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## Biomechanical analysis of long jump: the hitch Kick

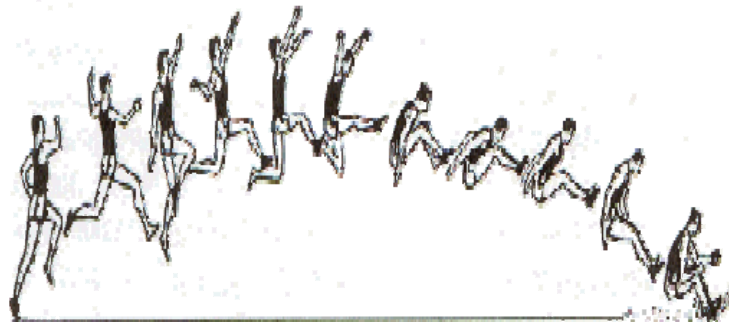
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### Introduction

Long Jump is an athletic (track and field) event where athletes combine *speed*, *strength*, and *agility* in attempt to land as far from the take-off point as possible. The Long Jump consist of four phases: Approach, Take-off (TO), Flight and Landing.

### The Hitch Kick



Preparatory Phase	Execution Phase	Follow Through
✓ Approach-Run	✓ Action in the air	✓ Landing
✓ TAKE-OFF		

**Phase I Approach:** The objective of the approach is to gradually accelerate to a maximum controlled speed at takeoff. The greater the velocity, or speed, at takeoff, the higher and longer the trajectory of the center of mass will be. The importance of a higher velocity at takeoff is a major factor in the success rate for many sprinters in this event.

**Objective of Approach Run:** To gradually accelerate to a maximum controlled speed at take off while conserving as much speed as possible.

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### The Approach-Run of Long Jump

Phase- I	Objectives	Movement Features	Law and Principle	Critical Features	Remarks
Approach Run	To gradually accelerate to a maximum controlled speed at take-off while conserving as much speed as possible.	Push like action Flexion and extension of all the joint will help in approach.	1 <sup>st</sup> Law of motion 3 <sup>rd</sup> Law of motion Dynamic Equilibrium	A runner will not move until his legs force against the ground	To start the motion. -to gain a maximum controlled speed. -C.G. within the base ensures the equilibrium in a state of motion.
Second Last Stride	To lower the center of gravity to set up and gather for the take-off.	Cyclic movements of legs and hands	Dynamic Equilibrium	To lower the C.G. by increasing the length of stride	To prepare the body for vertical impulse
Last Stride	To prepare for the take-off	Upright position of Torso.  Athlete should be on the balls of feet, natural head position.	Law of Impulse	Decrease the amount of time of foot contact by shortening the stride length.	Better transfer of speed in to actual jump.

**Phase II - Take-Off:** The objective of the takeoff is to create a vertical impulse through the athlete’s center of gravity while maintaining balance and control. This phase is one of the most technical parts of the long jump. While concentrating on foot placement, the athlete must also work to maintain proper body position, keeping the torso upright and moving the hips forward and up to achieve the maximum distance from board

contact to foot release. There are four main styles of takeoff: the kick style, double-arm style, sprint takeoff, and bounding takeoff. We will focus on the sprint take-off (TO).

**Objective of Take-Off:** To create a vertical impulse through the athletes center of gravity while maintaining balance and control.

Phase- II	Objectives	Movement Features	Law and Principle	Critical Features	Remarks
Take-Off	To create vertical impulse through the athlete’s center of gravity. While maintaining balance or control.	Fast pawing plant on sole of take-off foot.  Slight bending of the knee joint.  Ankle, knee, and hip joint extended during push-off Active use of free leg(flexed thigh horizontal opposite arm swing high and forward)	2 <sup>nd</sup> Law of motion  2 <sup>nd</sup> Law of Motion  Transfer of momentum	The greater the force the athlete exerts at take-off the greater acceleration and height or distance achieved.  The more the impulse jumper can generate the greater will be the take-off velocity in the vertical direction.  During jump centripetal transfer of momentum.	The muscles and joint quickly flex and creates a quick storage of energy.  Build up energy is then released with great force and this is what causes lift. (Vertical impulse is achieved by the upward acceleration of the free limbs. [the arms and non take-off legs]).

**Phase III – Flight:** The objective of this phase is to counteract the natural forward rotation of the body from takeoff while maintaining an effective landing position. Once a competitor leaves contact with the ground there is nothing that can be done to alter the flight path of his or her center of gravity. What “will” affect the distance of the jump is the body position at landing. If a competitor was to leave the ground without taking any action to prevent forward rotation in the air, the body would naturally move into a facedown position as the velocity of the lower half of the body at takeoff is greater than

the upper half of the body due to the contact with the ground. The three predominant in-the-air techniques used in the long jump in order of increasing difficulty of execution are the sail, hang, and hitch-kick. We will focus on the sail techniques.

**Objective of Action in the Air:** To control the body and prevent it from rotating forward.

#### The Flight

Phase- II	Objectives	Movement Features	Law and Principle	Critical Features	Remarks
Hitch Kick (Action in the Air)	To control the body and prevent it from rotating forward.	Cyclic motion of both arms and legs.	Law of Action and Reaction Law of Inertia Principles of end middle summations of forces	Bending of trunk results in lifting of legs as reaction for proper landing.	It helps to bring the legs up into a good position for landing and covering the maximum horizontal distance.

**Phase IV- Landing:** When landing, it is the primary objective of the jumper to not fall back in the landing pit. The jump is measured from the location in which the body contacts the sand closest to the takeoff point. For this reason many jumpers will work on keeping their feet in front of the body at a maximum distance from the hips.Upon landing, competitors will often use their arms in a sweeping motion to help keep the

legs up and the body forward. Generally a jumper will bend the knees upon contacting the ground to cushion the impact on the body.

**Objective of Landing:** Optimum landing distance avoid falling backward to absorb the shock and avoid injuries.

### The Landing

Phase- II	Objectives	Movement Features	Law and Principle	Critical Features	Remarks
Landing	To prevent the body from falling back. To absorb the shock and to avoid injuries.	Legs draw forward, snatching at the air. Arm swing forward on contact with the ground. Knees bend quickly and pelvis moves forward.	Law of Impact	Between ground and body.	Better landing to absorb and avoid injuries.

### References

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