field, and therefor have little shock absorbing cushion. Also note that wearing cleated shoes on extremely hard surfaces, such as fields that are very dry, will not only negate, but possibly be detrimental to their purpose. Use on hard surfaces can cause trauma to the feet resulting in blisters or stress fractures where the spikes transmit the force to the foot. Conditioning that calls for short duration, or minimal sprints, or sprints designed to focus on the initial explosion involving in the first three strides, are appropriate situations for the use of baseball shoes in conditioning. Otherwise these shoes should only be worn during actual play.

As mentioned training surface is also a consideration in training. Many athletes develop overuse and stress related injuries due to repeated activity on hard surfaces. If running on paved roads and sidewalks, or even treadmills causes pain, consider surfaces with more cushion such as a track, or a wood-chipped trail. In extreme cases, an athlete may consider running in a pool to eliminate the stress on the body while achieving the same benefits as running on land. One additional note about distance running on roads is that running consistently on one side of a crowned road can affect biomechanics because on foot is continually striking the higher ground. Run half of the distance on the right side and half on the left side. (Also use caution with vehicles).

When employing cardiovascular equipment such as treadmills, steppers, bikes, and elliptical trainers, make sure that they are in working order before initiating activity. All chains, belts, and electrical wiring, should be in working condition. Do not use any equipment that is torn, frayed, squeaking, or not moving fluidly as they are potential threats to one’s safety. Report the faulty equipment to the supervisor or maintenance staff.

Year–Round Break-Down for Conditioning Program

*Conditioning occurs 3-5 times a week. In the Prep Phase the athlete is responsible for completing the program, and can choose what days to work out and what days to rest, as long as the weekly protocol is meet. In the competition phase the coach is responsible for selecting the days for cardiovascular conditioning. Selection should be made in order to give the athlete optimal recovery for competition. In the transition phase, the athlete is given the chance to be creative with their fitness program choosing activities that benefit the cardiovascular system but are different and help to avoid burn-out.

Prep Phase

General Prep – 9/15 – 10/15

Week 1: 4 days/week

Day 1: 20 minute run
Day 2: 25 minute cardio machine
Day 3: 20 minute swim
Day 4: 30 minute Fartleks

Week 2: 4 days/week

Day 1: 30 minute Indian run
Day 2: 30 minute cardio machine
Day 3: Intervals
Day 4: 20 min. Jump rope

Week 3: 5 days/week

Day 1: 15 minute run – 3 min. rest – 15 min run
Day 2: 30 minute swim
Day 3: 30 minute Fartleks
Day 4: 35 minute cardio machine
Day 5: 45 minutes basketball/soccer/hockey

Week 4: 5 days/week

Day 1: 3 mile run
Day 2: 30 minute UBE
Day 3: Intervals
Day 4: 25 min. Jump rope
Day 5: 30 min. Indian Run

Specific Prep: 10/16 – 1/15

Week 5: 5days/week

Day 1: 30 minute run
Day 2: 25 minute cardio machine
Day 3: 30 minute swim
Day 4: 30 minute Fartleks
Day 5: 4 Suicides

Week 6: 4 days/week

Day 1: 30 minute Indian run
Day 2: Intervals
Day 3: 20 min. Jump rope
Day 4: Take-offs

Week 7: 5 days/week

Day 1: 3 - 1 mile runs
Day 2: swim
Day 3: 25 minute Fartleks
Day 4: 35 minute cardio machine
Day 5: Suicides

Week 8: 5 days/week

Day 1: 35 minute run
Day 2: Intervals
Day 3: 20 min. Jump rope
Day 4: Take-offs
Day 5: 25 min. pool workout

Week 9: 5 days/week

Day 1: 25 yd. sprints
Day 2: long-distance throw 15 minutes
Day 3: 25 minute Fartleks
Day 4: 35 minute cardio machine
Day 5: Suicides

Week 10: 5 days/week

Day 1: Intervals
Day 2: long-distance throw 20 minutes
Day 3: 20 min. swim
Day 4: 20 min. jump rope
Day 5: 60 min. basketball/soccer/hockey

Competitive Phase

Pre-Competitive Phase – 2/23 – 3/30

Week 11: 5 days/week

Day 1: foot speed and agility
Day 2: sprints
Day 3: Indian Runs
Day 4: base running
Day 5: suicides

Week 12: 4 days/ week

Day 1: 25 minutes - long distance throws
Day 2: Fartleks
Day 3: base running
Day 4: “seven-ups”

Week 13: 3 days/week

Day 1: take-offs
Day 2: sprints
Day 3: Tag game

Week 14: 3 days/ week

Day 1: Indian Runs
Day 2: “seven-ups”
Day 3: base running

Week 15: 2 days/week

Day 1: sprints

Day 2: Tag game

Competitive Phase 2/31 – 5/13

Week 16: 2 days/week

Day 1: base running

Day 2: suicides

Week 17: 1 day/week

Day 1: foot speed and agility

Week 18: 1 day/week

Day 1: intervals

Week 19: 1 day/week

Day 1: base running

Week 20: 1 day/week

Day 1: Fartleks

Week 21: 1 day/week

Day 1: sprints

Transition Phase – 5/14 – 9/14

Physical Activity- 25-60 minutes of activity, 3-5 times a week.

Description of Activity

Cardio machine:

Athlete has choice of aerobic training on the bike, stepper, or elliptical trainer
Follow designated time protocol.

Swim:

Helps condition the total body without the stress of land training.

Week 1:	5 min freestyle – 5min. w/ kick board – arms only (use leg floats) – 5 min. freestyle
Week 3:	6 min. freestyle – 6 min. kick board – 6 min. stroke of choice 6 min. arms only – 6 min. tread water
Week5:	6 min. freestyle – 6 min. kick board – 6 min. stroke of choice 6 min. arms only – 6 min. tread water
Week 7:	15 – 25yd (1 length) sprints at 75% max, followed by slow length swim back to edge of pool. Take a 5 min. rest between every 5 sprints.
Week 8:	**Pool Workout** – 5 min. run in deep end – 5 min tread water – 5- min kick board – sprint in shallow end – 5 min. tread water (arms above head)
Week 10:	10 – 25yd (1 length) sprints at 85% max, followed by slow length swim back to edge of pool. Take a 5 min. rest between every 5 sprints. Tread water for 10 minutes.

Fartleks are runs that progress from walk to jog to stride (80%) to sprint (100%)

	Time	**Sequence**	**Target HR**
Week 1:	30 min.	40sec-10sec-10sec–10sec	65% max HR
Week 3:	30 min.	30sec-20sec-10sec-10sec	70% max HR
Week 5:	2 -15 min.	30sec-15sec-15sec-10sec	70% max HR
	(3 min. rest between the 2 sets)		
Week 7:	20min/5 min.	30sec-15sec-15sec-10sec	70% max HR
	(3 min. rest between the 2 sets)		
Week 9:	25 min.	30sec-15sec-15sec-10sec	70% max HR
Week 12:	20 min	40sec-10sec-10sec–10sec	85% max HR
Week 20:	15 min	20sec-10sec-10sec–10sec	85% max HR

Indian runs are a distance running activity that incorporates both jogging and sprinting. A line of individuals jog one behind the other with about two feet between each body. The individual in the back of the line sprints to the front of the moving line to become the new line-leader. This continues with each individual sprinting to the front when they are the last in line. Fewer people in line will result in a higher frequency of sprints. The run can be modified to have the individual weave through the athletes in line to improve side to side agility.

	Time	**Sequence**	**Target HR**
Week 2:	30 min.	one line – 5 min jog – 10 min sprint - 10 minute weave- 5 min. jog	65% max HR
Week 4:	25 min.	2 lines – 5 min jog – 10 min sprint - 5 minute weave - 5 min. jog	70% max HR
Week 6:	30 min.	2 lines – 5 min jog – 10 min sprint - 10 minute weave - 5 min. jog	70% max HR
Week 11:	25 min	1 line – 5min. jog 15 min. sprint – 5 min. jog	75% max HR
Week 14:	15 min	2 lines 5 min run 10 min. sprints	85% max HR

Intervals allow the body to complete more work and rely less on anaerobic energy systems that create lactic acid that can ultimately lead to muscle fatigue/exhaustion. 1:2 and 1:3 work to rest ratios are used.

	Distance	**run time**	**rest time**	**target HR**
Week 2:	4- 400yds	1:15	1:3	75%
	4- 200yds	:40		
Week 4:	4- 400yds	1:15	1:2	80%
	6- 200yds.	:40		
	6- 50yds	: 08		
Week 6:	6- 200yds	:35	1:2	80%
	8- 100yds	:15		
	4- 50yds	:06		
Week 8:	4- 100yds	:15	1:2	85%
	6- 50yds	:06		
	8- 30yds	:03		
Week 10:	2- 100yds	:15	1:3	85%
	4- 50yds	:06		
	6- 30yds	:03		
	8-10yds			
Week 18:	4- 200yds	:15	1:2	85%
	8- 50yds	:06		
	8-25yds	:02		

Jumping rope can be done continuously or alternated with rest periods. Jumping rope is a good way to incorporate the upper body in the conditioning program. Additionally, this activity helps to increase agility.

Week 2:	Running in place 10min. Both Feet 5min. Both Feet side to side 5 min	70%
Week 4:	Running in place 10min. Both Feet 5min. Both Feet side to side 5 min	70%
Week 6:	Both Feet 1min. Alternate Right Foot/Left Foot 1min Both Feet side to side 1 min (repeat 5 times with 6 minute rest between repeats)	85%
Week 8:	Both Feet 1min. Alternate Right Foot/Left Foot 1min Both Feet side to side 1 min (repeat 6 times with 6 minute rest between repeats)	85%
Week 10:	Both Feet 1min. Alternate Right Foot/Left Foot 1min Both Feet side to side 1 min (repeat 8 times with 6 minute rest between repeats)	85%

The **UBE** (upper body ergometer) – a bike that works the upper extremity. Alternate five minutes in the forward direction with five minutes and the reverse direction.

Suicides are sprints that incorporate a change in direction. 5 cones are set up at five-yard intervals. The sprint begins with a 5yd sprint to the cone and back, then 10 yds to the second cone and back, and continues through until returning from the fifth cone 25 yds. away, for a total of 150 yards.

	# of suicides	**goal time**	**rest between**	**target HR**
Week 5:	10	:40	1:3	70%
Week 7:	10	:40	1:2	70%
Week 9:	10	:40	1:1	70%
Week 11:	6	:35	1:2	75%
Week 16:	3	35	1:1	85%

Take-offs are sprints up a hill followed by a slow jog/walk back to the base of the hill.

	# of take-offs	**distance**	**intensity**	**target HR**
Week 6:	10	50yds.	50%	70%
Week 8:	12	30yds	75%	85%
Week 13:	8	30yds	100%	90%

Foot Speed and Agility training incorporate short sprints with sport specific movements.

1. skip –25 yds.
2. stand facing backwards. On command turn and sprint 25 yds.
3. On command complete one somersault and continue 25 yd. Sprint
4. Begin on stomach. On command get up and sprint 25 yds.
5. Run through latter

Base running is similar to suicides but is done on the baseball diamond. Begin by sprinting 100% to first base and jog to second, third, and then home. The second time through sprint through 1^{st} and 2^{nd}. Jog around 3^{rd} and home. The third time through sprint though 1^{st}, 2^{nd}, and 3^{rd}. Jog home. Finally, sprint around all bases. Complete five times at 100% intensity, 90% target HR.

Seven-ups are sprints that involve a change in direction. A 10 yd. distance is marked off with cones. Sprint 10yds. Turn and walk back 10 yards. Sprint 10 yds. Turn and sprint 10yds. Turn and walk 10yds. Continue until you sprint seven consecutive 10 yard distances. Rest five minutes and complete another.

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Preparatory Phase		**Competitive Phase**		**Transition Phase**
General Prep. Sept.-Dec.	Specific Prep Jan-Feb.	Pre-Comp. March 1-15th	Competitive March 15th-June	July –August
General stretch	Gen +Sport Specific	Gen. + Sport Spec.	Gen. +Sport Spec.	General Stretch
Static	Static + PNF	Static + PNF	Static + PNF +Ballistic +Fauls	Static
3-5x's/wk	5-6x's/wk	Every warm up and cool down		3-5x'/wk