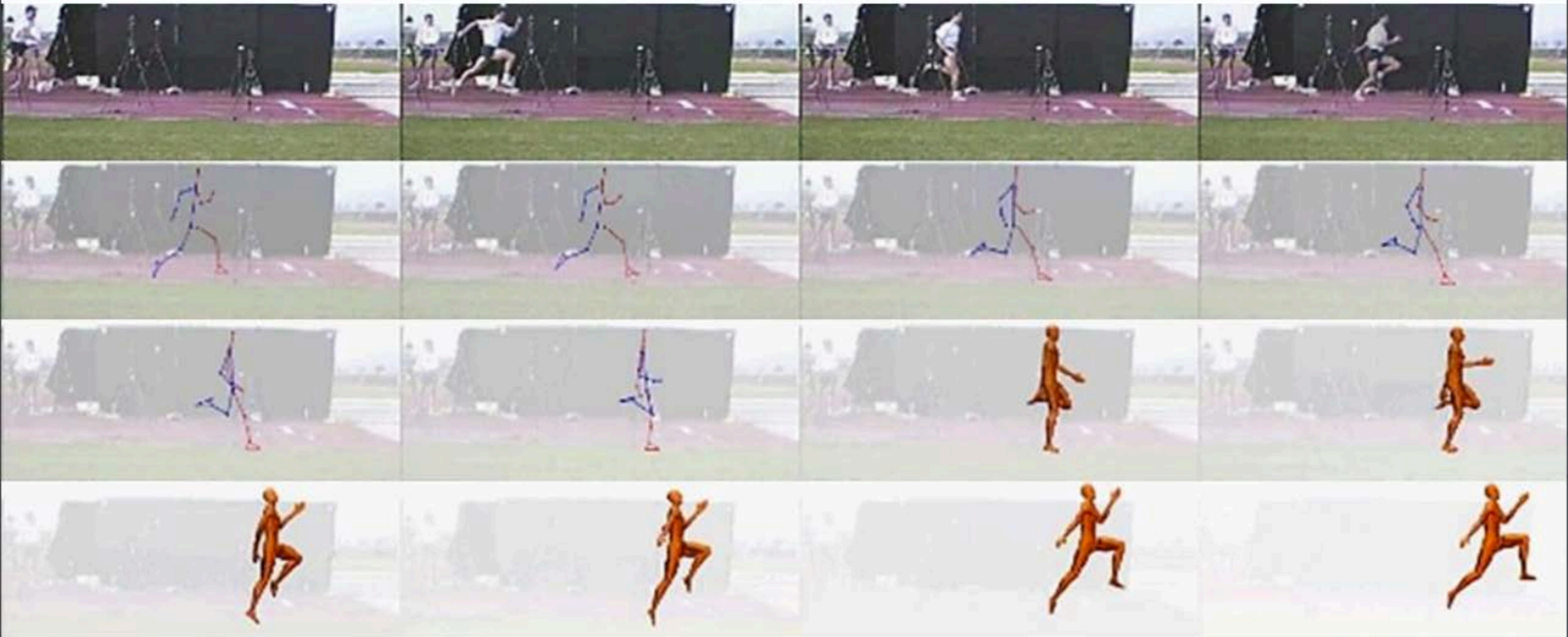


Factors that Affect Performance in the Horizontal Jumps

Jill L. McNitt-Gray, PhD, Professor, University of Southern California

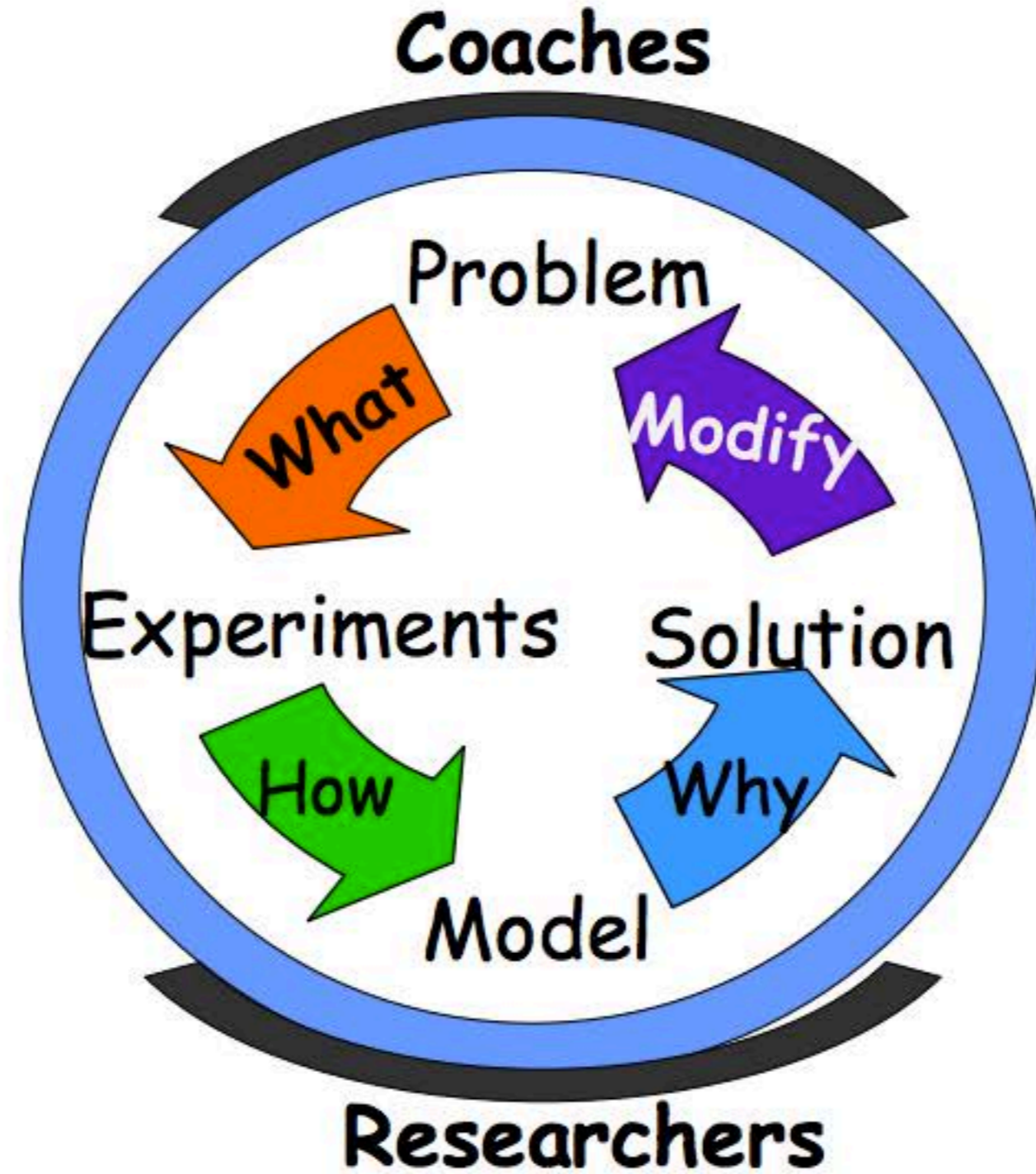
Melvin Ramey, PhD, Professor Emeritus, University of California, Davis

Christopher Ramos, University of Southern California





How do we improve the performance of individual athletes?



Horizontal Jumps: Series of Phases

Mechanical Objective:
Horizontally accelerate

↑ Horizontal velocity
More upright

Maintain Posture
Maintain Horizontal Velocity
Generate Vertical Velocity
Take-off behind board

CM $v_h = 0$

$v_h = \text{target}$

v_h

v_v
 v_h

First six

Middle six

Last six

Flight

Land

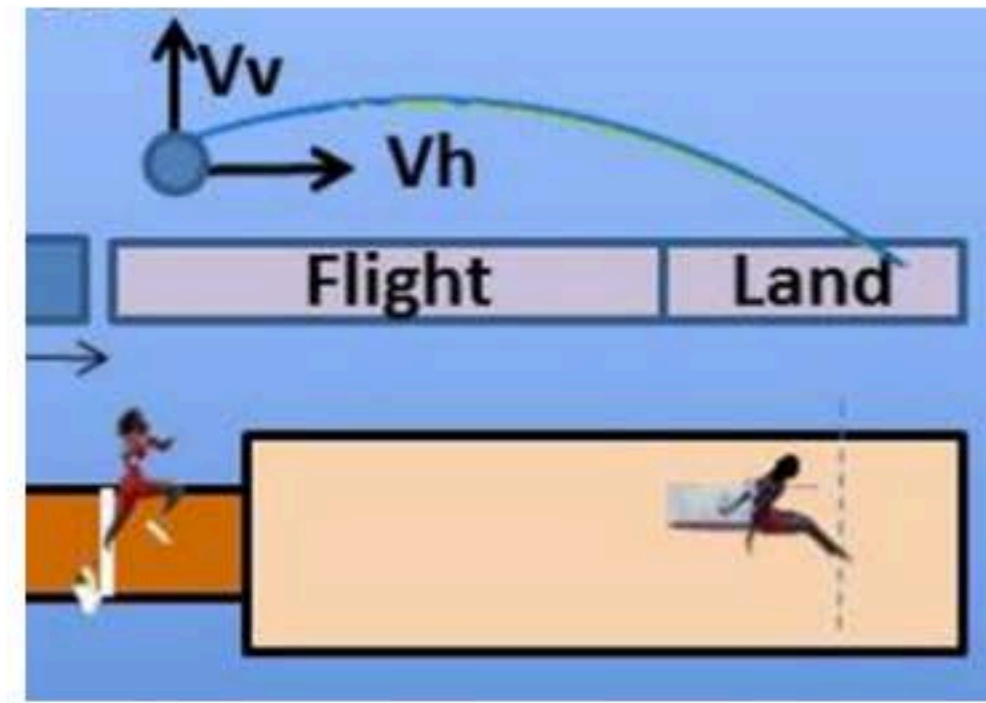


4 steps out
Prepare
Take-off

Performance
outcome measured in
Olympic competition

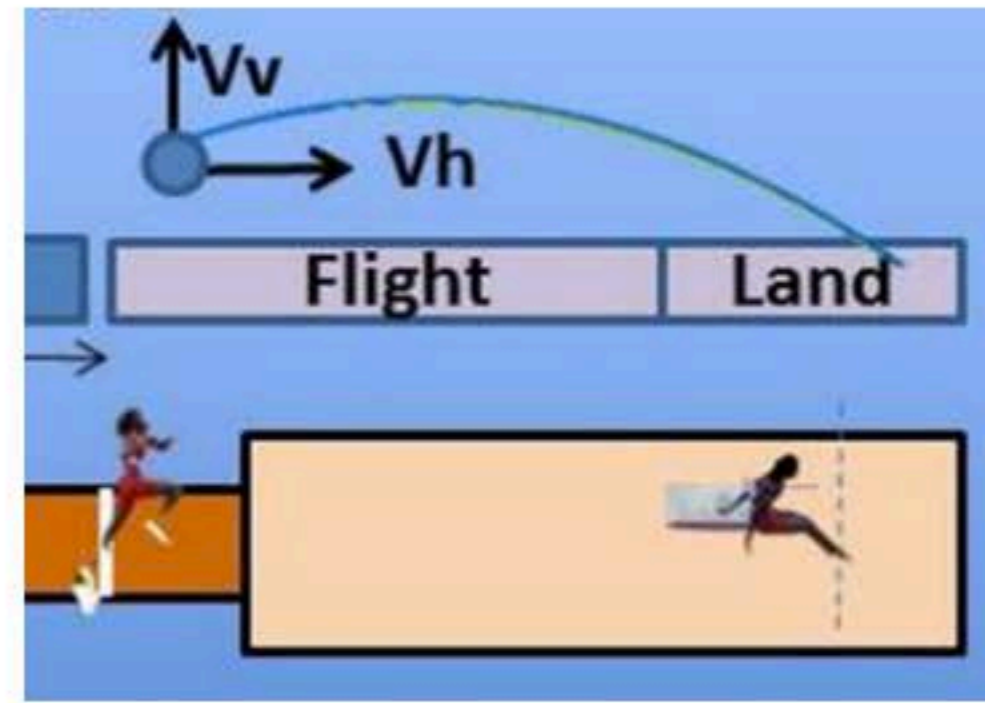
The output of one phase becomes the input of the next phase

Landing Phase: *maximize distance*



Flight Phase: *control of body during flight*

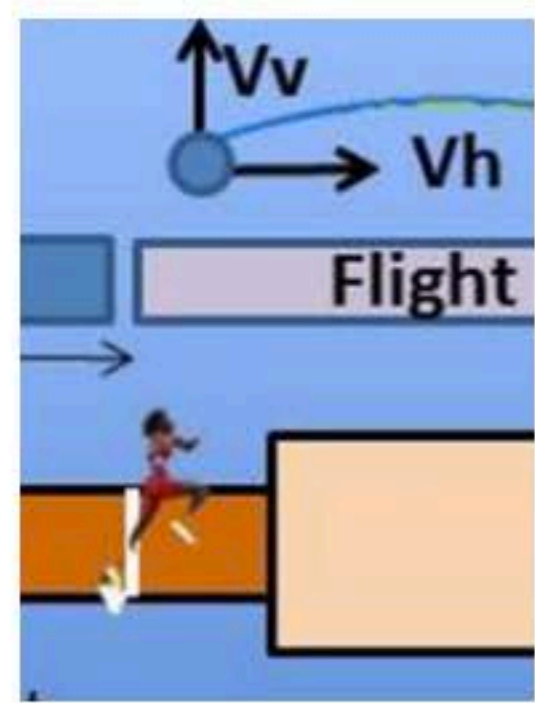
For Coaches: Cause-effect concepts (“why”)



For Athletes: Mechanical Objective (“what is the goal?”)

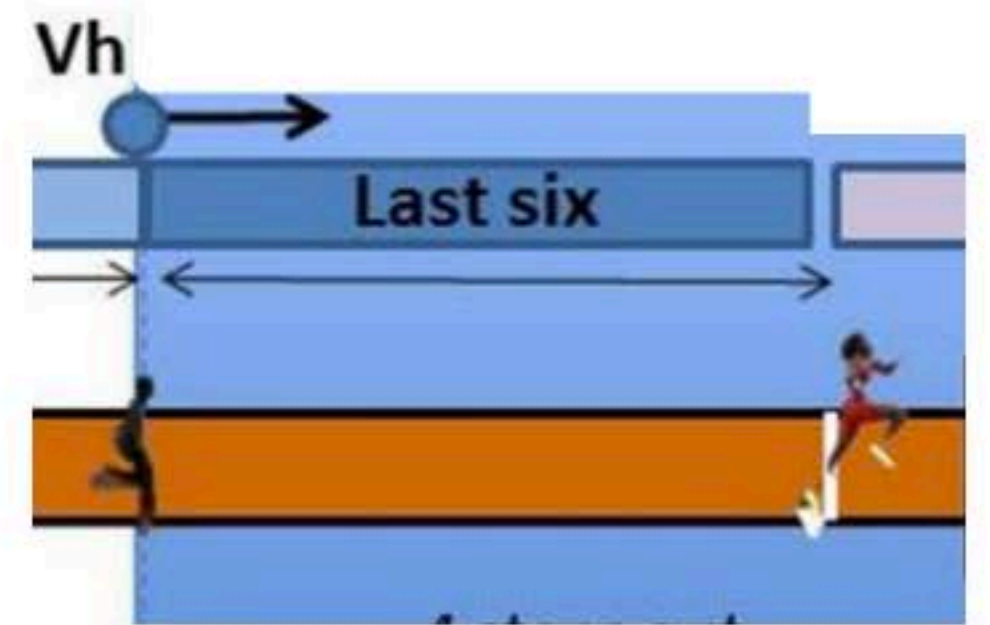
Take-off Phase: *generate vertical velocity*
maintain horizontal velocity

For Coaches: Cause-effect concepts (“why”)



For Athletes: Mechanical Objective (“what is the goal?”)

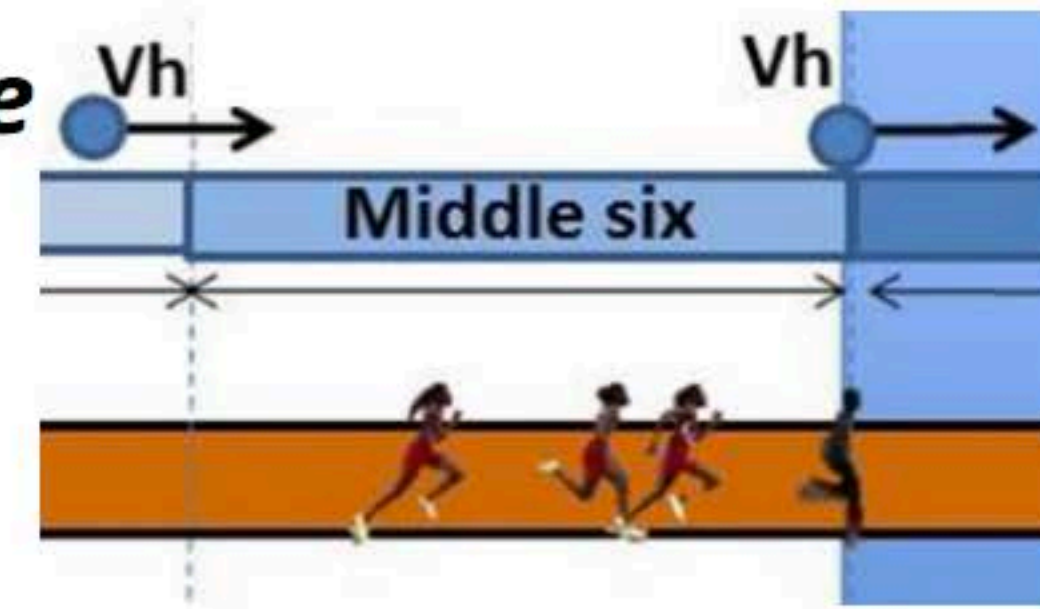
Jump Preparation: *maintain horizontal velocity*



For Coaches: Cause-effect concepts (“why”)

For Athletes: Mechanical Objective (“what is the goal?”)

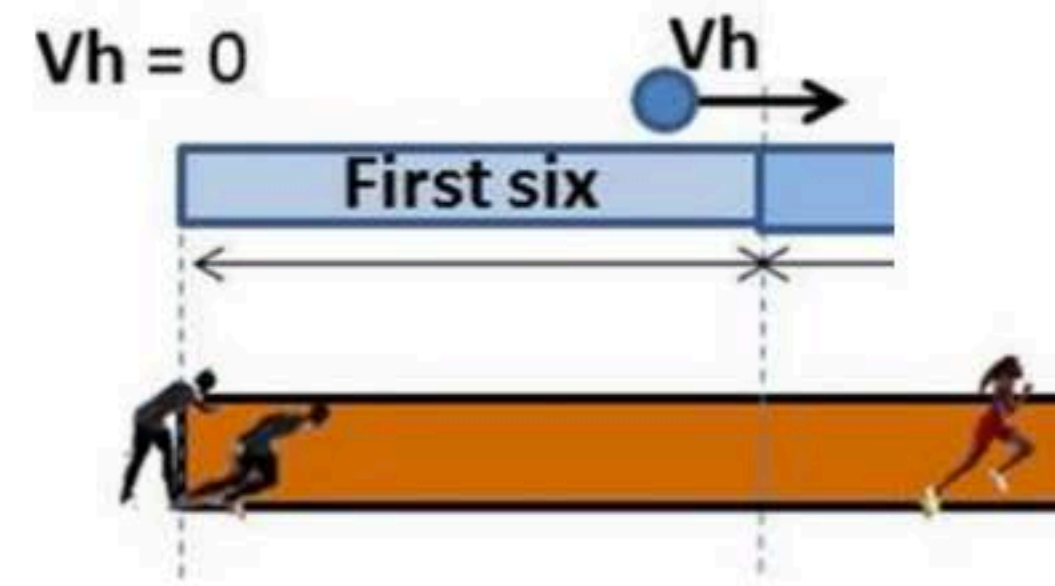
Run-up: *consistent position relative to scratch line*
controllable horizontal velocity



For Coaches: Cause-effect concepts (“why”)

For Athletes: Mechanical Objective (“what is the goal?”)

Acceleration Phase: *generate horizontal velocity*



For Coaches: Cause-effect concepts (“why”)

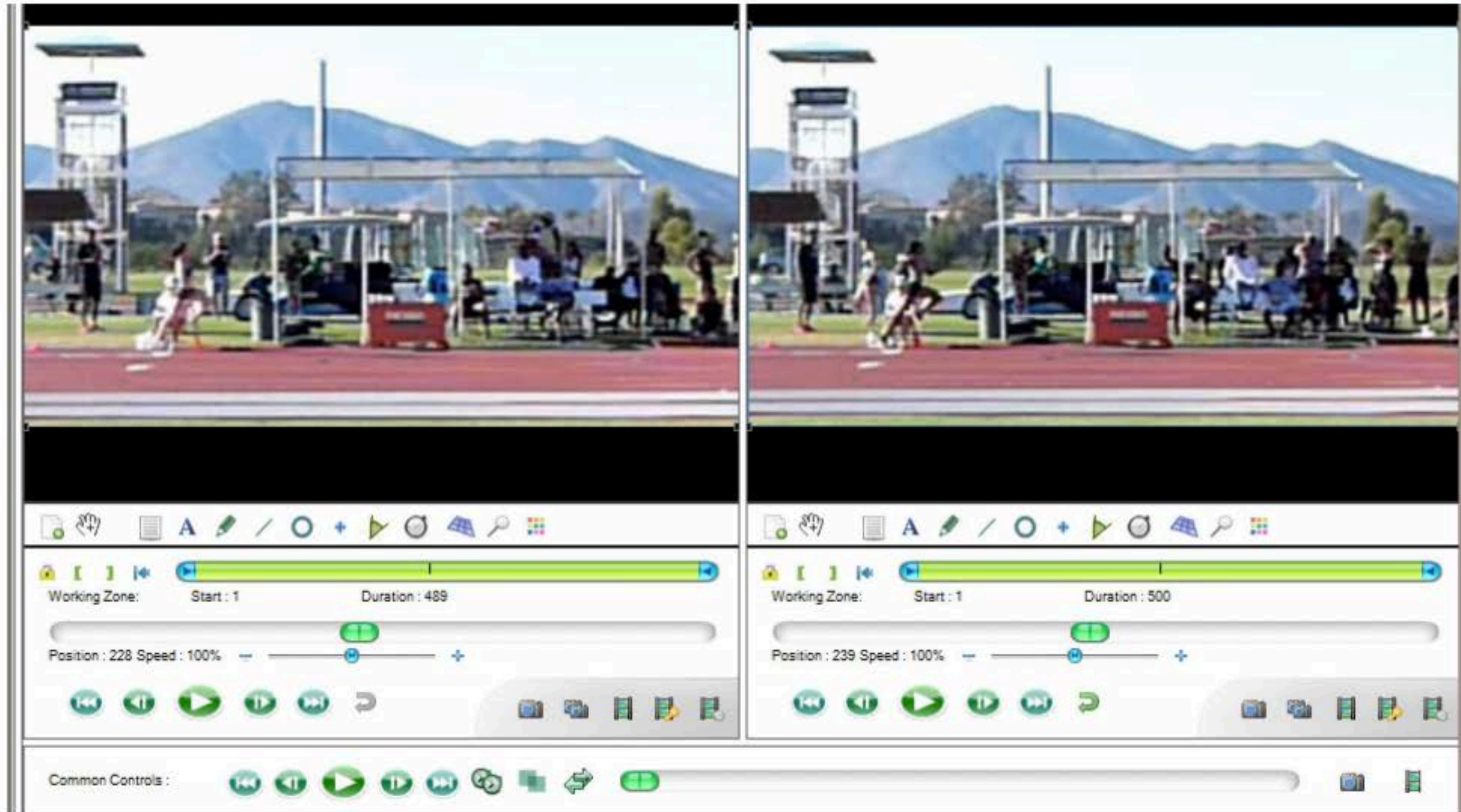
For Athletes: Mechanical Objective (“what is the goal?”)

Factors that affect force generation during contact

Factors that affect control of body trajectory during flight

Tools for Coaches: to *understand cause effect and evaluate outcomes*

PC Users: Kinovea (free) <http://www.kinovea.org/>



Tools for Coaches: to *understand cause effect and evaluate outcomes*

Flight Phase Analysis: Projectile Motion Analyzer <https://dornsife.usc.edu/labs/biomech/best-practices/>

Input: Take-off Horizontal (V_x) & Vertical Velocity (V_y)

Output: Flight Trajectory of Center of Mass

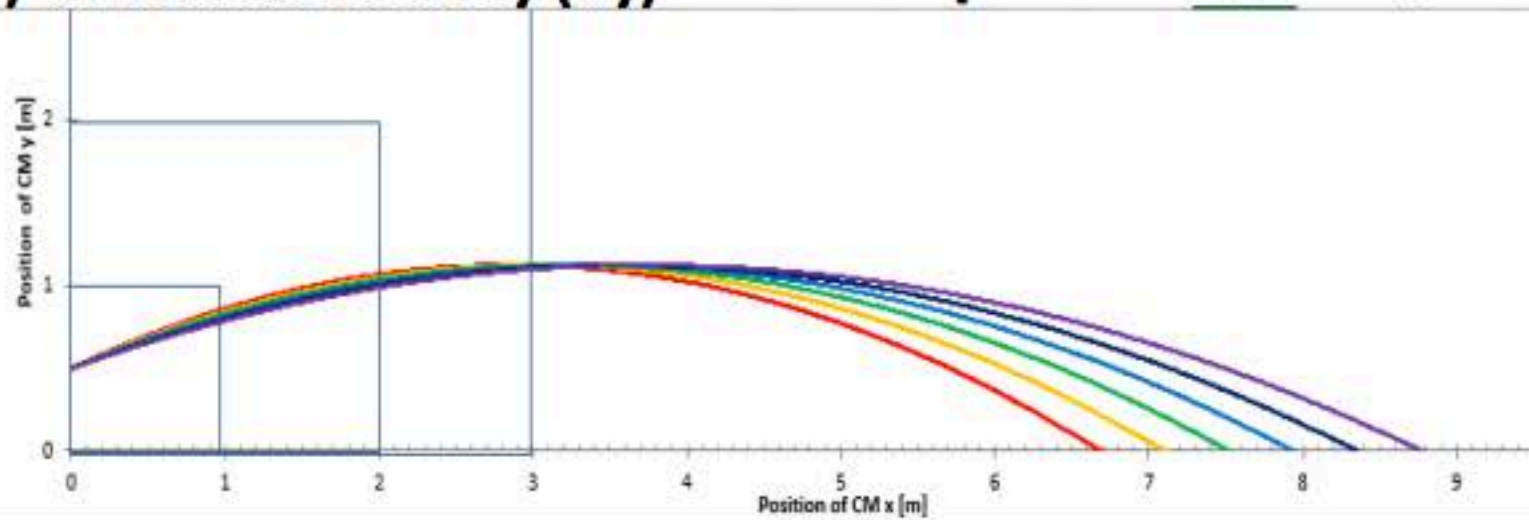
0.355686

TRIAL 2		Pos. X	Pos. Y
TimeStep =	0.001 s	7.157	-0.030
Target Distance (X) =	8.50 m	<	>
Change in CM _y =	0.50 m	TIME: 0.842	
Initial V _x =	8.50 m/s		
Initial V _y =	3.50 m/s		
Launch Angle =	22.38 deg		
Initial Velocity =	9.19 m/s		
PREDICTED Displacement:	7.10 m		

TRIAL 3		Pos. X	Pos. Y
TimeStep =	0.001 s	7.272	0.126
Target Distance (X) =	8.50 m	<	>
Change in CM _y =	0.50 m	TIME: 0.808	
Initial V _x =	9.00 m/s		
Initial V _y =	3.50 m/s		
Launch Angle =	21.25 deg		
Initial Velocity =	9.66 m/s		
PREDICTED Displacement:	7.52 m		

TRIAL 4		Pos. X	Pos. Y
TimeStep =	0.001 s	7.999	-0.030
Target Distance (X) =	8.50 m	<	>
Change in CM _y =	0.50 m	TIME: 0.842	
Initial V _x =	9.50 m/s		
Initial V _y =	3.50 m/s		
Launch Angle =	20.22 deg		
Initial Velocity =	10.12 m/s		
PREDICTED Displacement:	7.94 m		

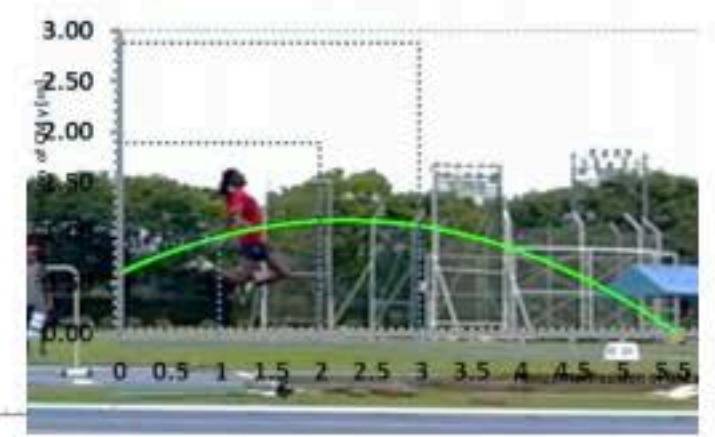
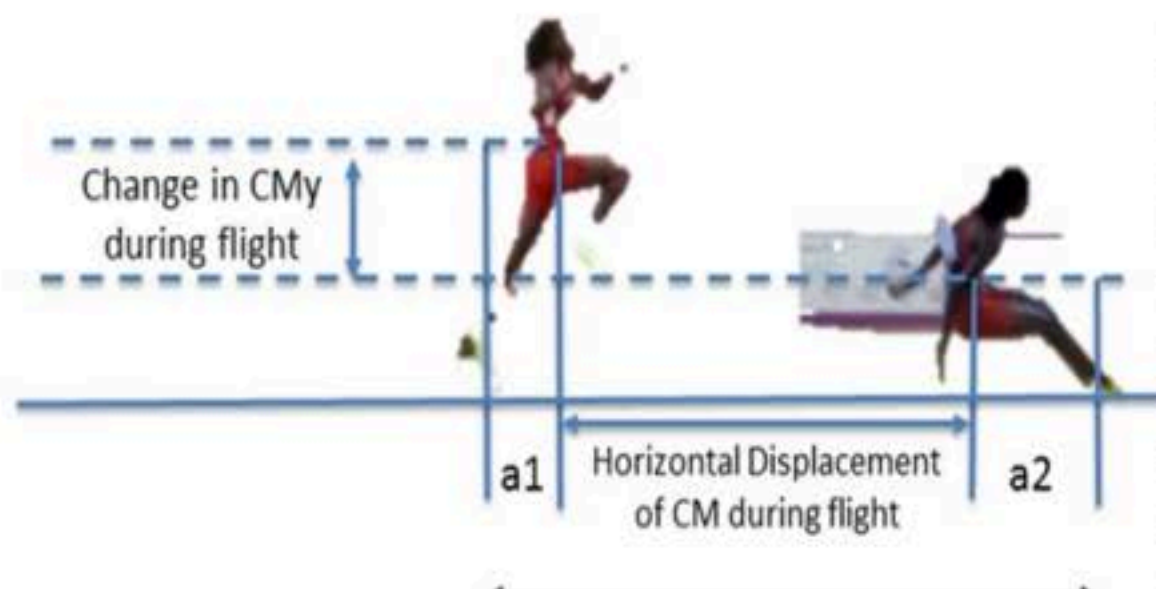
TRIAL 5		Pos. X	Pos. Y
TimeStep =	0.001 s	6.920	0.573
Target Distance (X) =	8.50 m	<	>
Change in CM _y =	0.50 m	TIME: 0.692	
Initial V _x =	10.00 m/s		
Initial V _y =	3.50 m/s		
Launch Angle =	16.50 deg		
Initial Velocity =	10.50 m/s		
PREDICTED Displacement:	6.92 m		



Plot of CM trajectory during flight

To estimate Jump Distance measured in competition:
 add horizontal position of CM in front of board at departure (last contact with board) = a1
 add horizontal position of CM behind feet at time of contact with sand (initial contact with sand)= a2

Measured jump distance = horizontal displacement of CM during flight + a1 + a2



Evaluation:

Areas of Excellence: Runway Management? Contact Phase Control? Conversion? *Jump at Speed?* Flight Phase Control?

Areas of Needing Improvement:

Daily Dozen (Pre-habilitation/movement integrity)?
Core stability: (strengthen/fatigue resistance/abs on!)
Joint Control: through out range of motion?

Jump at Speed?
Positions/Configurations?
Transitions (error)?

Body Preparation Progression:

Capabilities

Movement Skills

Jump Skills

Progression: Challenge/Recovery

Other?

Prepare to compete

Little things done well add up

**Every foot contact is an opportunity
to speed up, slow down, or maintain speed**

**Personalized Plans for Improvement:
More than one way to improve jump**

Clarity of purpose
What is the goal of this phase?

You get what you practice

Simplify!: *Develop an engaged CORE*

Balance:

Challenge with Recovery

Develop a team around the team:
*Sleep, Refueling, Mindfulness, Physical Preparation
Motor Control, Biomechanics, Sports Medicine*