



LEARNING OBJECTIVES

- + Define plyometrics and list the three primary components
- + Identify and describe each sub-component within the three primary components of plyometrics
- + Describe the performance and injury prevention benefits associated with plyometrics
- + Identify and design effective plyometric programming relative to individual differences and session demand

What should we consider when trying to optimize transfer from the weight room to sport?



Speed Demands...



Sport Demands...



01

PLYOMETRICS: DEFINED

PLYOMETRICS

- + 'Shock-method' was first proposed by Dr. Yuri Verkhoshansky and popularized through the use of 'depth/drop jumps'
- + The term **PLYOMETRICS** was later proposed by western track coach Fred Wilt
- + Plyometrics represent a category of movements that are meant to improve overall speed-strength qualities

DEFINING PLYOMETRICS

Drills aimed at linking optimal strength and speed during fundamental movement patterns (speed-strength)



Defined as a quick, powerful movements that utilize the stretch-shortening cycle (SSC)

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✦ SSC is defined as a rapid muscle lengthening followed immediately by a rapid muscle shortening

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- + SSC optimizes the use of the stretch reflex and stored elastic energy



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PLYOMETRIC COMPONENTS

MOVEMENT

Based on the dominant motor patterns being taught within the following Movement Skills session

DIRECTION

Based on dominant force vectors being taught within the following Movement Skills session

INITIATION

Based on the dominant contraction types being taught within the following Movement Skills session



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PLYOMETRIC: MOVEMENT

JUMP

Two foot take-off followed by a two-foot landing

BOUND

Single foot take-off followed by an opposite single foot landing

HOP

Single foot take-off followed by the same single foot landing



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|| MOVEMENT (JUMP)



Continuous Lin-Vert Jump



Continuous Lin-Vert Box Split Jump

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01 MOVEMENT (BOUND)



Counter-movement Lat-Horiz Bound



Counter-movement Lat-Horiz
45 ° Bound

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01 MOVEMENT (HOP)



Drop Hop (Plyo Prep)



Counter-movement Lin-Vert Box Hop

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PLYOMETRIC: DIRECTION

LINEAR

Movement direction includes Linear-Vertical and Linear-Horizontal

LATERAL

Movement direction includes Lateral-Vertical and Lateral-Horizontal

ROTATIONAL

Movement direction includes Rotational-Vertical and Rotational-Horizontal



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02 DIRECTION (LINEAR)



Continuous Lin-Vert
Alternating Split Jump



Double Contact Lin-Horiz
Hurdle Hop

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02 DIRECTION (LATERAL)



Counter-movement Lat-Vert Box Hop



Counter-movement Lat-Horiz
Hurdle Hop

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02 DIRECTION (ROTATIONAL)



Counter-movement Rot-Vert
180° Jump



Counter-movement Rot-Horiz
90 ° Bound

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PLYOMETRIC: INITIATION

NON COUNTER-MOVEMENT No lengthening action prior to shortening action (Concentric only)

COUNTER-MOVEMENT Rapid lengthening action prior to an immediate shortening action (SSC)

DOUBLE CONTACT Lengthening action preceded by a rapid ground contact and followed by a shortening action (SSC)

CONTINUOUS Linking multiple SSC repetitions together in quick succession (SSC)

DEPTH/DROP JUMP Lengthening action preceded by a rapid ground contact from a box and followed by a shortening action (SSC)



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03 INITIATION (NON-COUNTERMOVEMENT)



NCM Lin-Vert Jump



NCM Lin-Vert Box Split Jump

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03 INITIATION (COUNTERMOVEMENT)



CM Lat-Horiz Hurdle Hop-Lateral



CM Lat-Horiz Hurdle Hop-Medial

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03 INITIATION (DOUBLE CONTACT)



DC Lat-Horiz Hurdle Hop-Lateral



DC Lat-Horiz Hurdle Hop-Medial

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03 INITIATION (CONTINUOUS)



CONT Lin-Horiz Hurdle Hop-Lateral



CONT Lin-Horiz Hurdle Hop-Medial

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CHECK FOR LEARNING

01

- + List the 3 primary components of plyometrics and the associated 3-5 sub-components
- + Write down 3-5 different plyometric movements using the appropriate labeling



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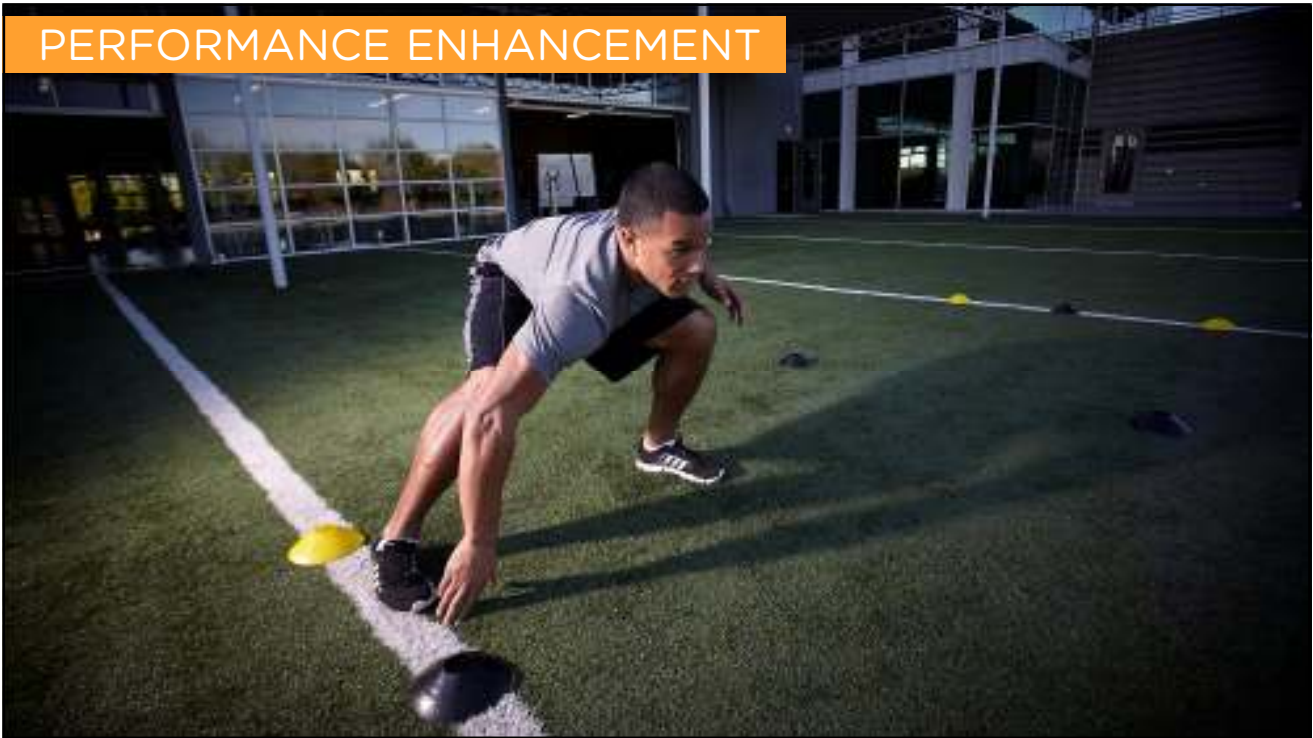
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02

PLYOMETRICS + OPTIMIZING TRANSFER

PERFORMANCE ENHANCEMENT



PLYOMETRICS: PRIMARY GOAL

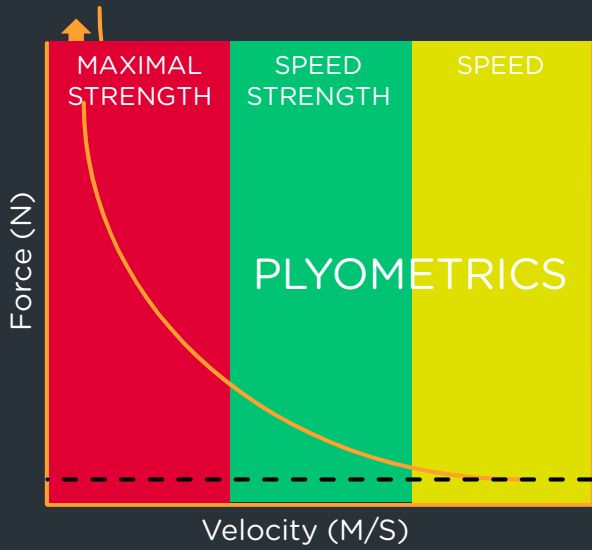
Apply optimal force (strength) and velocity (speed) in the correct direction within the shortest time (efficiency)

PLYOMETRICS: PERFORMANCE BENEFIT

- + Increased explosive strength due to improved rate of force development (RFD)
- + Increased reactive strength due to greater storage and reutilization of elastic energy
- + Improved ability to transfer force through the joints and minimize energy leaks

(Aagaard et al., 2002, Komi, 2003 and Turner and Jeffreys, 2010)

FORCE-VELOCITY RELATIONSHIP



(Newton & Kraemer, 1994)

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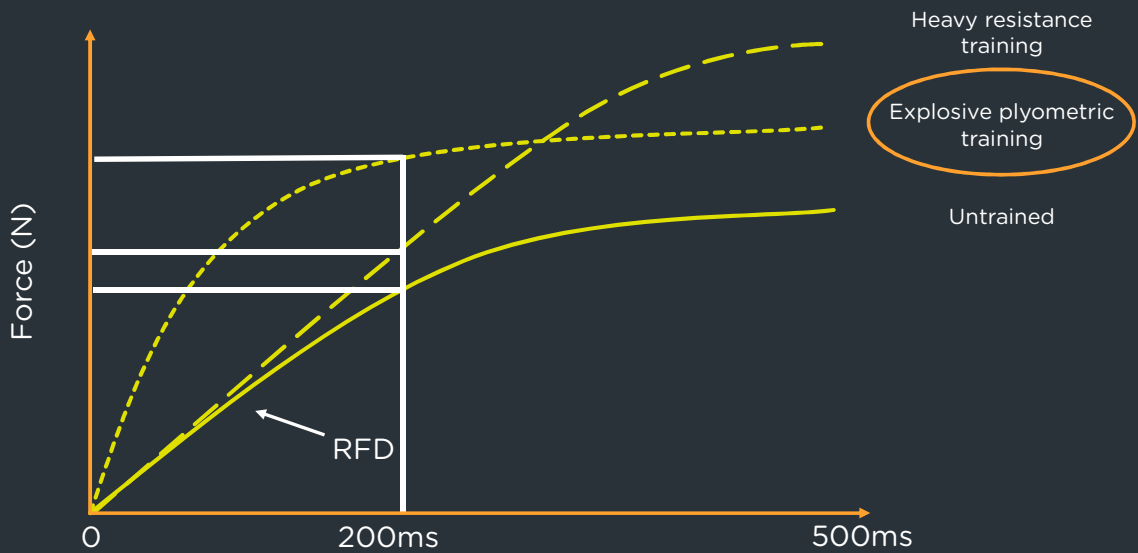
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High Speed Running > 3000ms



RATE OF FORCE DEVELOPMENT



(Newton & Kraemer, 1994)

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What are the mechanisms underpinning the performance benefit of plyometrics?

Stretch-Shortening Cycle (SSC)

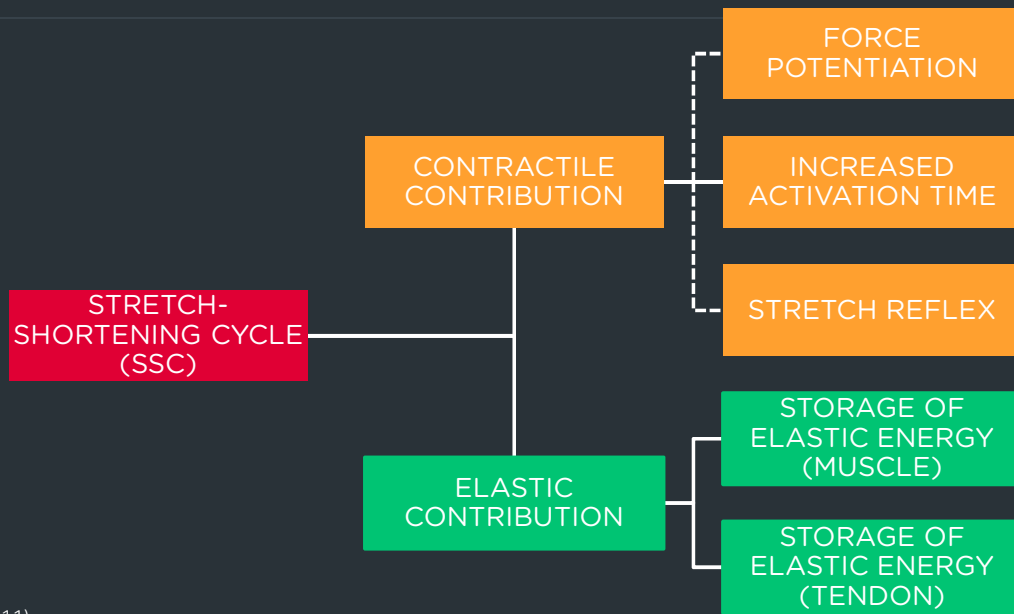
STRETCH-SHORTENING CYCLE



Movements utilizing a stretch-shortening cycle have been shown to increase performance by 10-15% compared to movements that do not.

(Turner & Jeffreys, 2010)

SSC: MECHANISMS



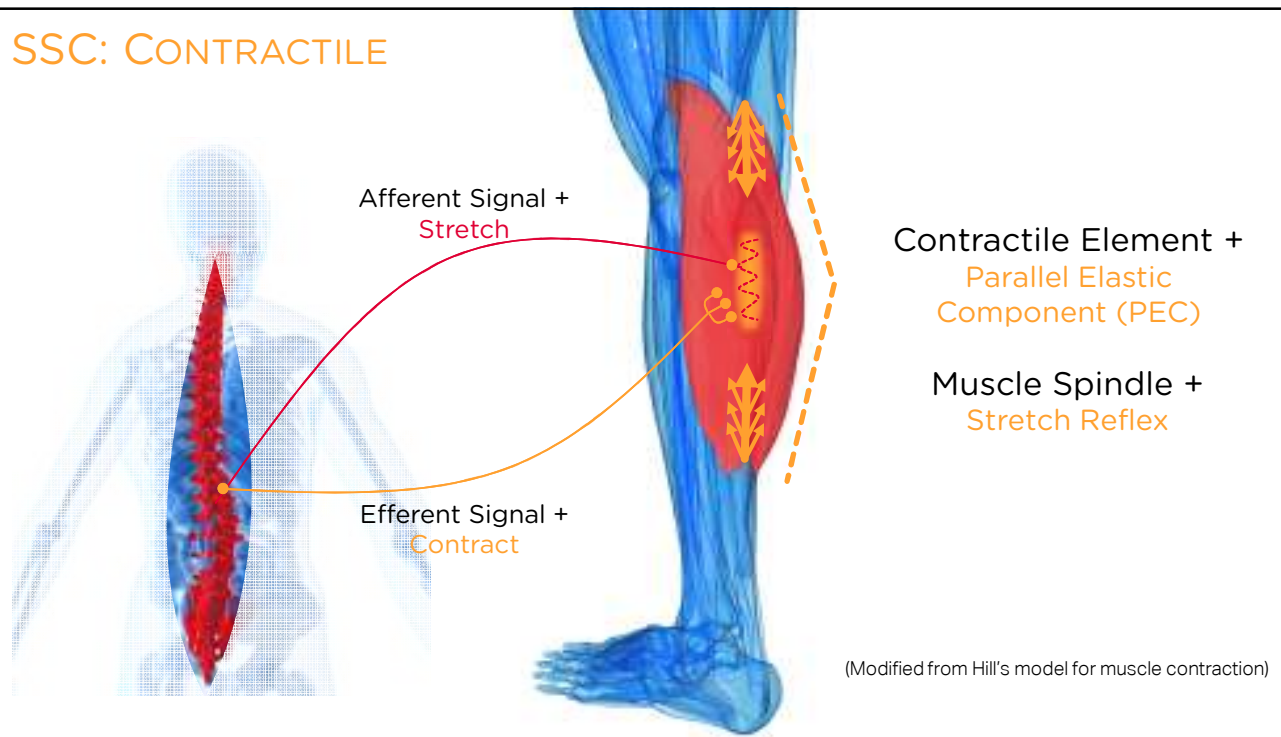
(Blazevich, A., 2011)



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SSC: CONTRACTILE



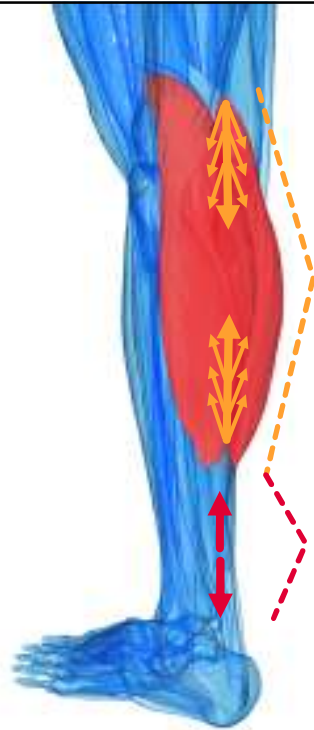
SSC: ELASTIC

Slow SSC >250ms:

- Walking
- Jogging
- CMJ

Fast SSC <250ms:

- Sprinting
- Change of Direction
- DC/Depth Jumps



Contractile Element +
Parallel Elastic
Component (PEC)

Tendon+
Series Elastic Component
(SEC)

(Schmidtbleicher, p. 381-395, 1992)

(Modified from Hill's model for muscle contraction)

INJURY PREVENTION



PLYOMETRICS: SECONDARY GOAL

Decrease risk of injury through increased tolerance to stretch loads at various speeds, loads, and directions

PLYOMETRICS: INJURY PREVENTION BENEFIT

- + Injuries primarily occur during unexpected over-lengthening of muscle/ligaments during landing and deceleration tasks
- + Many of these injuries occur when an athlete finds themselves in a position for which they do not have a robust motor response
- + Plyometrics improve an athlete's ability to handle rapid stretch loads and supports enhanced coordination of movement during reaction and rapid change of direction tasks

(Myer et al., 2008, Turner & Jeffreys, 2010 and Wilson & Flanagan, 2008)

Plyometrics have been shown to improve performance factors while decreasing biomechanical risk factors associated with ACL tears

+ **Design:**

- Females: N=18 (F) underwent 8 weeks of plyometrics training and N=18 (F) acted as a control and did no physical activity

+ **Results:**

- The plyometric group improved hop based performance measures while improving lower limb kinematics during single leg movement



Baldon et al., 2014

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A 2012 Meta-Analysis showed that males and females involved in neuromuscular based ACL prevention programs including plyometrics have a significant reduction in ACL tears (M: 85%; F: 52%)



Sadoghi et al., 2012

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CHECK FOR LEARNING

- + List at least 3 factors that contribute to the performance improvements seen during SSC opposed to non-SSC movement (i.e. NCM Jump vs. CM Jump)
- + Write down 3-5 sentences describing the role of plyometrics in preventing non-contact injuries (ex. ACL injury)¹



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PROGRAMMING

PROGRAMMING CONSIDERATIONS

- + Frequency
- + Volume
- + Intensity
- + Methods



FREQUENCY, VOLUME & INTENSITY

| FREQUENCY | VOLUME | INTENSITY | MOVEMENTS |
|--|---|--|---|
| Weekly: 2x (15-20min) Focus: Speed-Strength | Contacts: 40-60/session Total: ≤ 120 /wk | Sets/Reps: 2-3sets/4-6reps Rest Set/Session: 1-3min/72hrs | Movements: 3-5 Directions: 1-2 Initiations: 2-3 |
| Weekly: 4x (5-15min) Focus: Activation | Contacts: 20-30/session Total: ≤ 120 /wk | Sets/Reps: 1-2sets/4-6reps Rest Set/Session: 1-2min/24hrs | Movements: 2-3 Directions: 1-2 Initiations: 2-3 |

(de Villarreal et al., 2009)

KEY CONSIDERATION



Studies on plyometrics do not factor in total training volume (ex. inclusion of strength and movement skills) and make recommendations solely based on plyometric training

METHODS (EX. JUMP - BOUND - HOP)

| | LINEAR VERTICAL TO HORIZONTAL | LATERAL VERTICAL TO HORIZONTAL | ROTATIONAL VERTICAL TO HORIZONTAL |
|----------------------|---|---|--|
| CONTINUOUS | Lin-Vert Jump Lin-Horiz Bound | Lat-Horiz 45° Bound Lat-Horiz Hurdle Hop | Rot-Vert 180° Jump Rot-Vert 90° Hop |
| DOUBLE CONTACT | Lin-Horiz Hurdle Jump Lin-Horiz Hurdle Hop | Lat-Horiz Bound Lat-Horiz Hurdle Hop | Rot-Vert 270° Jump Rot-Horiz 180° Bound |
| COUNTER-MOVEMENT | Lin-Vert Jump Lin-Horiz Bound | Lat-Horiz 45° Bound Lat-Horiz Hurdle Hop | Rot-Vert 180° Jump Rot-Vert 90° Hop |
| NON COUNTER-MOVEMENT | Lin-Vert Box Jump Lin-Vert Hurdle Hop | Lat-Vert Bound Lat-Vert Hurdle Hop | Rot-Vert 90° Jump Rot-Horiz 90° Bound |

EXAMPLE PROGRAMMING: PLYOMETRICS

PLYOS: Linear Movement Skills

Novice Athlete (4x per week)

Movement 1:

- NCM Lin-Vert Box (12in) Jump
- 2 x 5 repetitions

Movement 2:

- CM Lin-Horiz (12in) Hurdle Jump
- 1 x 5 repetitions

Movement 3:

- CM Lin-Horiz (6in) Hurdle Hop
- 2 x 5 repetitions each

Total Contacts: 25

PLYOS: Multi- Movement Skills

Advanced Athlete (2x per week)

Movement 1:

- CM Lat-Horiz Bound (Quick-Stick)
- 2 x (3x3) repetitions each

Movement 2:

- Continuous Lat-Horiz 45° Bound
- 2 x 5 repetitions each

Movement 3:

- DC Lat-Horiz (12in) Hurdle Hop
- 1 x 5 repetitions each (medial & Lateral)

Total Contacts: 38

GUIDELINES

- + Movement (Jump – Bound – Hop)
 - More Stable to Less Stable
- + Direction (Linear – Lateral - Rotational)
 - General to Specific (Vertical to Horizontal)
- + Initiation (NCM – CM – DC – CONT – DJ)
 - Low Force to High Force (Progression & Continuum)
- + Equipment (Low Box – Ground – Hurdle – High Box)
 - Low Force to High Force

CHECK FOR LEARNING

- + Create a single 10 min plyometric program based on a 4x week intermediate athlete preparing for linear speed sessions
(Note: Only create the plyometric portion and include as much detail on volume and intensity as possible)



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CLOSING

MOVEMENT

- + Movements are selected based on the level of athlete (2-leg to 1-leg) and the specific movement characteristics in need of development (movement skills & sport)



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DIRECTION

- + Movement directions are selected based on the level of athlete (linear to rotational) and the specific directional force characteristics in need of development (movement skills & sport)



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INITIATION

- + Movement initiations are selected based on the level of athlete (NCM to DJ) and the specific speed-strength characteristics in need of development (strength & movement skills)



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APPENDIX

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