SPRINT TRAINING
Mike Holman
Lawrence Central High School
Boys State TF Champions
1998 and 2005
2005 100m Champion
Will Glover 10.45

Justin Gatlin

Special Training

USATF HIGH PERFORMANCE COMMITTEE
Athlete Centered
Coach Driven
Science Based
Unconsciously Incompetent
Consciously Competent
Unconsciously Competent

Physical Literacy
“LTAD”
Long Term Athlete Development
Running/Jumping/Throwing
Agility/Balance/Coordination/Neural Speed
Kinesthetic Awareness/Gliding/Bouyancy
Newton’s Laws

1st Law – Inertia
- Object in motion (rest) tends to stay in motion...

2nd Law – Acceleration
- Acceleration is proportional to the forces acting upon the center of mass

3rd Law – Conservation of Momentum
- Equal and opposite reaction force.

Summary of 3 Energy Systems

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>POWER</th>
<th>WORK</th>
<th>FUEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALACTIC ANAEROBIC</td>
<td>VERY HIGH</td>
<td>LOW</td>
<td>STORED PC</td>
</tr>
<tr>
<td>LACTIC ANAEROBIC</td>
<td>HIGH</td>
<td>Intermediate</td>
<td>GLUCOSE, GLYCOGEN</td>
</tr>
<tr>
<td>AEROBIC</td>
<td>DEPENDS ON AEROBIC FITNESS</td>
<td>VERY HIGH</td>
<td>GLUCOSE, GLYCOGEN &amp; FAT</td>
</tr>
</tbody>
</table>

Training Energy Systems

<table>
<thead>
<tr>
<th>Effort</th>
<th>System</th>
<th>Power/Capacity</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2.0 sec</td>
<td>Alactic/Nerv/ Stored ATP+CP</td>
<td>Power</td>
<td>Starts</td>
</tr>
<tr>
<td>2-5 sec</td>
<td>Alactic CP</td>
<td>Power</td>
<td>Acceleration</td>
</tr>
<tr>
<td>5-15 sec</td>
<td>Alactic CP</td>
<td>Power</td>
<td>Max Speed</td>
</tr>
<tr>
<td>15-30 sec</td>
<td>Alactic</td>
<td>Capacity</td>
<td>Speed End - hold</td>
</tr>
<tr>
<td>30-45 sec</td>
<td>Lactic- anaerobic</td>
<td>Power</td>
<td>Energy without Oxygen</td>
</tr>
<tr>
<td>45-90 sec</td>
<td>Lactic</td>
<td>Capacity</td>
<td>Ability to tolerate LA</td>
</tr>
</tbody>
</table>

ANAEROBIC TRAINING

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>DURATION</th>
<th>PHYSIO. ATTRIBUTE</th>
<th>DOMINATE ENERGY SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short Explosive Effort</td>
<td>&lt; 5 sec</td>
<td>Muscular Strength</td>
<td>High-energy phosphates (ATP, CP)</td>
</tr>
<tr>
<td>Short Sprint (High Power)</td>
<td>5-10 sec</td>
<td>Muscular Strength</td>
<td>High-energy phosphates (ATP, CP)</td>
</tr>
<tr>
<td>Sustained Sprint (High Power)</td>
<td>10-60 sec</td>
<td>Muscular Strength</td>
<td>Anaerobic Glycolysis</td>
</tr>
<tr>
<td>Middle Distance Moderate Power</td>
<td>60 sec-10 min</td>
<td>Endurance, anaerobic threshold</td>
<td>Anaerobic Glycolysis, Aerobic</td>
</tr>
</tbody>
</table>

Planning Training

- Speed - 90-100% effort of your max
  - Speed Power - 30-60m, 4-8 rest; 350-400m total volume
  - 3-6 sec
  - Alactic Speed - 50-80m, 3-5 rest, 400-600m total volume
  - > 9 sec (above 9 sec, begin touching on speed endurance)
  - Glycolytic Speed - 40-80m, 1-4 rest, 400-600m total volume
  - 5-9 sec (less rest than above)

When you stack efforts, you are now talking speed endurance

Biomotor Approach

- Sprint Performance Factors
  - Coordination - probably the most important factor, all things considered
  - Speed
  - Sprint/Power
  - Flexibility
  - Psychological
    - High self image
    - Aggressive
    - Enthusiastic in competition
    - Relaxed in competitive and pressure situations
### Elite Men's Sprint Norms

<table>
<thead>
<tr>
<th></th>
<th>Horizontal Velocity m/s</th>
<th>Stance Rate/m</th>
<th>Stride Length m</th>
<th>Ground Time GT</th>
<th>At Time AT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>9.37-9.40</td>
<td>4.07</td>
<td>2.19-2.21</td>
<td>.11</td>
<td>.133</td>
</tr>
<tr>
<td>Average</td>
<td>10.72-10.74</td>
<td>4.52</td>
<td>2.36-2.39</td>
<td>.10</td>
<td>.123</td>
</tr>
<tr>
<td>Good</td>
<td>12.06-12.09</td>
<td>4.97</td>
<td>2.54-2.56</td>
<td>.087</td>
<td>.113</td>
</tr>
</tbody>
</table>

### Block Starts
- Quick side
- Strongest leg
- Comfortable
- Confident
- Smooth
- Explosive

### Block Spacing
- 2 foot lengths from starting line to the front block
- 1 foot spacing from the front block to the back block
- Front knee angle at set position 90°
- Rear knee angle at set position 120°
- Key-balance and how they feel

### Suggested Block Positions for Different Leg Lengths

<table>
<thead>
<tr>
<th>Leg Length</th>
<th>Front Block</th>
<th>Between Blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>25”</td>
<td>14”</td>
<td>10.5”</td>
</tr>
<tr>
<td>26”</td>
<td>14.5”</td>
<td>11”</td>
</tr>
<tr>
<td>27”</td>
<td>15”</td>
<td>11”</td>
</tr>
<tr>
<td>28”</td>
<td>15.5”</td>
<td>11.5”</td>
</tr>
<tr>
<td>29”</td>
<td>16”</td>
<td>12”</td>
</tr>
<tr>
<td>30”</td>
<td>16.5”</td>
<td>12.5”</td>
</tr>
<tr>
<td>31”</td>
<td>17”</td>
<td>13”</td>
</tr>
<tr>
<td>32”</td>
<td>17.5”</td>
<td>13.5”</td>
</tr>
</tbody>
</table>

### Block Start Considerations
- Presetting the neuromuscular system for explosive jumps.
- Practice starts (research supports the fact that the 5th start is the fastest).
- Use motor set rather than sensory set to reduce reaction time.
- Have the athlete focus upon their first movement, not the gun.
- Arms with thumbs directly under the shoulders, maximizes distance.
- Shoulders directly over hands with the rear knee in contact with the hip.
- Muscle tension applying force against the block.
- Force must come from gluts and hamstrings to extend the hips.
- Foot dorsiflexion places the ankle joint in a mechanically advantageous position for the next ground contact and provides muscle tension for force production.
- Low heel recovery backside mechanics and eccentric contractions play a key role in sprinting.
Dynamics of Acceleration

<table>
<thead>
<tr>
<th>Dynamic</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>STRIDE LENGTH</td>
<td>Short to Long</td>
</tr>
<tr>
<td>GROUND CONTACT TIME</td>
<td>Long to Short</td>
</tr>
<tr>
<td>SHIN ANGLE WITH GROUND</td>
<td>Small to Large</td>
</tr>
<tr>
<td>VELOCITY</td>
<td>Slow to Fast</td>
</tr>
<tr>
<td>STRIDE FREQUENCY</td>
<td>Slow to Fast</td>
</tr>
<tr>
<td>HEEL RECOVERY</td>
<td>Low to High</td>
</tr>
</tbody>
</table>

Acceleration

- Begins with “on your marks” position
- The faster the sprinter, the longer the distance required to reach maximum velocity—usually reached in 4-5 sec
- Acceleration ability affects the distance of the acceleration phase
- Concludes when the athlete reaches maximum velocity
- Concentrate on 5 good pushes need to be strong and understand pushing and not pulling shin angle a key
- Straight line from head, shoulders, spine, hips, and shins to ankle
- Athletes will think they are staying down, when in fact, they have their head down and are bent at the waist—their shin angle will be near 90°, which is the angle for max velocity—foot should be behind the knee to push
- 64% of the 100m race is acceleration—should be reflected in training

Our Mission

- Decrease the time it takes to perform one stride by 0.01 seconds.

Some examples

- 40yd – 20 strides x 0.01 = 0.2 seconds
- 100m – 50 x 0.01 = 0.5 seconds
- 400m – 250 x 0.01 = 2.5 seconds
- 1600m – 1,000 x 0.01 = 10 seconds
- Marathon – 28,000+ x 0.01 = 3-5 minutes

100 METER RACE MODEL

- 0-30 meters: develop push mechanics with low heel recovery—focus on 6 good pushes
- 30-60 meters: transition/line-up to run fast and tall
- 60-80 meters: concentric to eccentric contractions; low heel recovery to step-over mechanics
- 80-100 meters: max velocity, maintenance phase, lose and fast
- 80-100 meters: deceleration phase, medals are decided in this phase; 2-6% increase in stride length, 1-9% decrease in stride frequency, 3-4% loss of speed
- There is a correct way to run the race—the more the athlete understands the race pattern, and trained to master the closer to their potential they will run

Analysis of Maximum Velocity

- Ground contact is composed of an eccentric phase and a concentric phase
- Eccentric phase: initiated at ground contact and ends when the C of M is directly over the foot where the sprinter must work against forces that create negative horizontal acceleration—most important phase in max velocity
- Concentric phase: initiated when the C of M is over the foot and ends at the start of leg recovery—contributes little if any to max velocity, but contributes greatly to the acceleration phase
- Frontside mechanics are very important in this phase—up, heel up, and knee up; ankle steps over the opposite knee
The heel should be pulled from the ground up under the glut or rear hamstring.
Tee should be dorsiflexed-pull toe up toward the knee.
This compact position allows the athlete to pull the ankle over the opposite knee in a quick and explosive fashion.
High knee lift is a result of correct position of heel to glut, dorsiflexed foot and ankle over the opposite knee.
As ankle is brought over the opposite knee, the athlete should be thinking down and back with the thigh, not the foot.
Shin angle on contact should be 90°.

FINAL THOUGHTS
- Practice only makes perfect if you practice perfectly.
- Neuromuscular learning—wire your athletes correctly from day one.
- Gradual progression in all aspects of training.
- Warm-up purpose—warm up maximal sprinting and race plan.
- Coaching is a visual discipline—train your eye to watch movement.
- Athletes must be involved to learn: Tell me and I’ll remember for a day, show me and I’ll remember for a week, involve me and I’ll remember for a lifetime.
- Athletes want three things: to be made competitive, to be treated fairly, and to be allowed to have fun. The order depends on the athlete.
- The body was meant to push not pull.
- Sprint up hills to help correct foot contact, among other things.

FROMAFAP
- F-full
- R-range
- O-of
- M-motion
- A-as
- F-fast
- A-as
- P-possible

TESTING
- 30m fly with 20m acceleration zone=max velocity in m/s.
- 30m crouch=starting acceleration
- 60m crouch=starting acceleration and transition to full speed
- 150m standing=speed endurance (lactic anaerobic)
- 350 m standing=speed/special endurance (lactic anaerobic)
- 600m standing=general endurance and strength endurance
- Standing T-lunge/jump=starting power
- Single leg hop for 20m=power and strength balance
- 10 bounds for time and distance=max speed, speed endurance, and strength endurance.

DRILLS