



A body is said to be in motion when it changes its position or location in respect to its surrounding.

**Or** in other words, motion consists of the movement of the body or movement of some member of the body.

**Or** the movement of some object or implement by the body.

Motion is a function of both direction and speed. The direction may be horizontal or vertical or at an angle with the horizontal or vertical or sometimes it may consist of circular movement about some point as a center of rotation.

## Types of motion

The motion is of mainly two types :-

1. Linear Motion
2. Rotary Motion

### 1. Linear Motion

Linear motion consists of movement of a body in a straight line, from one point directly to another.

e.g. ( example )

from start to the finish in 100 meter run.

## The linear motion again will be of two types i.e.:-

### a. Rectilinear Motion:

When the body moves in a perfect straight line or if the path of movement of a body is straight line, then it is called as rectilinear motion.

e.g.

100 meter run a dropped ball or the path of a pencil along a ruler (scale). The dropped ball travels rectilinear path towards the ground.

### b. Curve-Linear Motion:

When the body moves in a curve or if the path of movement of a body is a curved one then it is said to be a curve-linear motion.

e.g.

running in the curves of a track, broad jump or high jump, path of a thrown discus or javelin. The path of a thrown discus or javelin moving through the air is a curve-linear motion.

The distance that a system moves in a straight line it is called a linear displacement.

## 2. Rotary Motion

Rotary Motion consists of movement of a body about a center of rotation.

e.g.

in the above example of 100 meter run, the motion of legs in rotary The Joint serves as the location of axis of rotation for body segments.

The **change** in location of a rotating body is called as angular displacement.

and it is **designated** by the Greek Letter  $\theta$  (theta). The path of a rotating body, is **measured** in angular measurement units such as revolutions degrees and radians.

A **radian** is a proportion of a circle and is equivalent to approximately 57.3 degrees

To gain more speed in the rotary motion, the radius should be shortened.

## Linear and Angular Motion

In most of the human movements, the whole body or its segments or both move linearly and rotate at the same time.

e.g.

the body of the diver is falling linearly downward and simultaneously rotating around the **C.G. (centre of gravity)** of the body, which serves as the axis of rotation.

# Newton's Laws of Motion and their Importance in Sports

The below mentioned are the three simple laws given by Newton with which we can understand

"**Why** do bodies move as they do?"

"**What** makes a body to move?"

"**Can** a body at rest, move by itself?"

"**Can** a body set in motion, continue to move forever?"

## 1. Newton's First Law of Motion

It is also known as the Law of Inertia.

(**Everybody continues In a state of rest or of uniform motion in a straight line unless it is compelled by external force to change that state**)

According to this law, nothing starts or stops of itself.

It **implies** that greater force is required to start a body in motion **than** is required to keep it moving.

It **further** states that less force is required to keep a body moving at a uniform rate of speed, **than** to stop the body or to change its rate of speed.

**Therefore**, the runner or swimmer should employ those techniques which will help him get started as quickly as possible and with the application of force in the most effective manner.

And then he should accelerate to the greatest speed he can maintain throughout the race for the most efficient expenditure of energy.

## 2. Newton's Second Law of Motion

It is also known as a Law of Acceleration.

( **The acceleration of body is proportional to the force causing it** )

Therefore **applied** force must be greater **than** that required to maintain uniform speed for the body if the body is to be accelerated, **because** acceleration means a change in the velocity or speed of a body.

A body falling free in the air. is the best example for the application of this law.

**The force acting** on the body is constant and is causing a constant acceleration of  $32.2 \text{ ft/ sec}^2$ .

e.g.(1)

**While throwing** a ball with the greatest possible speed, the player will build greatest amount of speed before he releases the ball.

This can be done by the continuous movement of the body and this will develop maximum force at the moment of release.

e.g.(2)

**In the swing of the golf club**, when the player wishes maximum force during the impact, the process starts from zero velocity, when the club is lifted back,

i.e., at the end of back swing and will be continued till the ball is hit.

In this case, the acceleration will not be constant.

Actually, it will be greatest at the beginning of the stroke and least at the moment of contact, but the total force or the overall effect, produced by the various members of the body will be greatest at the moment of contact with the ball.

**Hence**, the acceleration is proportional to the force causing it.

### 3. Newton's Third Law of Motion

It is also known as Law of Interaction.

**( The law says that for every action, there will be always an equal and opposite reaction )**

**Or** in short, action and reaction are equal opposite.

Depending upon the results, this is **applied** in two different manners in sports.

e.g.

If the batter in baseball desires to bunt the ball, the force should be absorbed by moving the bat backwards in the direction of the ball and holding, the bat loosely at the moment the bat contacts the ball.

If the batter wants the ball to go off the fence, then he swings the bat backwards and then hits the ball with great force.

With these general principles, a player or a coach will understand the various aspects of force,

the way how it can be used best or the ways in which it can be applied advantageously and the various sources of force in human body.

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