Plyometrics

AMP

ATHLETIC MEDICINE
& PERFORMANCE

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KEEPING
ATHLETES
SAFE
HEALTHY
AND DOING
WHAT THEY
LOVE
THRU

SPORTS MEDICINE

EDUCATION

OUTREACH

PERFORMANCE
TRAINING

What are Plyometrics?

- Jump training or plyos
- Exercises in which muscles exert maximum force in short intervals of time, with the goal of increasing power (strength x speed).
- Greek words plyo (increase) and metric (measure)
  - To increase jump height, sprint speed or throwing and/or serving velocities.
- Used for decades by eastern European and Russian athletes, but made famous by Purdue University women's track coach Fred Wilt

- Both lower extremity (LE) and upper extremity (UE) sports use the plyometric concept as part of functional movement patterns and skill when performing the sport.

- Plyometric training utilizes the *stretch-shortening cyc*le (SSC) by using a lengthening movement (eccentric) quickly followed by a shortening movement (concentric)

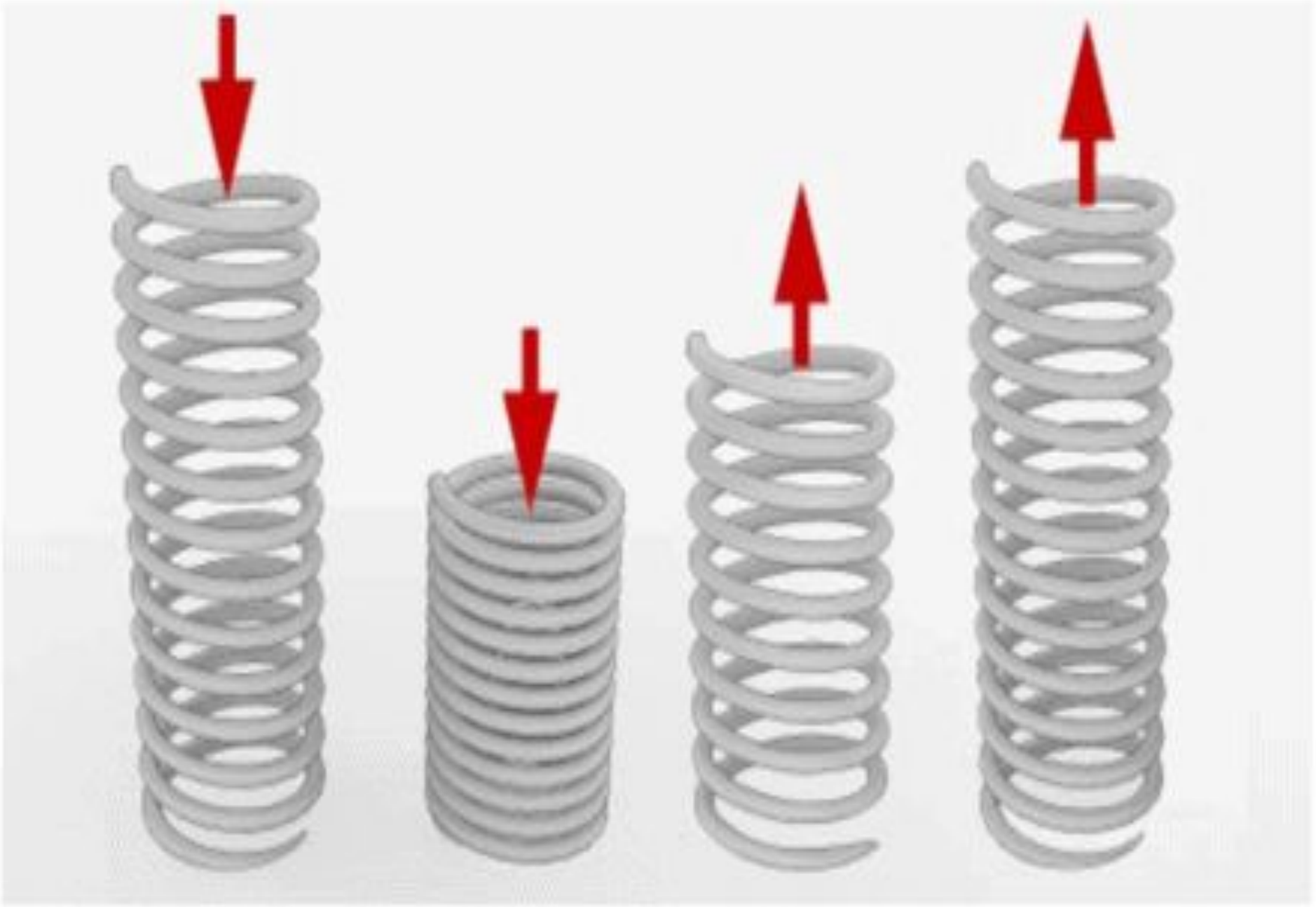
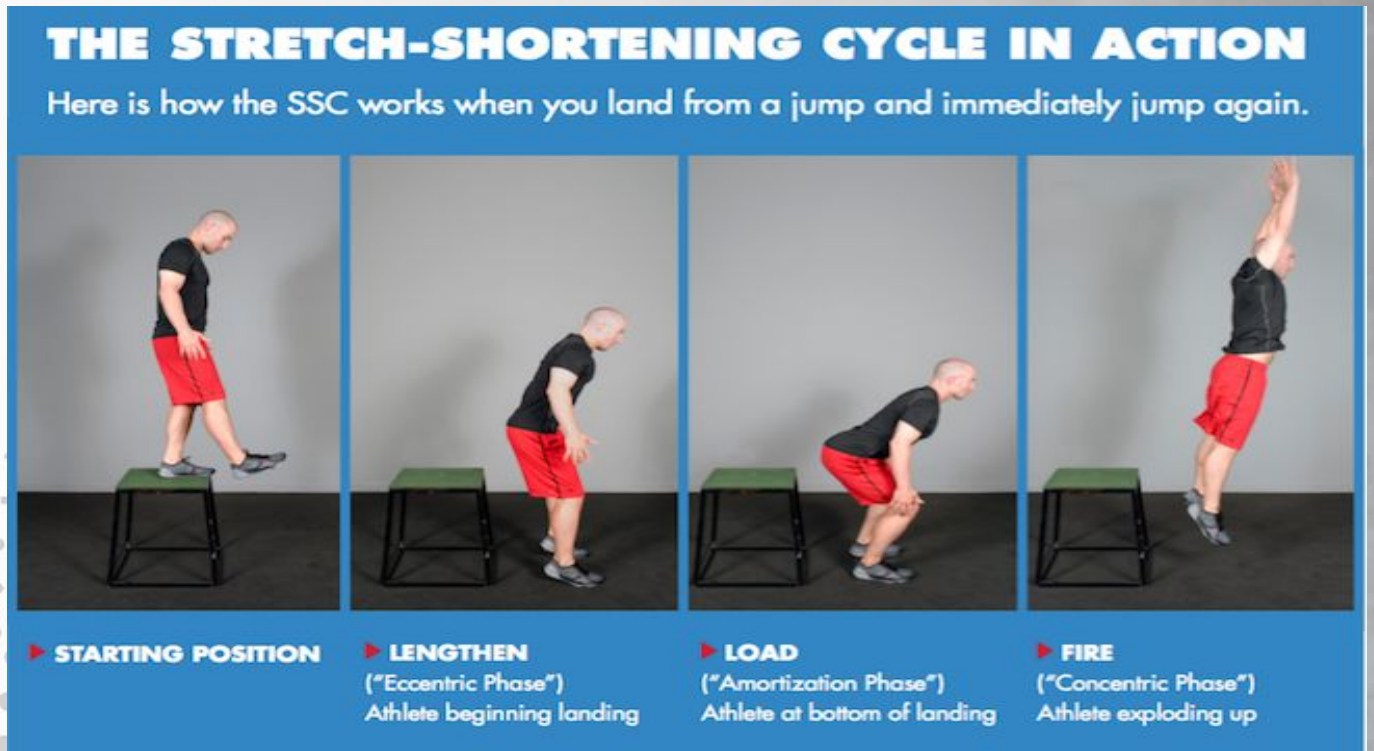


Figure 2. Spring-like mechanism of the SSC.

Phases

- Eccentric (loading)
- Amortization (transition)
- Concentric (unloading)



Eccentric (Pre-stretch)

- Often called the Neurophysiological – biomechanical phase. (layman's term the link and reaction between the brain and the muscles)
- Three stretch variables
  - Magnitude of stretch
  - Rate of stretch
  - Duration of stretch

Amortization (transition)

- The time of stabilization where the muscles move from loading energy to releasing it.
  - Key to performance of plyometrics
  - Shorter this phase the more powerful the plyometric movement
  - Goal is to shorten this phase

Concentric (shortening)

- Resultant power production performance phase (layman's using the stored energy in the elastic properties of the tendon and muscles coupled with the power generated by the shortening of the muscles to produce a greater outcome)

Why Plyometrics?

- Benefits include
  - Increased vertical jump
  - Increased running speed
  - Strength
  - Longer jumps
  - Injury prevention
  - Fun?

When Plyometrics?

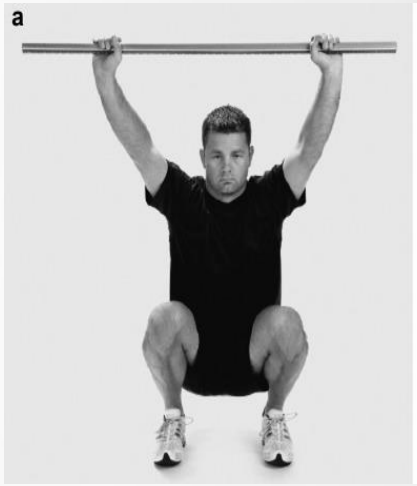
- Old rule was when the person can squat 1.5 x their own body weight.
- Have good balance
- Sufficient “core” strength
- Have adequate joint ROM and stability
- Transition from weight lifting to more athletic tasks
- Following injury to ease back into sport moves

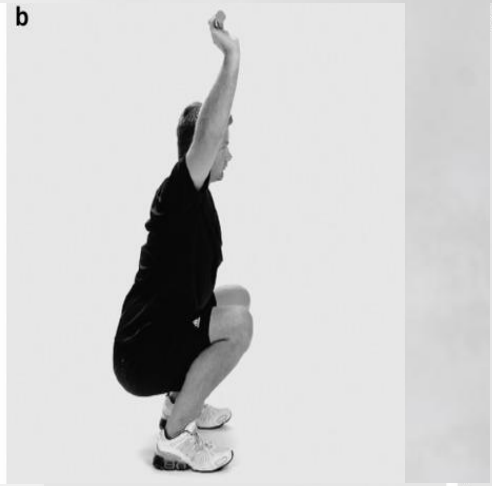
Suggested testing algorithm for preparation for plyometric training

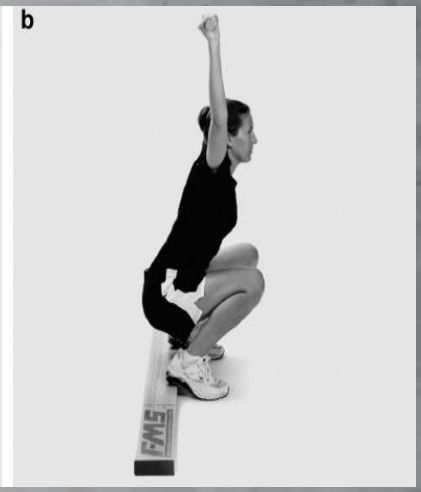
from: Current concepts of Plyometrics

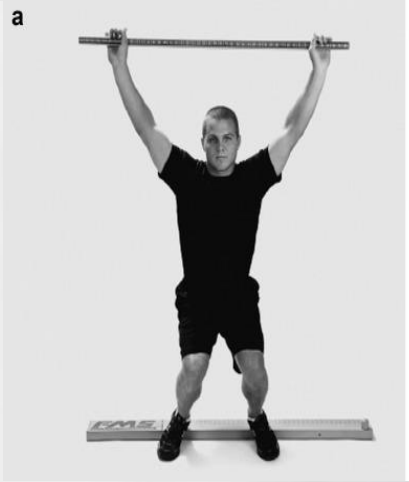
Tests & Methods	Specific criteria
Pain	None in lower extremities
ROM	Full ROM of all joints
Swelling	None
Balance-Eyes open	30 seconds
Balance-Eyes closed	30 seconds
Muscle strength	20% bilateral comparison
Muscle endurance	20% bilateral comparison
Neuromuscular control	Qualitatively good movement patterns with no compensations
Single-leg half squat	No pain and good qualitative movement patterns
Free weight squat: 1.5 to 2.5 times body mass	No pain and good qualitative movement patterns
Squat 60% of body mass 5 times within 5 seconds	No pain and good qualitative movement patterns
Lower level plyometric drills	No pain and good qualitative movement patterns

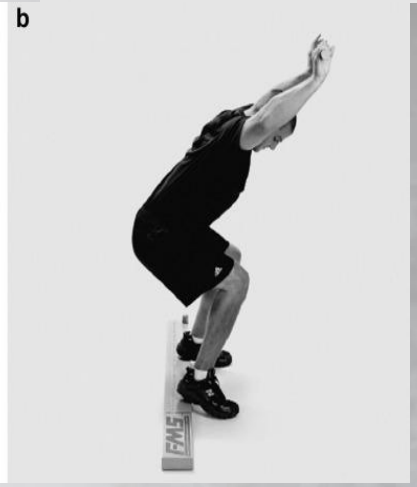
Functional Movement Screen (squat test)



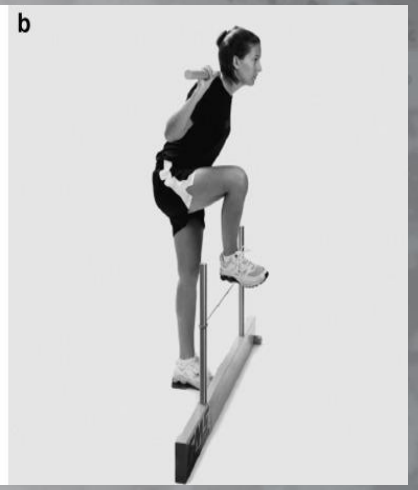




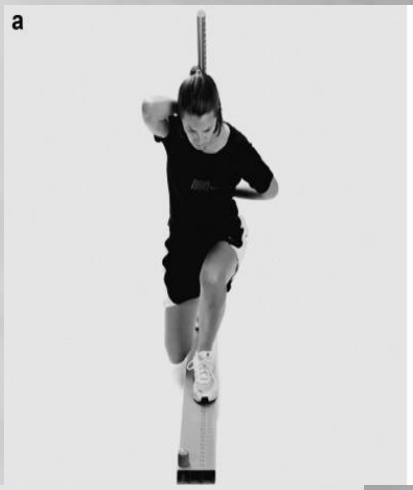


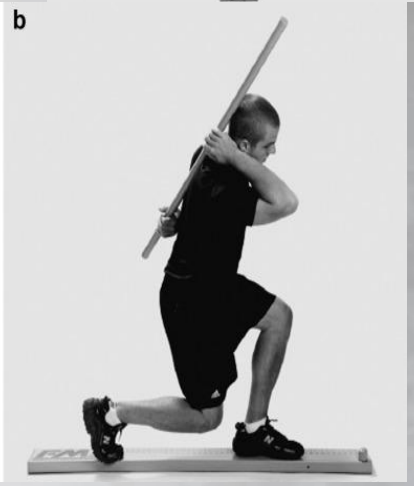


Functional Movement Screen (Hurdle test)



Functional Movement Screen (Lunge test)



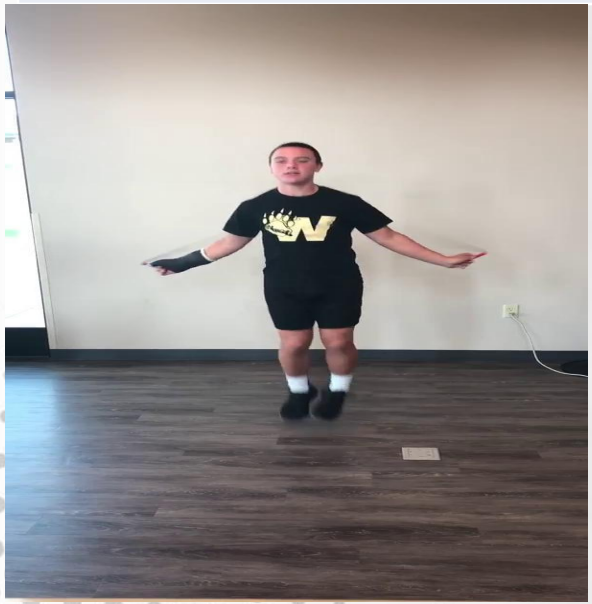


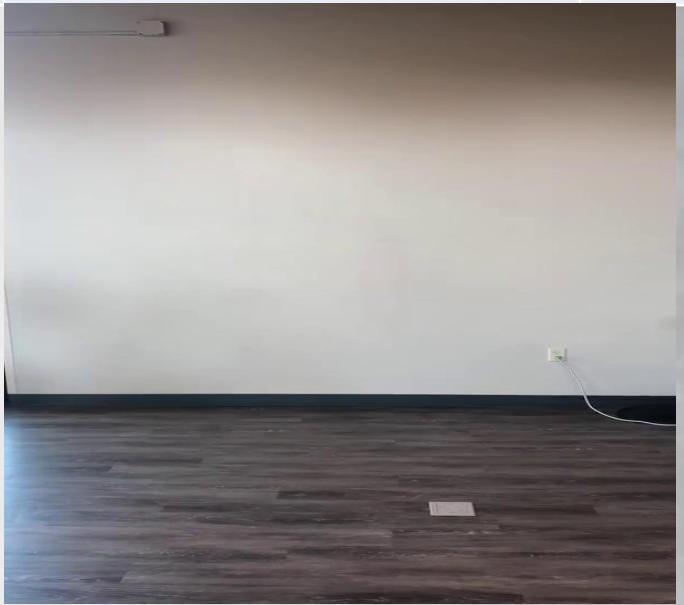
Plyometric preparation & progression

- Phase 1 Movement and Coordination
- Phase 2 Landing and Force Absorption
- Phase 3 Plyometric Strength
- Phase 4 Plyometric Power

Phase 1

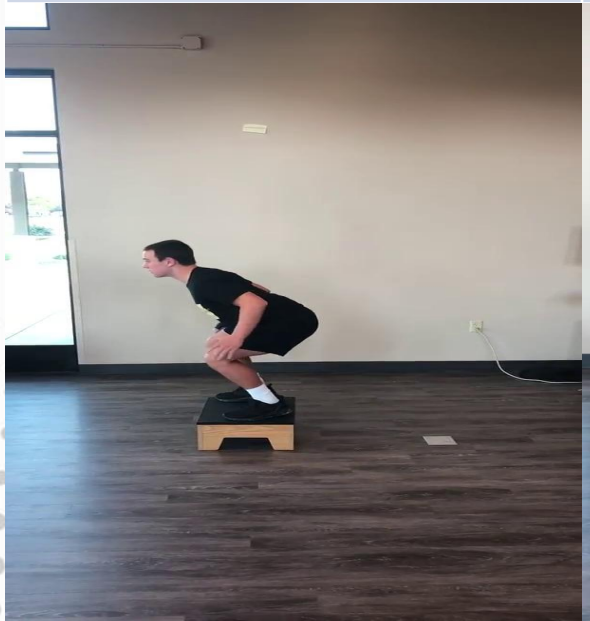
Examples	Focus	Characteristics
General Play	Self Directed	Low impact
Jumping	Unstructured	Challenge Neuromuscular system
Skipping	Coordination	Repetition
Jumping Rope	Fun	Intro into force reduction and production





Phase 2

Example	Focus	Characteristics
Box Jump	Structure	Low and Slow
Depth Drop	Landing Technique	Low level eccentric
Squat Jump	Force Absorption	Slow eccentric
Counter Movement Jump	Neuromuscular efficiency	Slower contraction times
Broad jump Hop and Stick Dynamic calf raise	Rate of force development Repetition Quality	Slower RFD Sub Maximal Large ROM



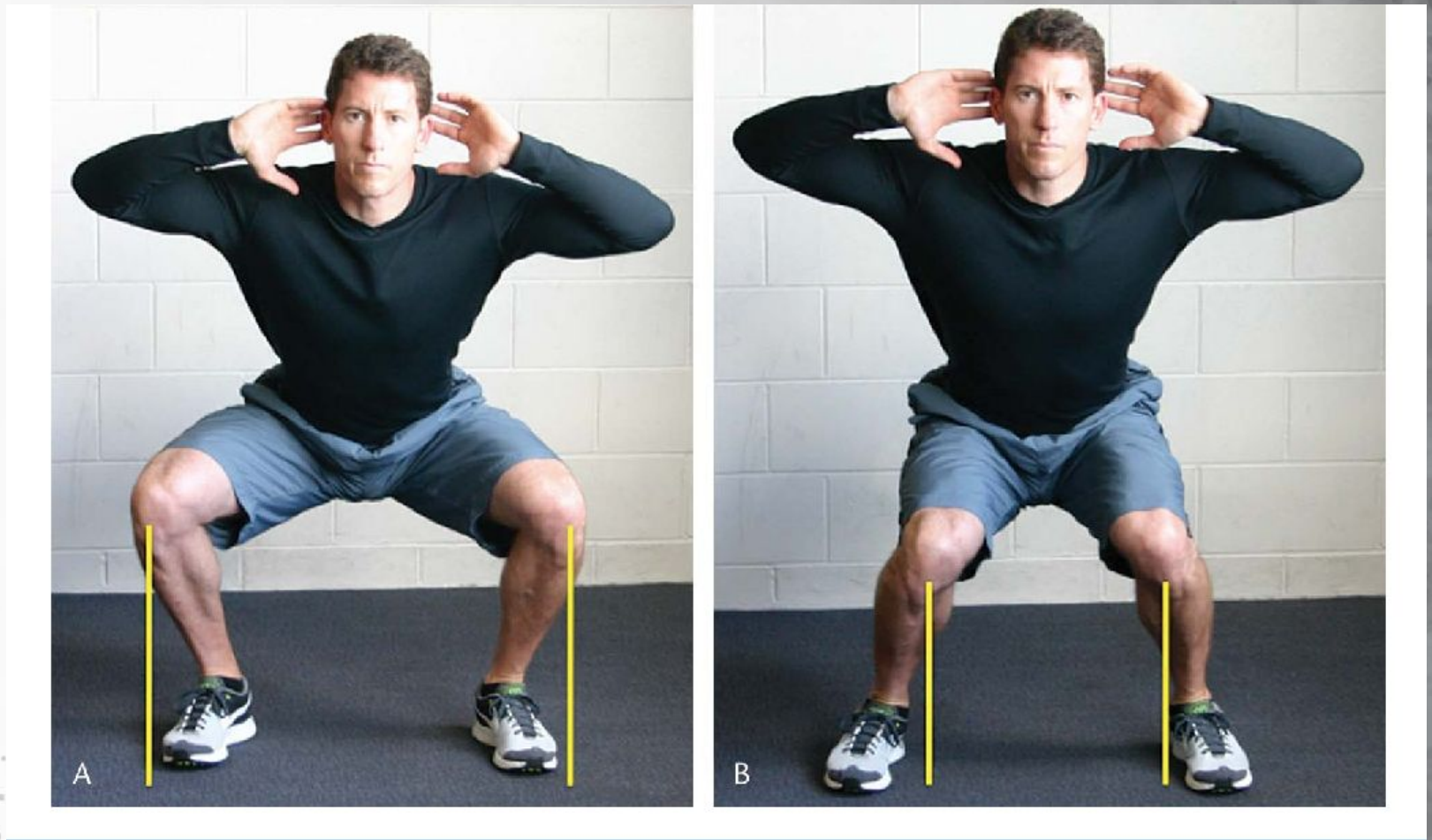
Teaching Proper Plyometric technique

- Stage I
  - Teach good hip hinge and spinal orientation
- Stage II
  - Introduce dynamic movement hip hinge triple ext. and arm swings
- Stage III
  - In place jumps focus on landing technique
- Stage IV
  - Introduce multiple jumps using ladder

Hip Hinge

Triple Extension

Watch The Knees



Overload Principles

- Neuromuscular Overload
- Spatial Overload
- Temporal Overload

Neuromuscular Overload (applied loads and distances)

- As the various specific drills and activities continue to place a greater demand on the contractile properties of the musculature, the body begins to adapt specifically to these increased demands.

Spatial Overload

- Movements can have the effects of overload from standpoint of ROM.

Temporal Overload

- Can be accomplished by concentrating on executing the movements rapidly and as intensely as possible.

My Suggestions

- Think of where the athlete needs to be
  - Are you looking to improve their jump height velocity?
- Where is the athlete starting at?
  - Where is their baseline and how much gain do they need?
- When do you need them to be at their peak ability?
  - Weeks, months, years
- When will be your milestone or testing intervals?

- 14 yo F Volleyball player
- You would like her to be able to achieve a 20” vertical so she can spike and block with better outcomes.
- You tested her current vertical jump at 16”
- The month is February and you currently have 7 months until next season
- You decide to re –test her vertical every month

Phase 3

Example	Focus	Characteristics
Squat Jumps	Structure	High Force
Continuous Jumps	Technique	High ROM SSC
Hops	Force generation	Low Rate SSC
Small Hurdle Jumps	Stretch Shortening Cycle	Quicker RFD
Alternating Split Jumps Pogos	RFD NM efficiency Quality	Shorter contact times Close to maximal effort Moderate to large ROM Less stiffness

NASM Optimum Performance Training ™ (OPT™) model

Plyometric exercises progress from stabilization (e.g., squat jump with a 3-5 second stabilization hold on landing), to strength (e.g., tuck jump), then to power (integrated, functional movements performed at a quick tempo such as ice skaters).

Developing your program

- Beginners
  - Low intensity
  - Foot contact (or throw) 60-100 per session
  - Examples jumps in place, standing jumps
- Intermediate
  - Moderate intensity
  - 100-150 foot contact (or throw)
  - Examples multiple jumps and bounds
- Advanced
  - High intensity
  - 150-200+ foot contacts (or throw)
  - Examples box drills and depth jumps

Training Variables

- Intensity
- Volume
- Frequency
- Recovery

Intensity

- Actual percentage of effort required by athlete to perform the activity.
  - double leg to single leg
  - height of box or hurdle
  - using a metronome to increase cadence

Intensity of Various Plyometric Exercises	
Exercise Type	**Intensity**
Depth jumps 32-48in (80-120cm)	High
Bounding Exercises	Submaximum
Depth jumps 8-20in (20-50cm)	Moderate
Low impact jumps/throws	Low

Volume

- Total work performed in a single work session or cycle.
  - Height of box + number of foot contacts = Volume (session or week)
  - Double leg or single leg + number of foot contacts = Volume (session or week)
  - Cadence speed and foot contacts = Volume (session or week)

Plyometric Volume Per Session	
Experience	**Ground Contacts**
Beginner	80 - 100
Intermediate	100 - 120
Advanced	120 - 140

Frequency

- Number of exercise sessions that take place during the training or Rehabilitation cycle.
  - 2 x week for 12 weeks

Recovery

- The rest time between your exercise bouts
- Allow 1:5 work to rest ratio (ex. 10 sec work / 50 sec rest)
- Cincinnati protocol:
  - no muscle soreness before workout then increase volume 10%.
  - If soreness resolves with warm up then intensity and volume stays the same.
  - If soreness does not resolve with warm up then decrease intensity and volume.

Phase 4

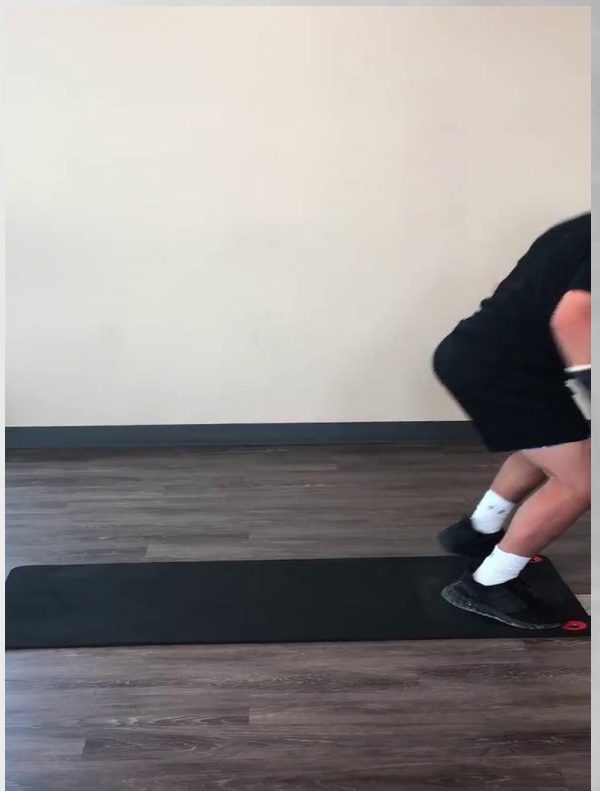
Examples	Focus	Characteristics
Drop Jumps	Structure	High Eccentric force
High Hurdle Jumps	Stiffness	Low ROM SSC
Rebound Jumps	RFD	High rate SSC
Bounding	Quick ground contact	Sport specific ROM
Distance Hop Pogos	Quality Intensity	Rapid contact times Maximal effort High Stiffness Quick RFD

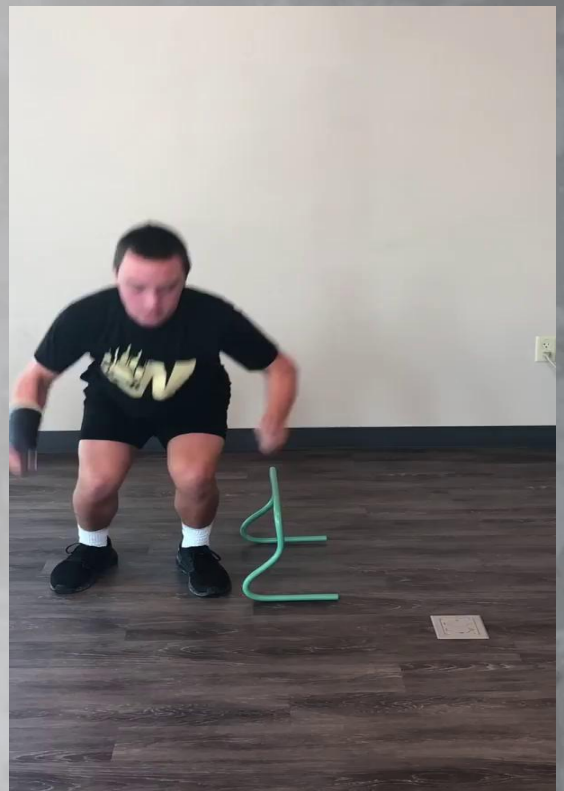
Types of Jumps

- Jump in place involve jumping and landing in same spot.
- Examples ankle jumps and squat jumps

Types of Jumps

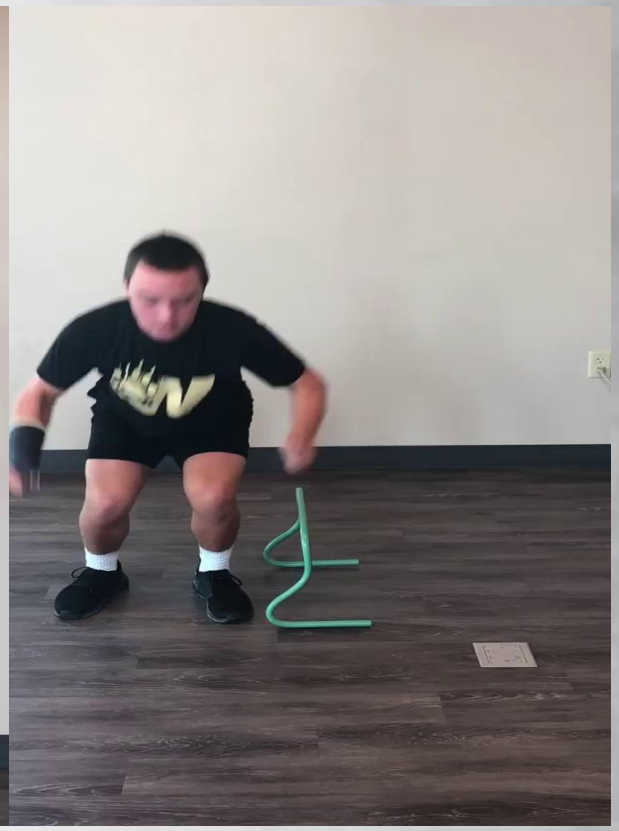
- Standing jumps involve jumping in a horizontal, vertical or lateral direction.
- Example jumping over a hurdle or barrier with maximum effort while allowing recovery between jumps





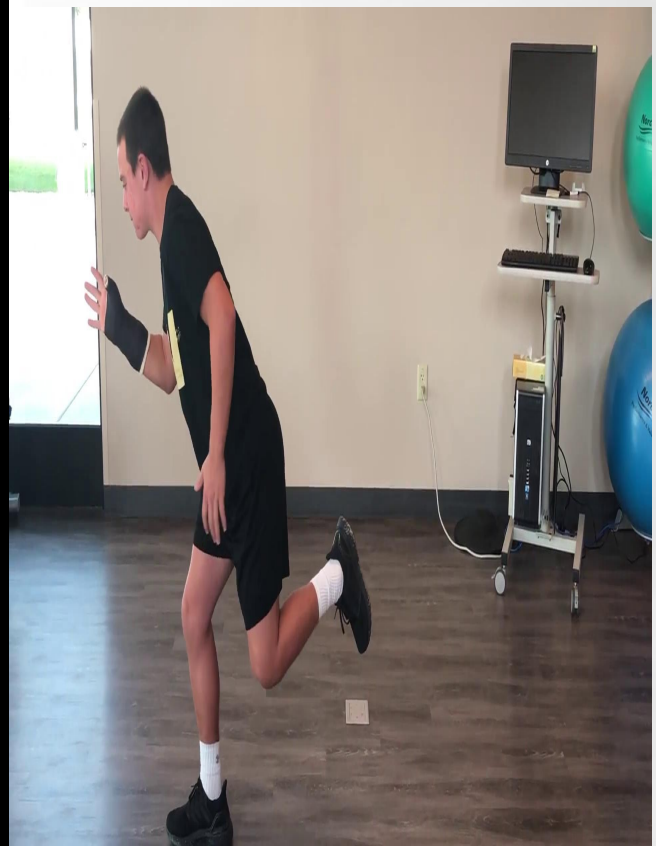
Types of Jumps

- Multiple jumps or hops are just that repeated jumps.
- Examples would be jumping or hopping over a hurdle or barrier in a direction multiple times



Types of Jumps

- Bounds are an exaggerated running or jumping motion in a forward or backward direction.
- Example is a long jump

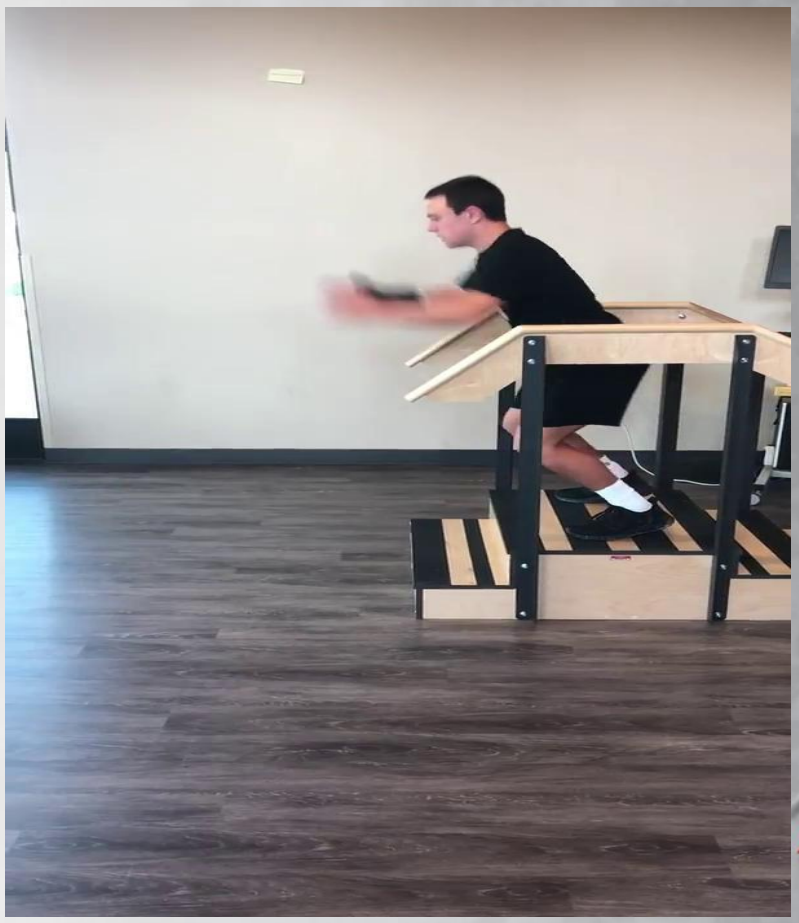


Types of Jumps

- Box Drills include jumping onto or off of a box varying in height from 6” and up with common being 18”, 24” and 42 “ boxes

Types of Jumps

- Depth Jumps involve stepping off a box height and following up with a horizontal or vertical jump or even a sprint.



Ballistic 6


I. Starting Point
Eccentric Phase
Concentric Phase
II. Starting Point
Eccentric Phase
Concentric Phase
III. Starting Point
Eccentric Phase
Concentric Phase
IV. Starting Point
Eccentric Phase
Concentric Phase
V. Starting Point
Eccentric Phase
Concentric Phase
VI. Starting Point
Eccentric Phase
Concentric Phase
I. Elastic External Rotation
II. Elastic 90/90 External Rotation
III. Overhead Soccer Throw
IV. 90/90 External Rotation Side-throw
V. Deceleration Baseball Throw
VI. Baseball Throw

Plyometrics is an effective way of getting your athletes to improve on their performance

While it can’t replace the need to increase strength, it can bridge the gap between the weight room and the functional performance of their sport.

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Questions