SPEED DEVELOPMENT for ATHLETES

Study Guide

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Thanks to...

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INTRO

About the author...

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<u>Education</u>

Cal State Long Beach - Bachelor of Science in Kinesiology

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Certified Personal Fitness Training - National Council for Certified Personal Trainers

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When I set out to make an online course I think about how my education can be different than the rest. Growing up I have always been fascinated and motivated by what I saw on the big screen. While my talents with cinematography or story telling are nowhere close to the likes of Christopher Nolan or JJ Abrams, my hope is that their inspriration has led to my overall vision of making new entertaining online education. I wont be physically shaking the camera or knowingly leave any cliff-hangers, so don't worry about looking for spoilers, but hopefully my education keeps you watching and learning.

Enjoy and always look for motivation in anything....

-Tyler

II

Structure & Makeup

Structure and Makeup of Speed Development

Muscle Fiber Types
Greater percentage of fast twitch muscle fiber than _________ _________ and __________ __________.

Structure
- Actual ________ of the muscle may influence speed.
- Kumagi et al.(2000) compared sprinters who could run 100 m in under 11 seconds with those who ran it between 11 to 11.7. They found that the faster sprinters had greater fascicle length (the lengths of bundles of muscle fibers running from proximal to distal tendons), which accounted for an almost 22% faster shortening velocity
- Abe et al. found similar results in sprinter vs 10-k runners and marathon runners
- Smaller __________ angles (degree of alignment with the long axis of the muscle)
- Research is not sure how trainable these are…

Flexibility
- Allows athlete to move limbs through _______ ROM without impedance
- Fluidity
- Efficiency – increase in stride length and frequency
- Stretching Routine

Dynamic vs Static
- __________ _____________ will have the greatest crossover to running

Fatigue
- Will interfere with a muscles ability to _________ quickly.
- Interfere with ___________, which leads to decrease in technique.

Technique
- Makes the runner more ____________ and faster
- Prevents injuries that could result from excessive loading to the tissues associated with bad form

Stride Length and Frequency
- SPEED = _________ __________ + _________ ___________.
- Hunter et al. (2004) showed a negative relationship between stride length and stride frequency (i.e. athletes with a greater stride rate had a lower stride length and vice versa), but also showed that when comparing sprinting trials (near maximum to maximum), stride length remained constant whereas stride frequency increased.
- For each individual athlete there is an optimal relationship between the two; both qualities should be trained.
- High-speed tredmill sprinting, elastic cord towing, and downhill sprinting are examples of over-speed training that are intended to improve stride frequency. The training method used to improve stride length is resisted training that includes the following: resisted sled training, weighted vest, uphill sprinting, strength training and plyometrics.

<u>Sprinting Technique</u>

Two phases – Driving Phase & Recovery Phase
- Driving Phase - Begins when the lead foot lands on the outside of the forefoot just in front of the athlete's center of gravity (i.e. the athlete's hip). The foot is driven to the ground by the ____

_______ muscles. It is important for the quadriceps to fire as the foot makes contact with the ground to keep the knee from flexing excessively, which would dissipate elastic energy. The ankle should be dorsiflexed with the foot' big toe pulled up, the combination of which will allow for the storage of elastic energy to be maximized to help with propulsion later. Once the toes leave the ground then the driving phase has ended.

- Key muscles – _____ and ______ ________.

Recovery Phase

- As the foot leaves the ground, the athlete should immediately dorsiflex the ankle to approximately 90 degrees while pulling the big toe up. As this is being done, the athlete should flex the knee and quickly bring the heel up toward the hips/buttocks.
- "_________ ____ _______" – allows leg to be swung forward
- As the heel is brought to the hip, the leg will be swung forward. As the athlete is stepping over the opposite knee, the athletes leg will naturally begin to unfold.
- Legs should be driven back down to the ground from the hips, which ends the recovery phase.

Three Phases – ____________ Phase from 0 to 10 m, Transition and then maximum velocity phase from 36 to 100 m during a 100 m sprint

- Mero (1988), acceleration phase was first 30-50 m followed by a maximum velocity phase and a phase of deceleration
- Many sports often do not have a _________ _________ component or rare, and acceleration training could be more applicable.
- Acceleration and maximum velocity are separate components and must be developed separately
- Acceleration involved technique and force production capability of the body, specifically the _______ _________.
- Way to train include: weight training, plyometrics, assisted and resisted sprinting techniques
- When you think about it, many athletes have to accelerate from a prone position or crouched position, from moving sideways or backwards, from a single leg stance or a pivot.
- Force capabilities of muscle is key!

Arm Swings

- Help with _______ and to help provide __________. Should be swung backwards from the shoulder powerfully. If the arms are swung back forcefully enough, the stretch ______ at the should will swing them forwards. Hands should be swung from the hips to the height of the shoulders, without crossing the midline of the body.
- Generally requires 12-15m of accelerating.
- Improve with coordination.

Acceleration vs Maximum Speed

- Running mechanics different over the first 12-15m
- Athlete is increasing velocity and stride length
- As stride length increases, the foot will be making contact wit the ground initially _______ the athlete (depending on starting position), then it will make contact in front of but closer to the athlete than during maximum velocity, which will mean a _______ shin angle during foot contact,
- Athlete should focus primarily on _____ ______ mechanics (high knee, dorsiflexion) and a little backside mechanics (plantar flexion, heel to hip). Body is too low for backside mechanics.
- Not many sports that athletes will sprint more than 12-15 m linearly; Usually ______ ___ ______ speed.
- So should athlete practice more than 12-15 m? Depends on the athlete. What are the demands?
- Less than 12-15m, frontside mechanics will help; if more than maximum-velocity running tech-

nique

Biomechanics of Acceleration Phase

Kinematics

- Sprint velocity is a product of step length and step frequency.
- Both increased to enhance velocity during the _________ phase.
- Each step comprises a _______ ______ and a _______ ________.
- Stance Phase – The time that the foot is in contact with the ground during the stride cycle
- Swing Phase – Ipsilateral foot strike to ipsilateral toe-off.
- Acceleration phase of sprinting is characterized by a relatively long stance phase as the runner creates _______ to generate velocity.
- The stance phase comprises _________ and _________.
- Both varied during different components of sprinting.
- Acceleration phase the stance phase is largely made up of propulsive component with minimal braking forces at the foot.
- Maximum Velocity Phase there is more braking .
- Mero (1988) saw that the braking phase was only 12.9% of the stance phase during acceleration.
- Mero et al. (1992) found that during the first few strides in sprinting the bodies COG undergoes a posterior shift, from an anterior position at foot strike to a position posterior to the point of foot strike.
- Athletes sprinting technique is determined by the angles of the trunk, thigh, knee and ankle.
- Frishberg (1983) reported a foot strike thigh angle of 29.9 at 50m from a sprint start
- Letzelter et al. (1995) mean thigh angle of 22.6 at 30m
- Literature is inconclusive. Specificity?
- Williams (1985) reported strike thigh angles ranging from 20.8 degrees to 30 degrees and stated that thigh angle did not seem to change appreciable with increased running speed.
- Mann and Herman (1985), more efficient sprinters terminated the nonproductive later part of the stance phase and began ________ more quickly.
- Hay (1985) believed that the thigh should move through as great a range as possible and that failure of the thigh to do was common fault.
- Knee flexion at the foot strike 10 degree to 30 degrees.
- Following foot strike the knee flexes further to absorb the energy associated with he ground reaction forces generated at foot strike.
- Knee flexion as foot strike is greater during the acceleration phase when compared to maximum velocity sprinting.

Kinetics

- _________ propulsive forces during the first ground contact have been reported to be 46% greater than those observed once maximum velocity is achieved. Vertical propulsive forces have been shown to be similar during the acceleration phase and maximum velocity phase of sprinting.
- Plamondon and Roy (1984) found that ________ braking forces decreased between steps 1 and 12, whereas horizontal braking forces increased up to the 12th stride, where they started to plateau.

EMG Activity

- Suggested that the __________ play an important role during the propulsive phase of stance, extending the thigh.
- Mero and Komi (1987) suggested that ________ _________ activity during the propulsive phase of stance during maximum velocity sprinting was limited.

- Propulsive role of the knee extensors during the acceleration phase may be greater.
- Wieman and Tidow (1995) found that during the first few steps of sprinting, the ______ ________ showed significantly greater activation during the stance phase compared to activity at maximum velocity.
- Accompanied by a significant decrease in hamstring activation during the stance phase.
- Harland and Steele (1997) reported an increase in activity of the _______ __________ during the sprint start. Suggests that the quadriceps are more for acceleration phase compared to maximum velocity
- Decluse et al.(1996) stated that although there was significant body lean during the acceleration phase, there was less reliance on the stretch-shortening cycle (SSC) and the knee extensors were the main accelerators.

NOTES:

Structure and Makeup of Speed Development Answers

1. Distance runners
2. Untrained individuals
3. Structure
4. Pennation
5. Full
6. Dynamic flexibility
7. Shorten
8. Coordination
9. Efficient
10. Stride Length + Stride Frequency
11. Hip Extensor
12. Hip and knee extensors
13. Shortens the lever
14. Acceleration
15. Maximum Velocity
16. Lower Extremities
17. Balance
18. Momentum
19. Reflex
20. Behind
21. Lower
22. Front side
23. Change of direction
24. Acceleration
25. Stance phase
26. Swing phase
27. Power
28. Braking
29. Propulsion
30. Trunk, thigh, knee and ankle
31. Recovery
32. Horizontal
33. Vertical
34. Hamstrings
35. Knee extensor
36. Vastus Lateralis
37. Vastus Medialis

III

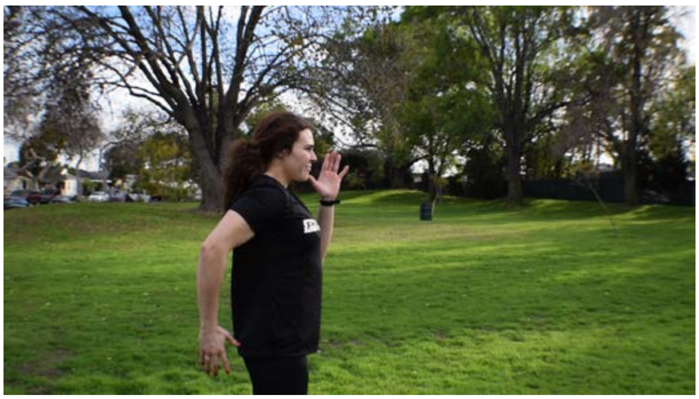
Application: Technique Drills

Application: Technique Drills

Technique Drills

- Provide different training stimuli and hence different adaptations
- Used to break the sprinting motion down into more manageable components.
- Slower speeds should be mastered (proper progressions)
- Eventually the athletes can ________ the techniques of the parts (drills) to the whole movement (maximum speed sprints depending on athlete).
- Drills: arm swing drills, ankling, heel kicks, high-knee drills, A drills and B drills

Arm-Swing Drills



- Arms act in opposition to the legs serving to prevent upper body ________, which leads to loss of balance and timing.
- Avoiding the arms crossing the midline.
- Contributes to ______-______ ________.
- If the arms are driven back forcefully, the stretch reflex at the shoulder will recover the arms forward, which will also serve.
- Allows athlete to focus on other aspects.
- Elite sprints elbow angles 60 degrees in front to about 140 in back (Cissik, 2002).

Progressions

- Seated -> Standing
- Cues: sit tall, right hand next to right hip, left hand in front of left shoulder. When commanded, the athlete will drive the left arm backwards until the left hand is next to the left hip.

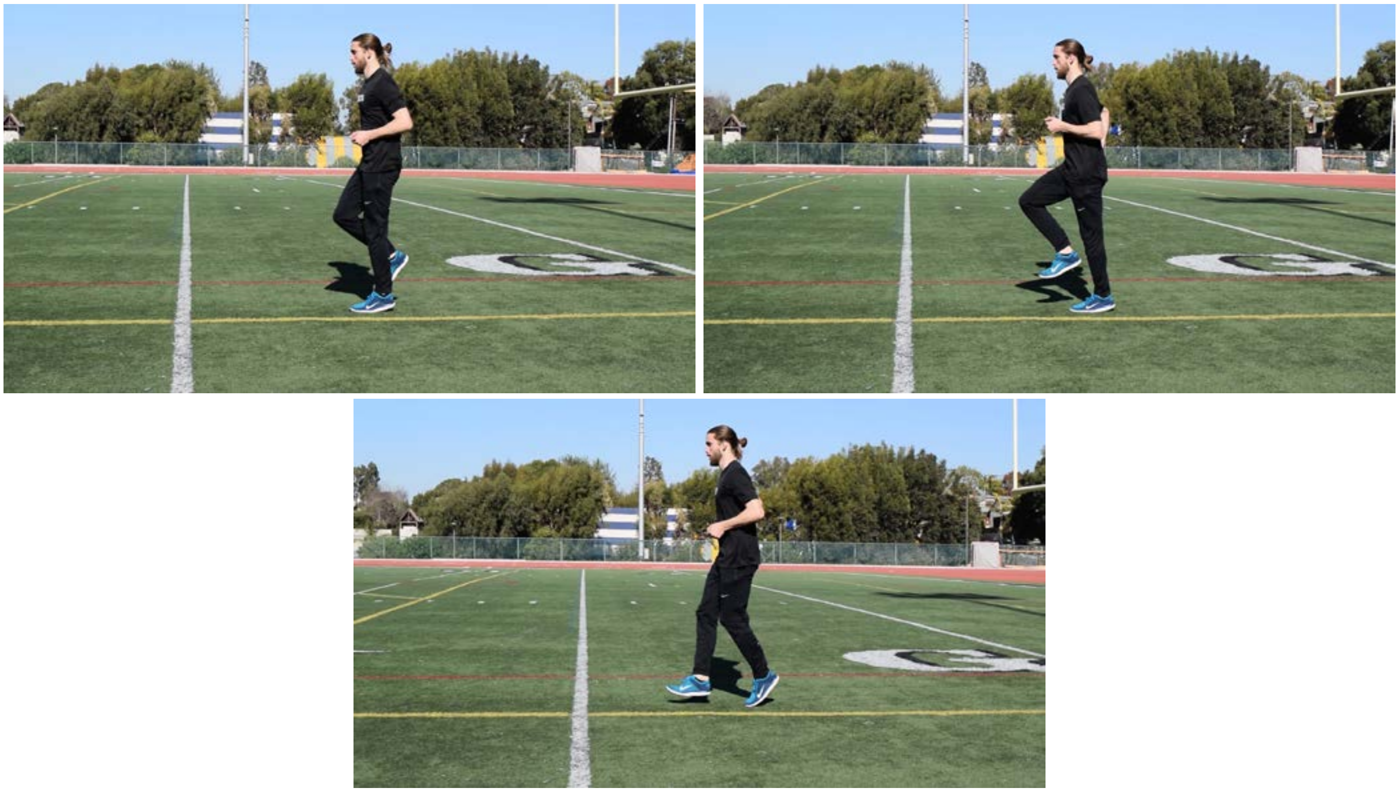
Common errors

- Athletes may not swing the arm from the shoulder. They may swing by locking the upper arm into place and only moving the lower arm. "________ _____ ________" or "______ _____ ________".
- Athletes may allow their arms to cross the midline. Increases the upper body rotation. Focus on arm drives.
- Athletes may swing the arms too high or not far back enough.

NOTES:

____
____
____
____
____
____

Ankling



- Teaches how to lift the feet off the ground and how to put them down during sprinting.
- __________ time that the foot is spent on the ground.
- Minimizes power lost into the ground by creating a more stable ankle position.
- Minimizes chance of _______ which might be caused by poor foot placement.
- Optimal foot action should emphasize _____________ as the hips pass over the foot to push the body forward. When the back foot breaks contact with the ground, it should immediately be "______". Casting refers to dorsiflexing the ankle to approximately 90 degrees while pulling the big toe up. The foot should remain in the cast position until it is again on the ground and the hips are passing over it. During ankling the foot will be driven forward from the hips, and the outside of the forefront will make contact with the ground and will pull the body over it.

Progressions

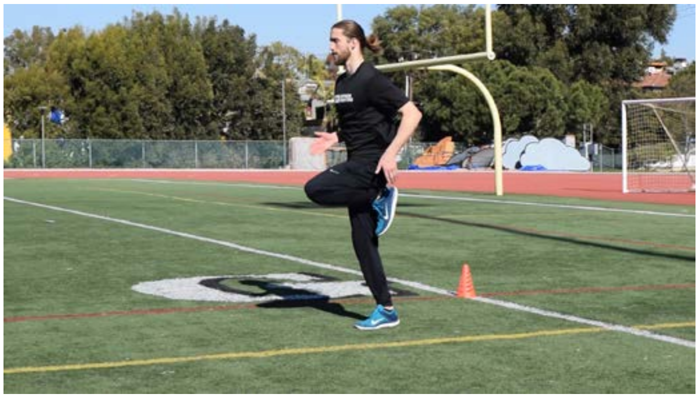
- Walking version is meant to be perfected and ______.
- Drill is performed walking, focusing on one leg at a time. With the legs stiff, move forward until the hips have passed over the right foot. As this happens, the right ankle will go into plantarflexion before the foot breaks contact with the ground. When the right foot breaks contact with the ground, it should be cast and driven forward from the hip. The outside of the right forefront will contact the ground and will pull the body over it.
- After you can go to straight leg bounding.

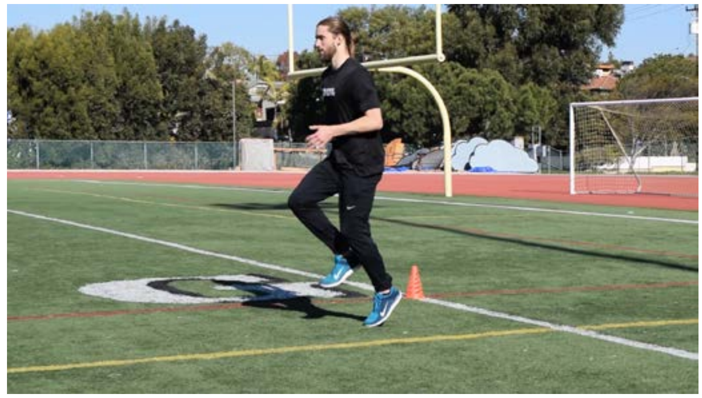
Common errors

- Running on toes or running _______-__-______. Causes balance problems.
- Can work on _______ movements

NOTES:

Heel Kicks





- Designed to build upon the mechanics taught by _______ drills.
- Bring the heel to the ___ immediately following plantarflexion.
- Serves to _______ the lever so that the mass of the leg is closer to the axis of rotation, allowing the leg to be cycled forward more quickly during sprinting.

Progression

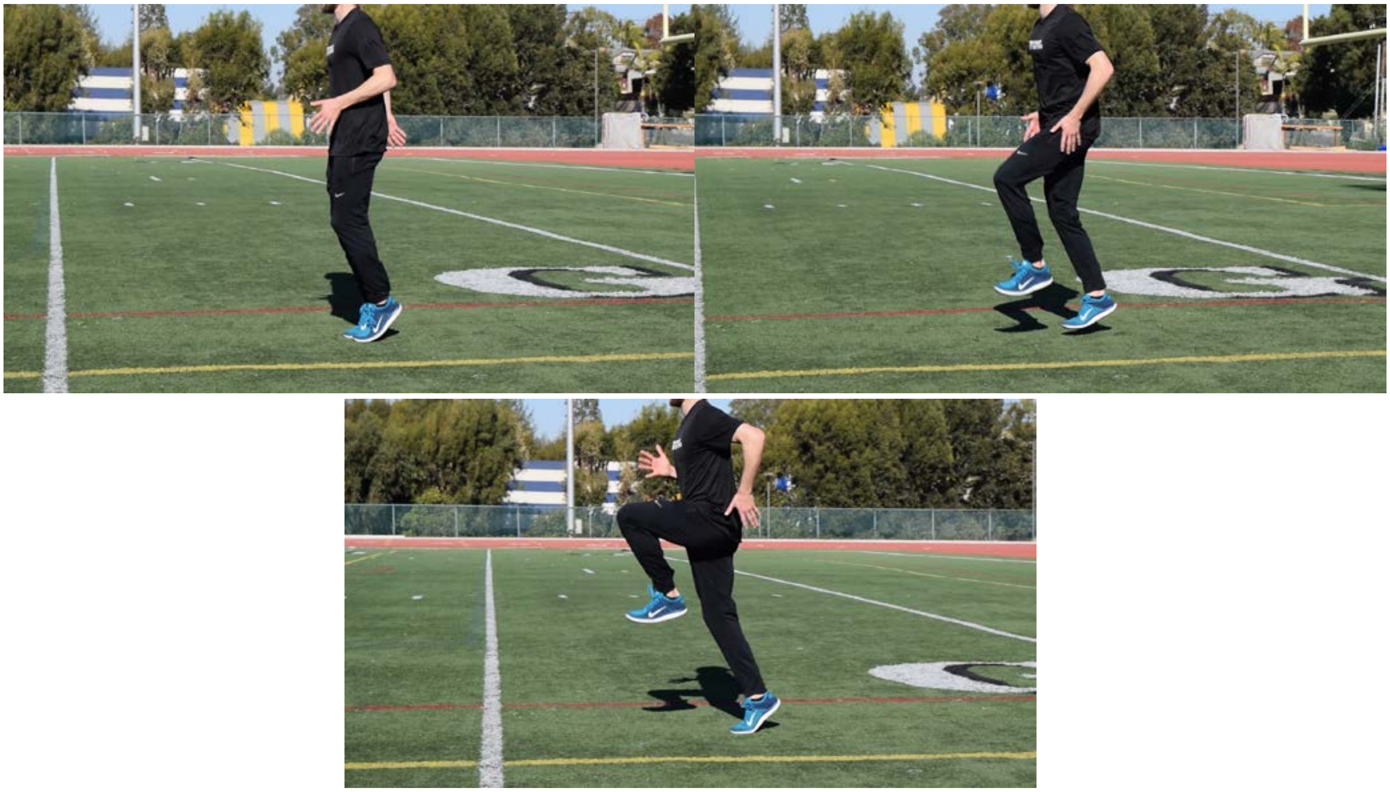
- Heel-kick drills begin at a walking pace and focus on one leg at a time
- As the hips move over the right foot, the right ankle should plantarflex as it breaks contact with the ground. When the foot breaks contact with the ground, it should be “cast” and immediately lifted up to the right hip. As the heel is lifted up, the right hip will flex to approximately 45 degrees.
- Once mastered, move to alternating -> jogging
- Athletes that lack _______ will have trouble bringing the heel to the hip during this drill, especially at slower paces. Can be used to unmask areas to work on.

Common errors

- Many athletes will perform this drill by pointing the knee _____ toward the ground. It should be emphasized that the hip will flex during this drill, and this is important for sprint motion. i.e. not a quadriceps stretch.
- Athletes will lose the cast to their foot while it is brought to the hips. Must remember that they should not allow their foot to dangle and to keep stability.

NOTES:

High-Knee Drills



- Help to teach ___________ mechanics while reinforcing casting the foot and also help to condition the hip flexors.
- Initially taught at walking speeds.
- To perform the right ankle will plantarflex as the hips passover it. As the foot leaves contact with the ground, it should be cast as the right knee is lifted high (parallel to the ground). Keeping the foot cast, place it on the ground slightly in front of the hips so that the outside of the forefoot contacts the ground. The foot should be _________ to the ground from the hips.

Progressions

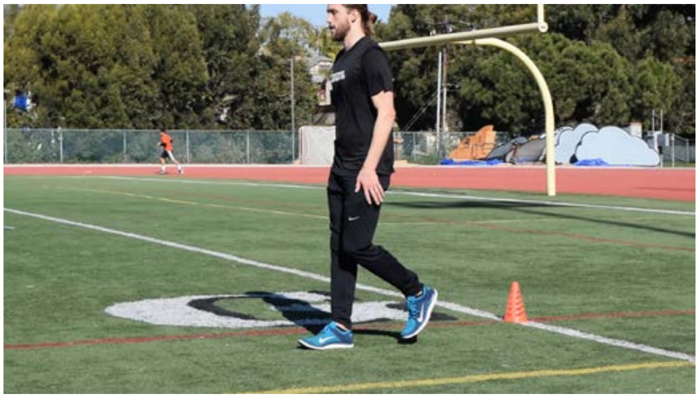
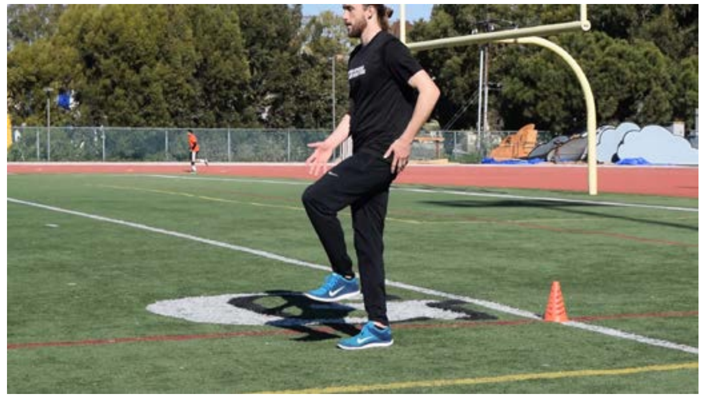
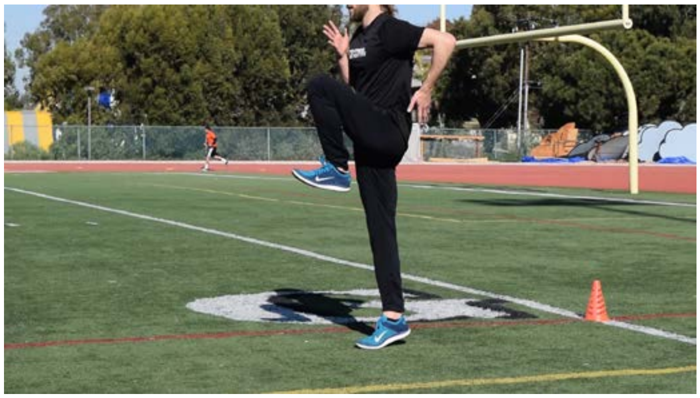
- Start walking and one leg, move to alternating sides and then progress to drill with a skip.

Common errors

- Athlete with weak or tight _______ ________ have trouble staying tall while performing the drills.
- Forward torso tilt.
- Athlete will lose cast to their ankle.

NOTES:

A Drills

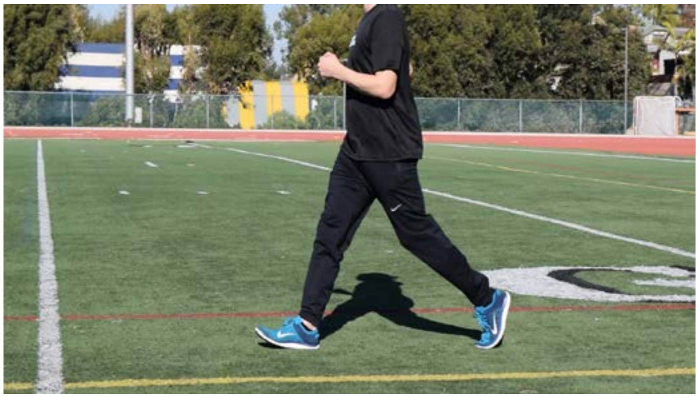
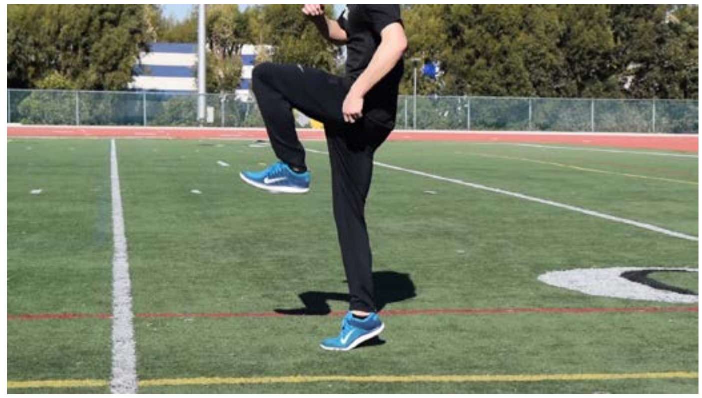
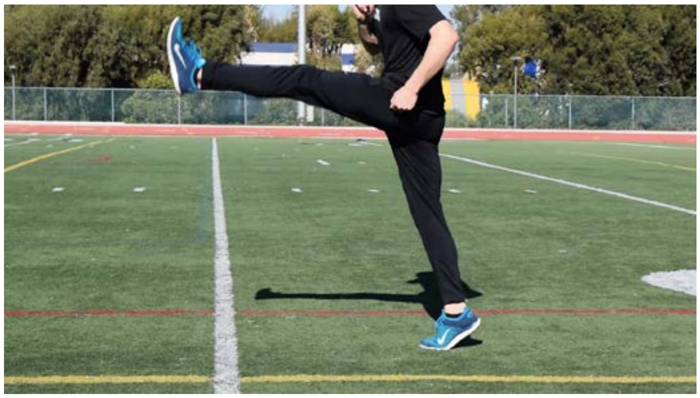
- Combines _____-_____ ______ with _____ ______.

Progressions

- Drill performed as a walk focusing on one leg at a time, when focusing on the right leg, the right ankle will ____________ as the hips pass over it. As the foot leaves contact with the ground, the foot should be cast and immediately brought to the right hip (just like heel kicks). Keeping the heel in contact with the hip, the right leg should be cycled forward. _________ leg should focus on stepping over the opposite knee. As the leg is cycled forward, the knee will be lifted high and the leg will begin to unfold. The foot should be driven down from the hips.
- Start walking and one leg, move to alternating sides and then progress to drill with a skip

NOTES:

B Drills

- __________ drill that teaches the athlete how to exert more force against the ground.
- Athlete will perform the A Drill but as the leg is cycled forward, the _________ are relaxed. The combination of the relaxation of the hamstrings and the driving forward of the knee will cause the leg to extend the knee. The extended leg is then driven down (from the hips) much like the other drills

Progressions

- Start walking and one leg, move to alternating sides and then progress to drill with a skip
- Integrating arm motions
- Combing A Drills with B Drills

Common errors

- __________ lean while extending the knee can lead to over striding which causes the athlete to spend more time with foot contact
- Remember this drill is meant to carryover to sprinting and bad mechanics can effect maximum effort sprints

NOTES:

Overall Progression

- Normally ankling and arm swing drills are taught first.
- Moderately skilled athletes can progress through many of the arm-swing and ankling progressions in minutes.
- Once ankling and arm swings are mastered, heel kicks and high-knee drills are taught.
- Then A-Drills.
- Lastly B Drills.

Overview

- Technique drills are useful for breaking down the sprinting motion and developing portions of sprinting.
- Proper technique at all times.
- Poor mechanics or technique can lead to poor carry over and poor performance.
- Technique drills not a substitute for sprinting.

NOTES:

Application: Technique Drills Answers

1. Transfer
2. Rotation
3. Upper-Body Rotation
4. “Beating the drum” or “milking the cows”
5. Minimizes
6. Injury
7. Plantarflexion
8. Cast
9. SLOW
10. Heel-to-toe
11. Pawing
12. Ankling
13. Up
14. Shorten
15. Mobility
16. Down
17. Front side
18. Driven
19. Hip flexors
20. High-knee drills; heel kicks
21. Plantarflexion
22. Opposite
23. Advanced
24. Hamstrings
25. Posterior lean

IV

Application: Stride Length & Stride Frequency Drills

Application: Stride Length & Stride Frequency Drills

Stride Length Drills

- Help improve speed or the _______ of a sprinters stride.
- Need to determine the _______ stride length for athlete.
- Measure from greater trochanter of the femur to the floor.
- Females multiply by 2.3 to 2.5 for stride length; Males 2.5 to 2.7.
- Downside is if with many athletes this is time consuming, but can be incorporated into __ _________.
- Upside is that athletes can be put into groups once info is collected.
- Drills typically done at percentage of optimal stride length (60-105%).
- Too high of a percentage can lead to ______ _______.
- Drills will be performed with _______ (cones, hurdles, tennis ball, etc) laid out at certain distances.
- Example: Athlete has a leg length of 36 inches. 2.5 X 36 inches = 90 inches (optimal stride length). 60% of 90 in = 54 inches and 105% of 90 in = 94.5 inches
- With elite athletes drills are performed at ________ distances to help train the sprinter to confirm to the new rhythm or stride.
- Macfarlane (1993), stride length drills should not be taken much farther than 20 markers and that a 5-m acceleration zone should be provided so that the athlete can reach his or her stride.

Stride Frequency Drills

- Improving frequency will lead to improvement in running speed
- Modalities: fast leg drills, resisted sprinting and assisted sprinting
- Fast leg drills allow the athlete to move a limb at a _______ speed than would normally be possible during the running motion
- Could lead to a __________ to sprinting, which would result in increased stride frequency and speed
- First performed with ankling. Example: right foot does ankling for three steps and then the left leg performs an A-Drill
- Once mastered move to second step A-Drill

Varying Distances and Intensities

- Technique drills alone are not a substitute for actual sprinting; just like stride-length and stride-frequency drills are not a substitute for sprinting
- Different motion and different speed

General Sprinting Guidelines

- Sprinting must take place at close to __________ speed because sprinting at submaximal speeds will alter running mechanics, stride frequency, and stride length
- Train slow be slow...
- Sprinting at high speeds is extremely taxing and requires optimal ______ between sessions (24-48 hours)
- Distances used for a sprint will depend on athlete and goal. If the desire is to train _________ speed then the distances will need to be greater than 50m. If the desire to to train _________ then shorter distances will be used, 5-50m.
- Rest. Sprints are taxing on the system. Fatigue interferes with speed. Excessive fatigue will interfere with skill acquisition.
- More frequent training can be performed but should not be trained on ____________ days.
- If not working with track athletes, then it is probably not necessary for an athlete to train the components of speed more than 3 times a week (Cissik, 2005)

- Ozolin (1978) the _______ _________ is a nervous system pattern that develops as a result of long term use of similar training methods and training loads. A.k.a. leveling off.
- To break through use assisted sprinting methods, varied pace sprinting and resisted sprinting
- Unclear if speed barrier exists. Does it apply to non track athletes?

Varied-Pace Sprints
- Sprints that have several change sin velocity during the sprint.
- Athlete runs at different speeds, the sprints give the athlete to recharge the ________ _________ between maximal efforts.
- Sprints teach the athlete how to run relaxed at high velocities, which is important for tension which can cause the athlete to slow down.
- Sport specific. Resembles actions that can take place on field of play.

Drills
- Flying Sprints
- Ins and Outs
- Delayed Starts

Resisted Sprints
- Make sprinting motion more difficult; Develop ________.
- During the acceleration phase, there is a longer _______ ________ (a large proportion of which is propulsion), greater knee and trunk flexion at foot strike, greater propulsive forces, and possibly greater EMG activity in the knee extensors
- Believed that the resisted-sprint exercises will ________ more muscle fibers and require more neural activation, therefore increase stride length over time.
- Modalities: Sled, tire, parachute, weighted vest, running uphill, running in sand or in water.
- Too much resistance may alter kinematics.
- Athletes will spend too much time on the ground, and unable to completely extend their hips because of too much _____ lean.
- Use sparingly with little resistance and during specific points in a program.

Guidelines
- Resistance should not _____ down the athlete more than 10%, anymore will alter running mechanics.
- Should be 15-20 m and have gradual release.
- Proper running _______ should be stressed.
- Food for thought? If you athlete rarely does maximum velocity sprinting in a performance, would it be beneficial to just do resisted sprints?

Limb Loading
- REASON: Involves the attachment of weights to the extremities of the athlete in order to provide overload while sprinting
- Likely to increase the moment of _______ considerably and increase muscle activity required during sprinting.
- Ropret et al.(1998) studied the effect of arm and leg loading on sprinting velocity, step length and step frequency. 0.66 on the upper extremities showed no significant improvement. 0.6, 1.2 and 1.8 had significant reduced sprinting velocity. Step length remained the same, so the decrease in velocity was attributed to a decrease in step frequency.
- Martin (1985), compared the effects of adding lead to specially developed shoes and loading the thighs by wearing lead weighted bike pants during treadmill running. Results showed that foot loading and thigh loading lengthened step length, increased recovery time of the ___________ limb, and increased swing phase duration.

- Significant only with ankle joint loading.
- Illustrated how the increased inertia forces associated with distal loading resulted in a greater effect on running technique, especially in terms of decreasing step frequency.

Uphill Running

- Most popular and most cost-effective method of resisted sprint training.
- Reason: Uphill running will place increased load on the ______ __________ muscles as athletes try to maximize step length. Research has shown that results have shown a shortened eccentric phase and an extended concentric phase for propulsion
- Thigh extensors thought to be important in the __________ phase of sprinting, the associated gain in strength is thought to increase the athlete's step length when sprinting on a flat surface.
- Dintiman et al.(1998) suggested that the hill incline should be at a _______ that does not compromise running form. Steeper inclines to improve the star and acceleration phases of sprinting (8-10 degrees in 2.5 -3.5 seconds) and progressively reduced inclines for longer sprint training. Greater than 3% is beneficial for developing hip extensor strength.
- Kunz and Kaufman(1981), biomechanics showed that inclined running resulted in a _________ in velocity of 1 m/s, no change in step length, and an increase in trunk-thigh angle. Concluded that uphill running might result in longitudinal adaptations, increased step length and shortening the stance phase during during sprinting on a flat surface.
- Paradis and Cooke (2001) analyzed sprinting up a 3 degree slope. Found that velocity was significantly ___________ when sprinting uphill compared to sprinting on a flat surface. Primarily attributed to a decrease in step length. Changes in body position between sprinting uphill and on a flat surface. Trunk flexion was significantly increased, and the shank angle (the angle between the lower leg and the running surface) was reduced at both foot strike and toe-off. Thigh-to-thigh angle (the angle between the right and left thigh segments) was significantly decreased at toe-off. Suggested these kinematics changes resulted in an increase in the contribution of the propulsive phase to the stance phase.

Drawbacks

- Ineffective possibly because of the angle of slope being too small or uphill sprinting not ________ training on a flat surface. Not sport specific…
- Finding a suitable hill with “correct” slope angle. Wrong slope may lead to a change in sprint kinematics (decreasing the eccentric phase before foot strike and increasing the concentric phase of push off), which can alter the transfer to a level surface.

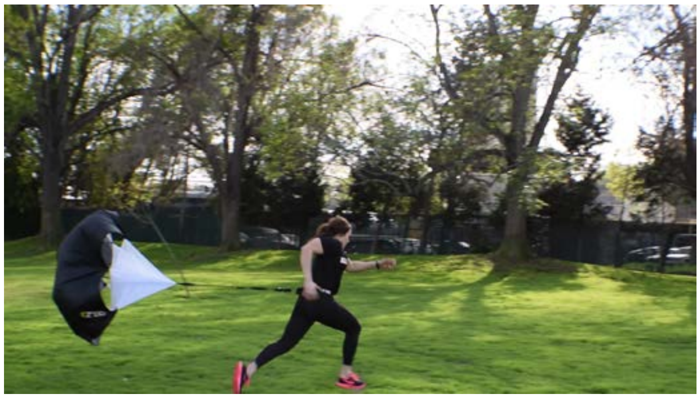
NOTES:

Weighted Vests

- Provide overload by increasing the _______ load during foot strike, increasing the braking forces, and perhaps overloading the SSC to better effect.
- May have better applications for ___________ _________ training, but may have application to acceleration training by increasing ________ strength which will decrease the duration of the stance phase.
- As with all other drills, too much load may result in technique adjustments which would _________ performance.
- Vest sprinting with loads of 15-20% of body mass has increased sprint times at 10 m and 30 m. Suggested that the athletes had less additional force to overcome in the early stages of the sprint during vest sprinting, but that as they developed velocity, the need to control the additional mass around the trunk resulted in decreased performance.
- Increase in sprint times was attributed to decreased step length and step frequency and to increased stance times. Similar joint kinematic between loaded and unloaded
- Bosco et al.(1986) investigated the effects of vest training by using sprinters performing jump and sprint training with a load 7-8% of their body mass. They wore the load for 3 weeks from morning till evening. Normal training volumes were other unchanged, the ability of those subjects who wore bests to produce greater force at higher velocities dramatically improved with this form of conditioning. This study did not investigate sprint mechanics or sprint performance. ___________ might increase the vertical force at each ground contact, thereby increasing the eccentric load on the extensor muscles during the braking phase.

NOTES:

Resisted Towing



- Sleds and tires are the most common method, but parachutes are another example
- Reason: may ________ the load on the athlete's torso and therefore may require more ___________. Increases muscular force output at the hip, knee, and ankle, leading to potential increase in stride length that can result in an improvement in acceleration. Develops strength in the muscles used in sprinting, and with the proper weight used, the __________ are the same as unrestricted sprinting. May increase pelvic stabilization.
- Letzelter et al.(1995) studied the acute effect that different loads has on performance variables with female sprinters. Found that a 2.5 kg load resulted in an 8% decrease in performance over 30m, and 10 k resulted in a 22% decrease in sprint performance. _____ _________ was affected to a far greater extent than step frequency by the increased resistance. As the load increased, decreasing step length accounted for a greater proportion of decreasing velocity. The variable affected most by increasing resistance was stance phase duration. Increased loads also caused increased upper-body lean and increased thigh angle at both the beginning and the end of the stance phase. Increased thigh angle reflects the increased need for force production during the prolonged stance phase.
- Lockie et al.(2003) studied the effect of sled towing on the ____________ phase kinematics in field-sports. Athletes towed loads between 12.6 – 32.2% of their body mass over a 15 m distance. Sled towing resulted in a decrease in stride length of 10 and 24%. Stride frequency was significantly decreased compared to baseline with both both towing loads. The duration of the stance phase was also significantly increased during towing. Concluded that the heavier load led to a greater disruption of running kinematics, and recommended training with lighter loads.
- Kafer et al.(1993) studied the effects of _________ and _________ training on sprint times over 20, 40 and 60 m distances on rugby players. Resisted group recorded an average improvement of 0.08 seconds and 0.35 seconds in sprint times over 20 and 60 m distances. The combined group was significantly faster post training over both 40m and 60m. The control group showed improvements over 60m. Studied showed that the combined resisted-assisted group was signifi-

cantly faster than the control group. Increases in speed could have been due to sprint training with athletes not used to maximum velocity sprints. Concluded that increased resistance from the sled resulted in increased force production to develop and maintain velocity.

Guidelines

- Towing loads less than 10% of body mass
- Harness should be worn on the hips. The higher the harness is above the hips, the greater the lean, and too much lean negatively affects sprinting kinematics by increasing the knee joint angle of the support leg. Cue: Athlete should focus on driving their legs when there is a loss of stride length instead of focusing on increasing their stride frequency.
- Seagrave(1996) believed that the load should be determined by the extent to which performance is affected, if performance variables decrease by more than 10%, the load being used is too great and will effect sprinting technique
- Frictional forces contribute to resistance experienced by the athlete when towing the sled. Difficult to quantify, frictional force is dependent on the mass on the sled and the characteristics of the ground surface and the sled. When training, the load on the sled and the surface over which it is moving will be the variables that can be most easily manipulated to change the frictional force and hence the resistance against which the athlete is working. Be conscious of how much mass is on the sled and the surface.
- Different loads can be used for training different phases of sprinting
- Greater resistance should be used for training the acceleration phase and light loads for increasing maximum velocity phase.

NOTES:

Assisted Sprints

- Main purpose of assisted sprinting are to achieve higher ________ beyond the current capability of the athlete, and to train the neuromuscular system to maintain these high rates without assistance.
- By creating an ___________ environment, the stretch-shortening cycle (SSC) of the neuromuscular system can improve the efficiency of the ground contact phase.
- Leads to the muscles being able to tolerate greater stretch loads and possibly storing more _____ power by increasing the stiffness of the muscle in the eccentric phase of the SSC.
- Athlete runs at greater velocities than he or she is normally capable of.
- In theory the athlete will learn how to run at greater stride ____________.
- Modalities: being towed, sprinting downhill, and high speed treadmill running
- Faccioni (1995), assisted sprints can improve stride rate and elastic energy production
- Must ensure that athlete is not allowing themselves to be pulled
- Downhill sprinting will ________ horizontal velocities and stride length. Declines greater than 3% may lead to excessive stride lengths that will result in increased braking during sprinting. Should build up to assisted sprints
- Research has shown that ______ ________ will eventually reach a plateau and stride frequency may continue to increase when approaching maximal sprinting speed; therefore attention should be focused on improving stride frequency.

Assisted Towing



- Athlete focuses not on increasing stride length but on increasing his or her ______ _________. The purpose of towing is to force the athlete to take faster steps without changing technique.
- The person being towed is the athlete who will be focusing on ___________ training. Allows the athlete to achieve speeds beyond his or her unassisted capability.
- Assisted towing is the best method because of the ______ ________ characteristic. With assisted towing, the athlete still experiences an acceleration phase, with a transition to the maximal

velocity phase

Guidelines

- Athlete must not allow themselves to be pulled
- Distances should not achieve speeds greater than 106-110% of their maximum running speed

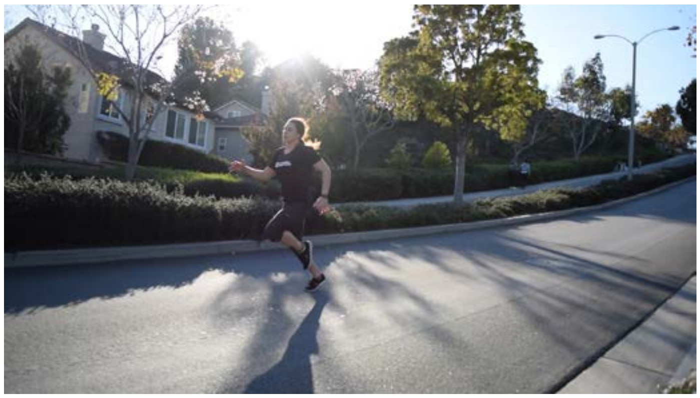
NOTES:

High Speed Treadmill Sprinting

- _____________ of high-speed treadmill sprinting are very similar to over ground sprinting, and as velocity increases, the stride frequency increases and flight time and stance phase decreases.
- Treadmill sprinting adaptations in stride frequency are created by increases in muscle activation of the lower extremity-which also produces a larger ____________ load on the hamstrings – and through increases in joint angular velocities.
- Significant increases in peak hip extensor and knee flexor torques were recorded. An increased hip extensor torque can result in a greater stride length
- Against. Difficult to create the smooth and consistent acceleration patterns generated during a sprint race. Possible changes in ________ because if the belt moving and the athletes not having to propel their mass forward, which does not increase kinetic energy. Although, there is an enhanced stride frequency, the moving ground of the treadmill may change the amount of kinetic energy the athlete would have to create if sprinting on a normal surface.

NOTES:

Downhill Sprinting



- Most popular, efficient and cost-effective method
- Purpose is to improve stride frequency and the athlete uses his or her body mass, the acceleration because of gravity and the downhill slope to increase sprint speed beyond normal level ground sprinting
- Discrepancies in the recommended degree of slope
- Slope should not exceed an angle of 2-3 degrees to prevent changes in mechanics
- Another study said slop of 5.8 degrees was more beneficial than 2.1, 3.3 and 4.7
- Dintiman and Ward (1998) recommended a slope of 1-2.5% to prevent braking effect
- Bottom line… what sport does you athlete play? What phase are you training?
- Declines greater than 3% may lead to ______________ stride lengths, with no increases in stride frequency, and will result in an increase in braking effect

Guidelines
- Distances should not cover more than 30-40 m
- Downhill sprints should not have an angle greater than 2-3
- Speeds should not exceed 106-110% of maximum
- Preach technique!

NOTES:

Sample Offseason Speed Training

	Day 1	Day 2	Day 3
Exercises	Goal of session - Speed 1) Dynamic Warm Up + 2-3 Technique Drills 2) Workout Parachute Sprint 5 sets x 60 meters 3) Cool down Myofascial Release and static stretching	Goal of Session - Acceleration 1) Dynamic Warm Up + 2-3 Technique Drills 2) Workout Uphill Sprints 3 sets x 30 meters & Assisted Towing 5 sets x 30 meters 3) Cool down Myofascial Release and static stretching	Goal of Session - Conditioning 1) Dynamic Warm Up + 2-3 Technique Drills 2) Workout High Speed Treadmill Running 10 sets x 100 meters 3) Cool down Myofascial Release and static stretching
Rest between reps / sets (min)	3	3	1

Application: Stride Length & Stride Frequency Drills Answers

1. Rhythm
2. Optimal
3. Pre assessment
4. Over striding
5. Markers
6. Precise
7. Greater
8. Carryover
9. Maximum
10. Rest
11. Maximum
12. Acceleration
13. Consecutive
14. Speed barrier
15. Nervous system
16. Acceleration
17. Stance phase
18. Recruit
19. Trunk
20. Slow
21. Mechanics
22. Inertia
23. Contralateral
24. Thigh extensors
25. Propulsive
26. Grade
27. Decrease
28. Decreased
29. Resembling
30. Vertical
31. Maximum velocity
32. Eccentric
33. Decrease
34. Sprinting
35. Increase
36. Stabilization
37. Kinematics
38. Step length
39. Acceleration
40. Resisted
41. Assisted
42. Velocities
43. Overspeed
44. Elastic power
45. Frequencies
46. Increase

47. Stride length
48. Stride frequency
49. Overspeed
50. Sport-specific
51. Kinematics
52. Mechanical load
53. Kinetics
54. Excessive

V

Application: Strength Training & Plyometrics

Application: Strength Training & Plyometrics

Strength Training

- Goal is to increase the size of the _________ _________ and strength of athlete, which improves the ability to generate __________.
- Biomechanically, a coach must know which muscles are the most important for the particular sport being training. Sprinting is a unilateral and mainly horizontal movement. During ground contact, only one leg is loading the muscles to propel the body's mass forward, while the other leg is in the swing phase preparing for ground contact. To meet specificity of training, more unilateral and horizontal exercises are needed for sprinting.
- Squats and single leg squats will help improve short sprints and starting ability, and reverse hyper-extensions, and Romanian deadlift or single leg RDLs that strongly activate the gluteal and ham-string muscle groups are more specific to maximum-speed sprinting.
- Research suggests that the musculature around the ____ is more important in sprinting than that around the knee.
- Muscles around the hip acts as a ________ ________. The ___ ________ assist in pulling the leg forward- a faster flexion of the hip and leg recovery. The _____ ___________(gluteals and hamstrings) drive the body forward and perform concentric and eccentric actions during the ground contact phase.
- Elite sprinters had superior hip extension velocities compared with subelite sprinters.
- _____ __________ produce the greatest muscle moments during sprinting and are active during the start of the sprint and increase activity as running speed increases. Although the hamstrings play a more important role than the gluteals, they are many sprinters weakest link.
- Hamstrings have significant potential to limit sprint performance.
- ____________ undergo the greatest amount of force during the eccentric contraction of the swing phase and are the most prone to injury.
- Hamstring curls focusing on a rapid eccentric component.
- No clear consensus as to which load intensity is most beneficial during resistance training. The relationship between speed and maximal leg strength tends to be nonsignificant because of the squat exercise having a different velocity/acceleration profile than sprinting.

Unilateral RDL

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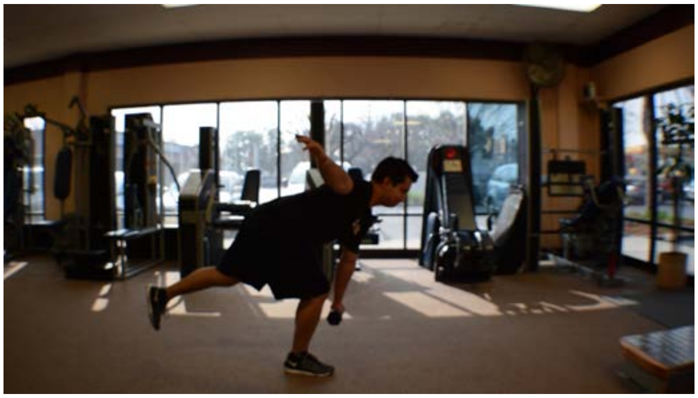
Contralateral RDL

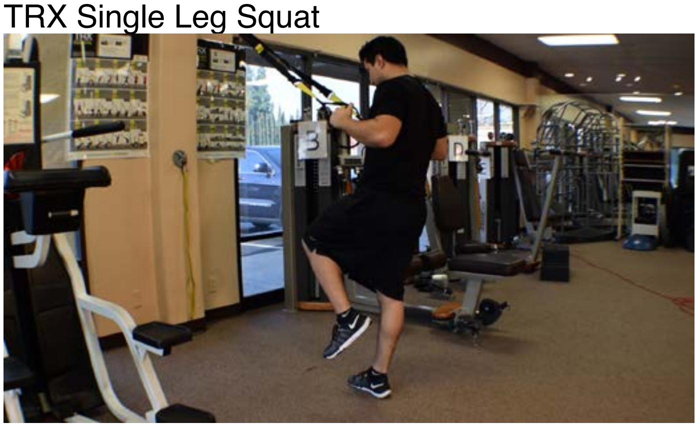


Notes:

TRX Split Squat

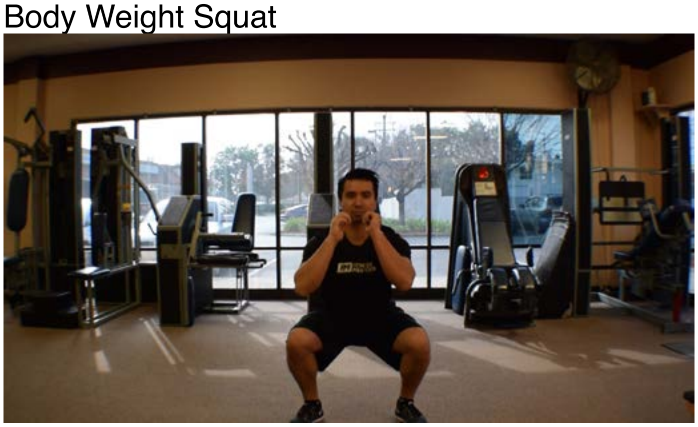
Notes:

TRX Single Leg Squat



Notes:

Body Weight Squat



Notes:

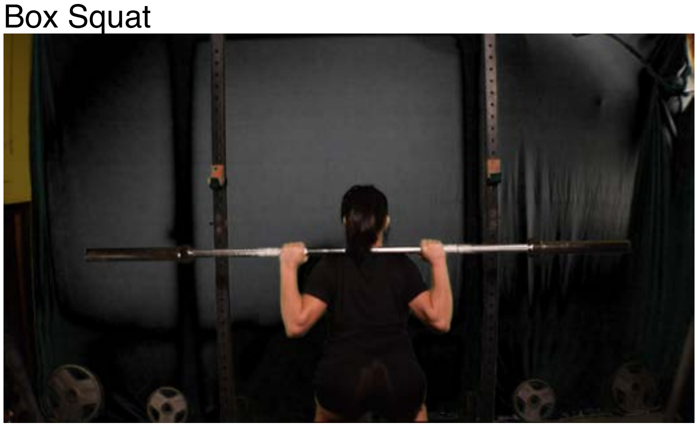
Reverse Hypers

Notes:

Bench Press

Notes:

Box Squat



Notes:

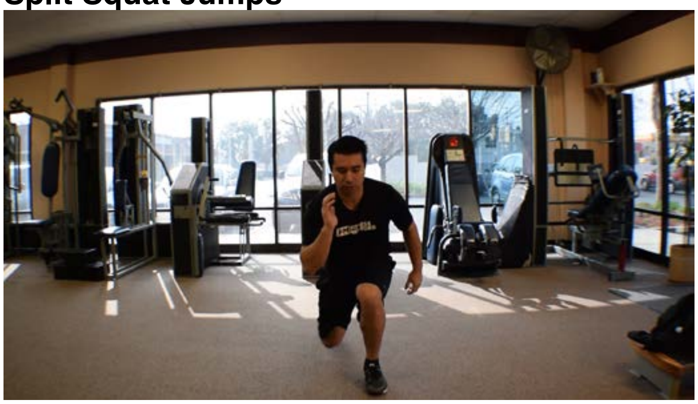
Barbell Squat

Notes:

Plyometrics

- Used to develop ___________ force in a short amount of time by training the SSC. During the eccentric contraction, elastic energy is generated and stored for the concentric contraction. The elastic energy stored during the eccentric phase is then released during the concentric phase. The faster the eccentric loading, the more powerful the ___________ contraction. The objective of plyometric training then is to achieve ____________ ___________ ____________ on, which loads the muscle and then rapidly switch to a concentric contraction.
- Specificity of training applies to plyometrics.
- Sprinting is a horizontal movement and requires movement in the horizontal plane. The plyometric exercises that involve muscle velocities that closely resemble those of sprinting and emphasize forward motion with minimum vertical motion will have the greatest transfer to sprinting ability.
- Place a large amount of strain on the body, and a high-frequency training plan may push the body beyond its limit; thus a solid base of weight training is recommended before starting plyometrics

Split Squat Jumps



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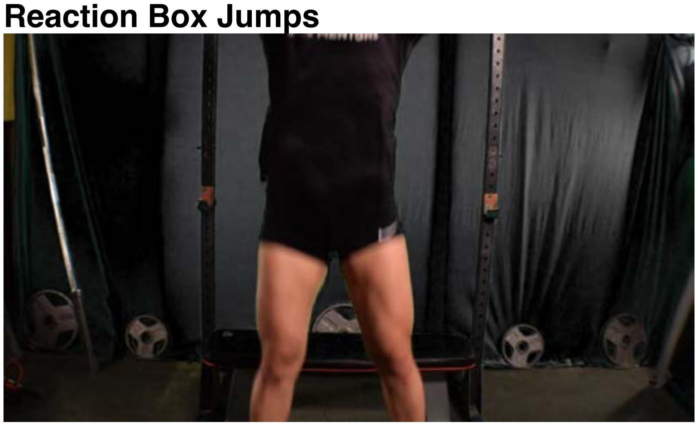
Reaction Box Jumps



Notes:

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Speed Training Programming Guidelines

- Specificity of Sport! Create a program that meets the need of your athlete.
- Distances
- Drills
- Frequency
- Etc
- Keep your athlete fresh. Sprinting is taxing and maximum sprinting can have negative effects
- Sound technique should always be stressed
- Athletes should be progressed in an appropriate manner
- Your programming should have a plan and focus per day
- Have appropriate rest periods!

NOTES:

VI

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