



## UNIT-X: SPORTS TRAINING

### Contents

- Strength: Definition, Types and Methods of Improving Strength- Isometric, Isotonic and Isokinetic
- Endurance: Definition, Types and Methods to Develop Endurance- Continuous Training, Interval Training and Fartlek Training
- Speed: Definition, Types and Methods to Develop Speed- Acceleration Run and Pace Run
- Flexibility: Definition, Types and Methods to Improve Flexibility
- Coordinative Abilities: Definition and Types
- Circuit Training- Introduction and Importance

### Learning Outcome

At the end of this unit students will be able to:

- classify Isometric, Isotonic and Isokinetic training
- understand different methods of endurance development
- differentiate different method to improve flexibility
- explain Coordinative Abilities
- describe Circuit Training

### Discussion

Choose any sport that you would like to play. Research 5 exercises you can do to increase your performance in the sport. You will need to include what the exercise is, how to properly perform the exercise (include pictures if needed), what muscles are used, and why this exercise will improve your sports performance.

Name of Exercise	How to properly perform the Exercise	The muscles that are used in the Exercise	Why this Exercise will improve your sports performance





### 10.1.1 Introduction

Sports training is a multidimensional process for preparing athletes on several aspects like technical skills, tactical efficiency, fitness proficiency and various other physical, mental and social aspects required for optimal performance. Fitness is one of the very essential aspects for all athletes for improving performance and preventing injury while developing skill proficiency. Fitness components like Strength, Speed, Endurance, Flexibility and Coordinative ability does play an integral role in athlete performance but it needs scientific training for development and improvement at desired level and optimal level. There are various scientific methods of training and developing the different fitness component, lets try to understand the training aspect of each of the basic Sports fitness components.

### 10.1.2 Strength

According to **Singh, (1991)**<sup>1</sup>, *“Strength is the ability to overcome resistance or to act against resistance.”*

According to **Barrow and McGee**<sup>2</sup>, *“Strength is the capacity of whole body or any of its part to exert force.”*

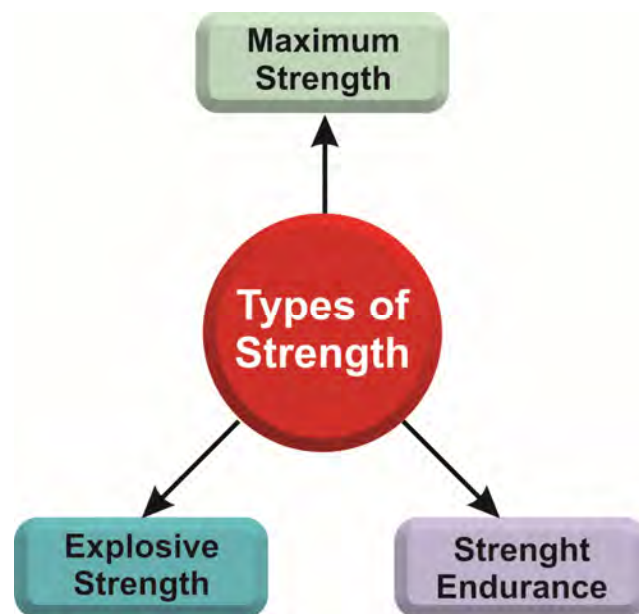
Strength is one of the most important motor components of fitness and plays a major role in all sporting events. It is the amount of force that muscles can produce to complete a task. In simple words, strength is the ability of a muscle or a group of muscles to act or overcome resistance. The development of strength also influences the other motor components of fitness like speed and endurance.

As all movements in sports are caused by muscular contraction, therefore, it can be said that strength is a part and parcel of all the motor abilities, technical skills and tactical actions.

### 10.1.3 Types of Strength

Almost all sports and games require some amount of strength according to their nature. For example, a weightlifter requires different kind of strength in different amount as compared to a basketballer shooting a ball in the ring. Thus, different sports require different types of strength, which can be classified as follows:





1. **Maximum Strength:** It is the ability of a muscle to overcome maximum resistance in a single repetition or single maximal voluntary contraction. Maximum strength means to exert force against resistance in maximal effort. Though maximum strength does not hold much importance in majority of sports but is certainly required in sports like long jump, shot put, javelin throw, weightlifting, discuss throw, etc.
2. **Explosive Strength:** It is the ability of the muscles to overcome resistance as fast as possible. In other words, it can be said that it is a combination of strength and speed. Explosive strength is highly specific to the nature of movement and is greatly influenced by motor coordination. This type of strength is mainly used in spiking of volleyball, jumps in basketball, sprint events, etc.
3. **Strength Endurance:** It is the ability of a muscle to overcome resistance under the condition of fatigue or as long time as possible. Strength Endurance is the ability of a muscle to perform repeated contractions and withstand fatigue. Just like explosive strength, strength endurance is a product of two motor abilities namely; strength and endurance. Strength endurance can be static or dynamic strength depending upon whether the movement is isometric (static) or isotonic (dynamic). This type of strength is mainly used in long distance races, swimming, distance cycling, Tug of War (static) etc.

#### Do You Know?

##### Factors Determining Strength

1. Muscle composition
2. Gender
3. Age





4. Size of the muscle
5. Number of muscle fibres.
6. Body weight
7. Muscular coordination

#### 10.1.4 Methods to Develop Strength

As stated earlier, strength is a highly trainable motor component and therefore, there are certain methods that help an athlete to develop or improve strength. These methods are discussed below:

1. **Isometric Exercise:** The term *isometric* combines the Greek words *isos* meaning **equal** and *metria* meaning **measuring**. This means that in these exercises the length of the muscle and the angle of the joint do not change, though contraction strength may be varied. In isometric exercises muscle and joint movement is not visible as there is no direct movement and the work performed cannot be seen directly eg., pushing a wall. Although work is done when pushing a wall, ie., force is exerted, but the work done cannot be seen as the wall remains at the same place and doesn't move a bit. When such exercises are done there is no change in the length of the muscle, hence they are called "isometric." These exercises need less time and equipment and can be performed practically anywhere and everywhere. These exercises, if performed regularly, may result in the change of muscle size and shape.



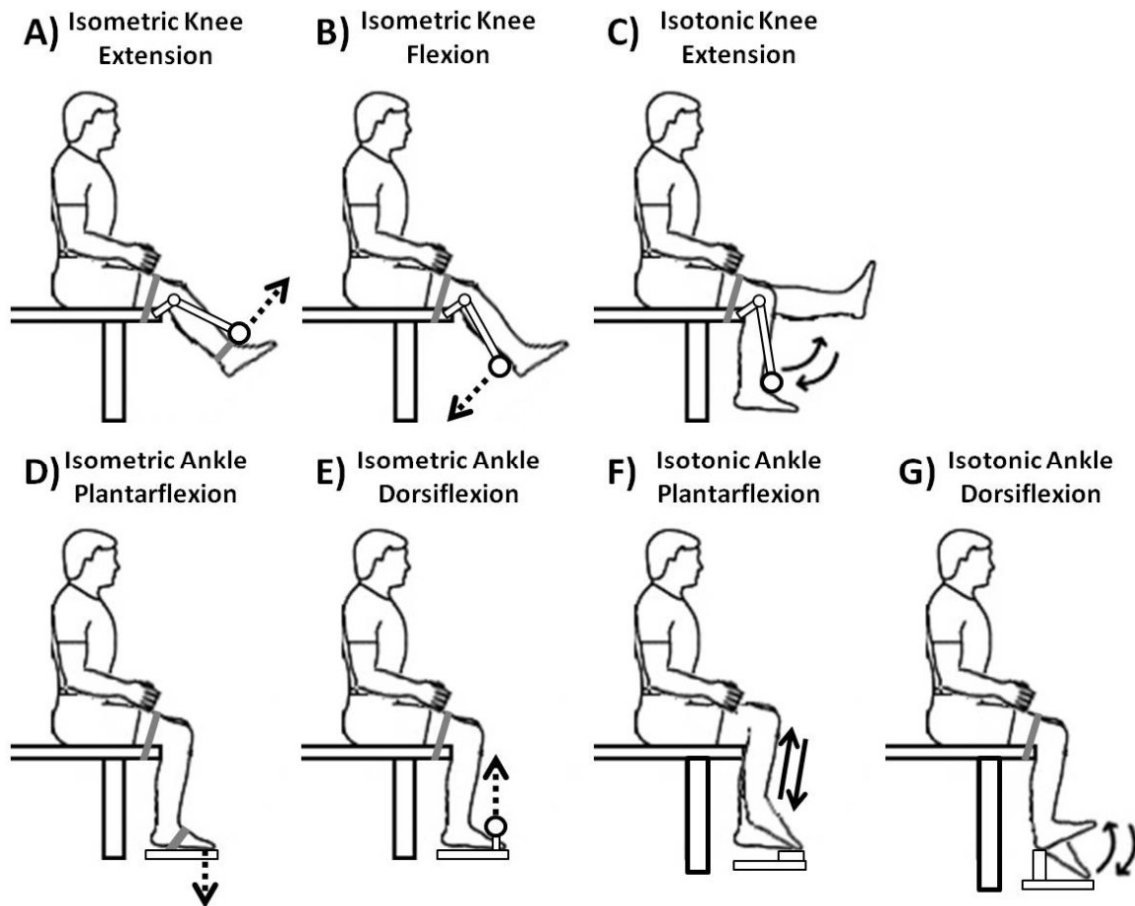
Picture Source<sup>3</sup>

2. **Isotonic Exercise:** The term *isotonic* comes from the Greek *isos* meaning **equal** and *tonos* or **tone**. The word isotonic means **maintaining equal (muscle) tone**. The muscle maintains equal tone while shortening in isotonic exercise. These are exercises in which movements can be seen directly. Isotonic exercises result in toned muscles and increased muscle length. These exercises have great importance in sports. Running





and jumping on the spot, weight training exercises, calisthenics exercises are some of the examples of isotonic exercises. This method is considered to be the best method to develop strength.



Picture source<sup>4</sup> (Gwin & Ferris, 2012)

3. **Isokinetic Exercises:** The term *isokinetic* comes from the Greek *isos* meaning **equal** and *kinetic* means **movement**, so isokinetic stands for **equal movement**. This method of exercise was introduced by J.J. Perrine in 1968 and involves special type of muscle contraction called isokinetic contraction generally used in sporting events like rowing and swimming. These exercises are performed on specially designed instruments. In isokinetic contraction, the muscles apply maximal force throughout the range of motion around the joint. Whereas, in isotonic contraction, the force is applied at a particular angle. The use of isokinetic contraction is very limited hence, the contribution of isokinetic contraction in developing strength is yet to be scientifically proved.





### Do you Know?

#### Preventive Measures in Strength Training

While doing strength training appropriate supervision is a must as it is always accompanied with a high risk of injury. Therefore, it is very important to know the ways of preventing such incidents. These are:

1. Strength training must be done after proper warming up.
2. Strong and stable joints are a prerequisite for strength training. Therefore, strength and stability of Musculo-Skeletal system must be ensured by doing general strength training with low intensity.
3. While exercising with heavy weights, correct technique is required. Otherwise it will result in serious injuries.
4. A strength training programme includes a variety of exercises. These exercises must be done in a proper sequence preferably agonists and antagonists muscles one after the other.
5. The load must be increased gradually and as per the athlete's ability and requirement.
6. Recovery or rest plays a vital role in strength training. Proper and effective use of recovery period helps in preventing injuries.
7. Improper breathing while exercising with heavy weights lead to serious disturbance in the blood circulation. Hence, as a rule, a sportsperson must breathe continuously and if he/she holds the breath, it should be for a minimum duration possible.
8. Safety equipment like belts, boots, wrist bands etc. should be used when necessary.
9. In case of children, the load should be low till the age of 16 years as chances of injuries are very high in children.



**Extension Activity**

Under the supervision of your physical education teacher form yourselves into two groups. Tell one group to do isometric and the other to do isotonic exercises one hour in a day for 3-5 days in a week. Test their strength after two months. Prepare a table and evaluate which method is better.

Date \_\_/\_\_/\_\_\_\_/ to \_\_/\_\_/\_\_/

Name:						
Objective:						
Warm up Activity						
	Set	Repetition	Time	Distance	Intensity	Remarks
Strength Training Exercise						
	Set	Repetition	Weight	1 RM	Rest	Remarks
Cool Down Activity						
	Set	Repetition	Time	Distance	Intensity	Remarks

**I. Tick the correct options.**

Q1. Isokinetic method was developed by .

- (a) HC Buck
- (b) Joy Perrny
- (c) **J.J. Perrine**
- (d) JJ Coubertin





Q2. In Exercise no movement takes place.

- (a) **Isometric**
- (b) Isotonic
- (c) Isokinetic
- (d) Isonomic

Q3. Under which kind of strength would you put Shotput?

- (a) Strength Endurance
- (b) Explosive Strength
- (c) **Maximum strength**
- (a) Speed Strength

II. Answer the following questions briefly.

1. What is Strength?
2. Explain Isometric exercise with suitable examples.
3. Write a short note on the different types of Strength.

III. Answer the following questions in 150-200 words.

1. Explain the preventive measures to be kept in mind during strength training.
2. What is Strength? What are various methods for developing Strength? Write in detail.

### 10.2.1 Endurance

**Harre** (1986)<sup>5</sup> defines endurance as “the ability to resist fatigue.”

**Barrow** and **McGee**<sup>6</sup> define endurance as “the result of a physiologic capacity of an individual to sustain movement over a period of time.”

Endurance is, thus, the ability of an individual to sustain an activity for a long period without undue fatigue. Like strength, endurance is also a conditional ability. Endurance has been studied thoroughly and deeply because it holds great importance in health, training and competition. Endurance play a vital role in almost every activity directly or indirectly. It is either measured by the number of repetitions of a task or the time for which an activity is performed.

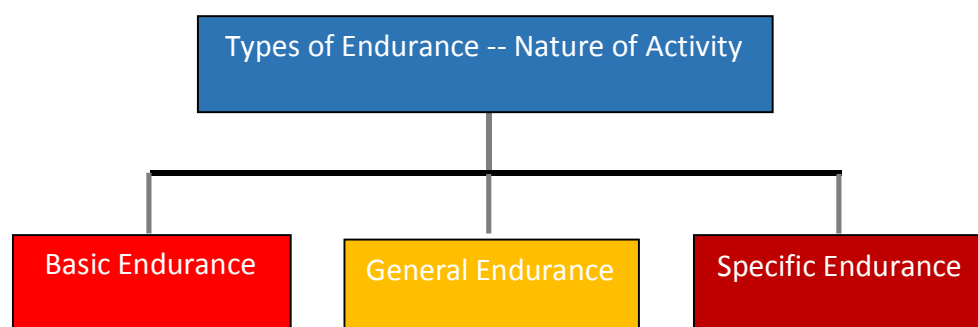






Picture source : (douglas, 2018)<sup>7</sup>

### 10.2.2 Types of Endurance



Different games and sports require different type of endurance which majorly can be classified into the following categories:

#### 1. Classification according to the Nature of the Activity:

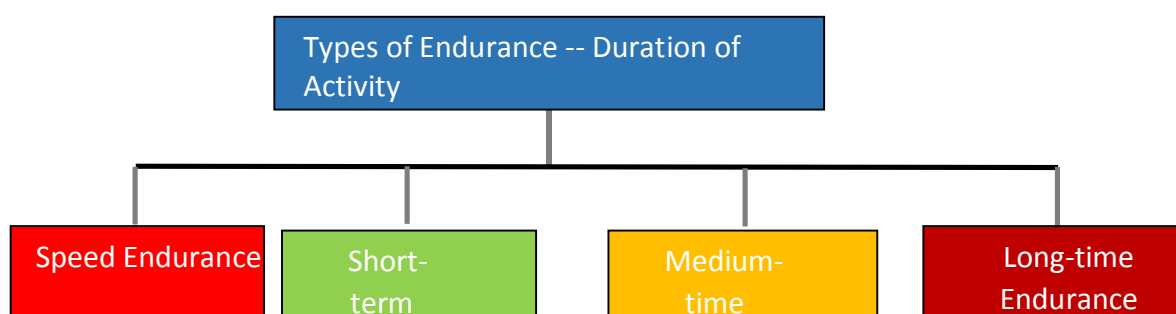
This classification is based on the kind of activity for which endurance is required. It can be classified into following types:





- (a) **Basic Endurance:** Basic Endurance is the ability of a person to resist fatigue in which the load is of medium intensity and involves aerobic muscular metabolism. Therefore, it can be said that it is the ability to do movements that involve a large number of muscles at a slow pace for a prolonged period of time. For example: jogging, cycling, swimming for more than 30 minutes. Basic endurance forms the base for all other types of endurance.
- (b) **General Endurance:** General Endurance is the ability to do such sporting movements, for prolonged duration, that are general in nature. This type of endurance is not specific to any sport and can be developed by performing general exercises. Unlike basic endurance, in which the intensity of the activity is medium, general endurance activities may incorporate high intensity exercises. But the duration for general endurance is much shorter than basic endurance.
- (c) **Specific Endurance:** Specific Endurance is the ability that is required by a sportsperson to perform movements of a particular sport in order to resist fatigue. Specific endurance varies from activity to activity as it depends on the nature of fatigue. For example: specific endurance of a hockey player is different from a marathon runner or a cyclist as the need of the activity is different.

## 2. Classification according to the Duration of the Activity



This classification takes into consideration only cyclic sports activities and is based on physiological factors. From the view point of Harre (1986), this classification can be divided into following sub-categories.

- **Speed Endurance:** Speed Endurance is the ability to resist fatigue in cyclic activities that last up to 45 seconds. A classic example for this type of endurance is 400m sprint in track and field events. This type of endurance is largely dependent on the power and capacity of an individual to produce energy.
- **Short Term Endurance:** Short Term Endurance is needed for the activities that last from 45 seconds to about 2 minutes. The most appropriate example for short term

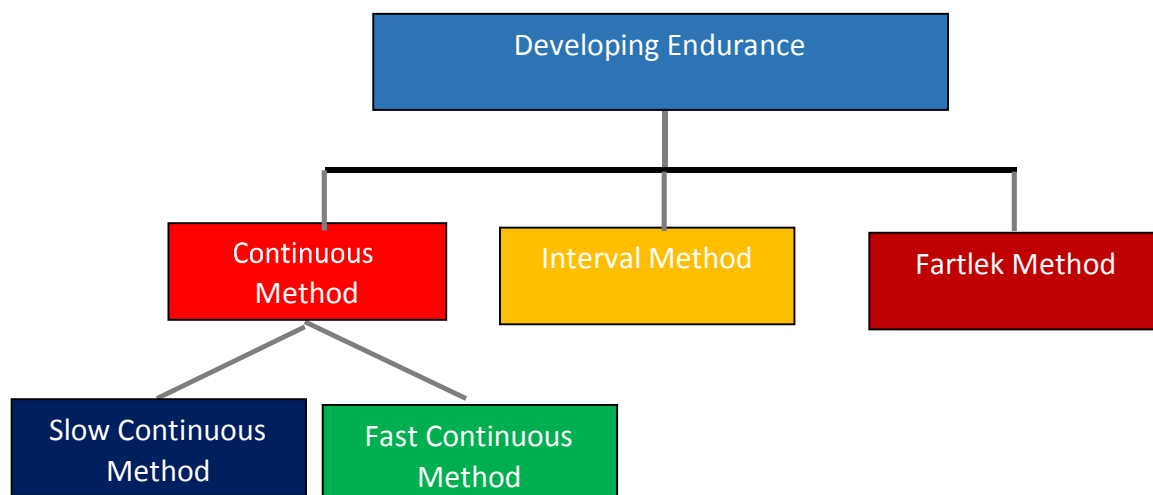




endurance is 800m run. This endurance depends majorly on speed endurance and strength endurance.

- **Medium Time Endurance:** To resist fatigue in activities that lasting from 2 minutes to about 11 minutes medium time endurance is used. The most common example of this type is 1500m and 3000m run and 100m rowing. Similarly, as short-time endurance, this type of endurance also depends on speed and strength endurance but to a limited extent.
- **Long Time Endurance:** Long Time Endurance is needed for the activities that last for more than 11 minutes. This type of endurance is required in events like marathons, cross country races etc.

### 10.2.3 Methods for Developing Endurance



The various methods to develop endurance are discussed below:

#### 1. Continuous Method



Picture Source<sup>8</sup>

[345]





As the name suggests, this method is about continuity. In this method, an exercise is done for a long duration of time without any rest. Because the duration of the activity is long and continuous in nature, the intensity of the activity is set to be low. This method has following sub categories:

- (a) **Slow Continuous Method:** in this method, the activity is performed at a certain speed without any break for a long duration. The speed of exercise is usually determined according to heart rate. For a trained athlete, heart rate during activity should be between 140-160 beats per minute. The duration of the activity should not be less than 30 minutes. This method is used for activities like walking, running, cycling etc.
- (b) **Fast Continuous Method:** in this method, the activity is performed at a comparatively fast pace but the speed will remain uniform throughout the activity. Heart rate during the activity should be between 160-180 beats per minute. Because the intensity is high and is more strenuous and exhaustive than slow continuous method, the duration of the activity should be at least 20 minutes.

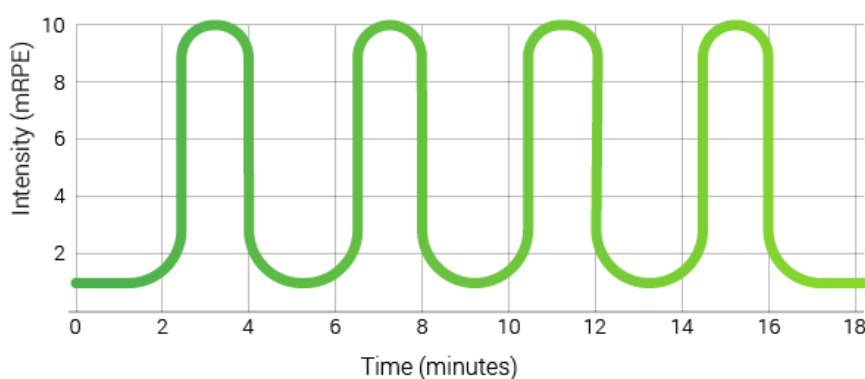
#### Extension Activity

Working in groups, plan a video of exercises to improve endurance.  
Record the video and put it on YouTube.

## 2. Interval Method

This is the most versatile method used for improving endurance. In this method, the activity is done at a comparatively high intensity with intervals or breaks of incomplete recovery. It is based on the principle that, “work should be done with sufficient speed and duration so that the heart rate goes up to 180 beats per minute. After this there should be a short interval and when the heart rate drops down at to 120- 130 beats per minute the work should be started again.”

Sprint interval training protocol: intensity vs time



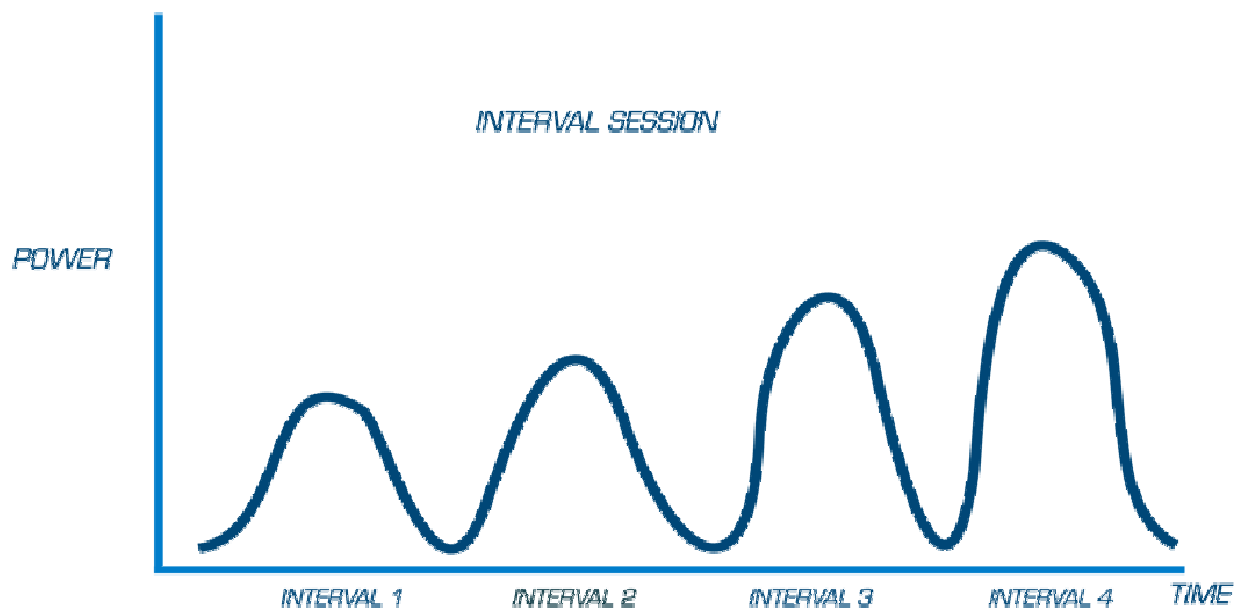
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### 3. Fartlek Method

Fartlek is a Swedish word which means 'speed play'. In other words, it is another variation of variable pace method. The difference between the two is, in the Fartlek method the speed variation is not planned. The athlete changes the speed with his own accord during the activity due to the changes in terrain, surroundings and his feelings. The heart rate usually ranges between 140-180 beats per minute during this method. The duration of this method may range from 15 minutes to 1 hour. Due to the varied pace, this exercise is very strenuous and should be done by trained athletes.



Picture Source<sup>10</sup>

#### Do you Know?

**Volume:** It is primary component of training which include duration or time of training, distance covered, volume load (sets in weight training), number of repetition, or performed work in given time. It is a quantitative component of work.

**Intensity:** It is a qualitative component of work. More work or efforts done by the athlete in per unit of time. Assessment of intensity vary sports to sports. Speed is assessed by meters per second, resistance in kilogram, in team games or distance races may be assess by heart rate etc.





**I. Tick the correct option.**

Q1. Which is not a type of endurance according to nature of activities

- (a) Basic Endurance
- (b) General Endurance
- (c) Specific Endurance
- (d) **Speed Endurance**

Q2. 400m sprint event comes under

- (a) **Speed Endurance**
- (b) Short Endurance
- (c) Medium Endurance
- (d) Long Endurance

Q3. There will be no variation in pace in activity in

- (a) Fartlek Method
- (b) **Continuous Method**
- (c) Interval Method
- (d) None of Above

**II. Answer the following questions briefly.**

1. Define Endurance.
2. Write about the different types of Endurance based on duration of activity.

**III. Answer the following questions in 150-200 words.**

1. Explain types of endurance according to the duration of the activity.
2. Explain types of endurance according to the nature of the activity.
3. What do you mean by endurance? Explain methods to develop endurance in detail.

### 10.3.1 Speed

**Theiss** and **Schnabel**<sup>11</sup> defined speed as *“the prerequisite to do motor actions under given conditions (movement task, external force, individual prerequisite) in minimum of time.”*

**Johnson** and **Nelson**<sup>12</sup> defined speed as *“the capacity of an individual to perform successive movement of the same pattern at a fast rate.”*

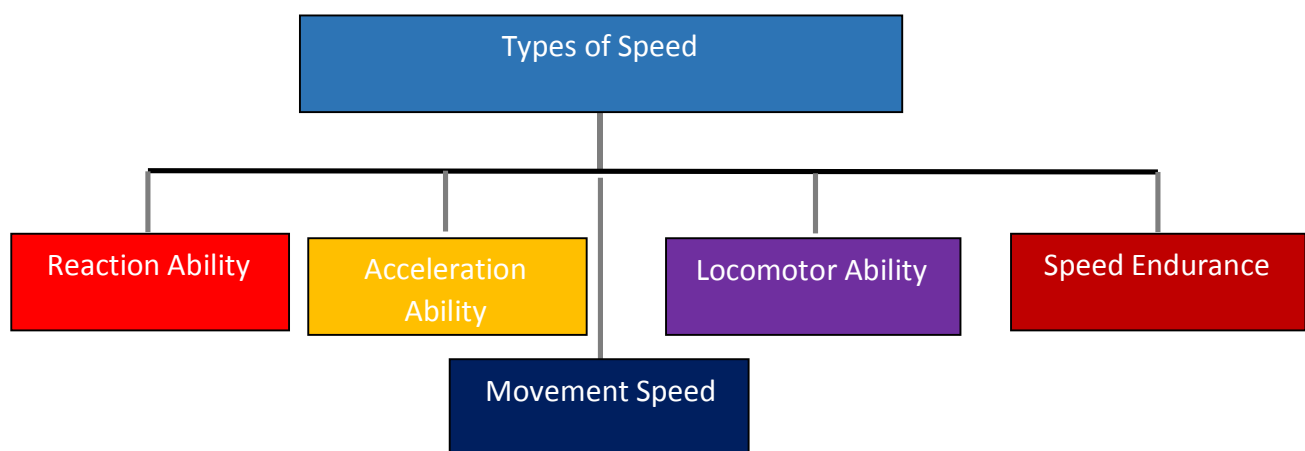
Speed is an ability to do task in minimum possible time. Speed has a complex nature and depends considerably on the central nervous system. Speed ability, in sports, signifies the ability to execute motor movements as quickly as possible. These movements can be cyclic or acyclic in nature.





There are certain factors that helps in determining the speed of an individual. These include mobility of the nervous system, explosive strength of an individual, correct technique of performing a task, bio-chemical reserves and metabolic power of an individual, flexibility, and certain psychic factors like optimum arousal, attention, motivation, concentration, ability to relax etc.

### 10.3.2 Types of Speed



From general point of view there are five different types of speed that are discussed briefly as follows.

1. **Reaction Ability:** Reaction Ability is the ability to react quickly to a stimulus or signal. It depends entirely on the coordinative abilities of an individual. Different games and sports have different types of signals like visual, auditory and tactile to name a few. And to respond to such signals accurately and as quickly as possible is known as reaction ability. It can be further classified into simple and complex reaction ability.
2. **Acceleration Ability:** Acceleration Ability is the ability to achieve high speed of locomotion from a stationary position. It depends greatly on the explosive strength, technique and movement frequency of a sportsperson. This ability is important in almost every game and sport, but holds a great influence in sprinting events.
3. **Movement Speed:** Movement Speed can be defined as the ability to perform a single movement in the minimum possible time. It is highly related to acyclic sports, though in cyclic sports its importance is limited to the initial phase. It is dependent on the technique and explosive strength of the sportsperson.
4. **Locomotor Ability:** Locomotor Ability is the ability to maintain maximum speed when in motion for maximum possible duration or distance. It is important in sports like 100m and 200m sprints, speed skating and short sprints in cycling. Locomotor ability





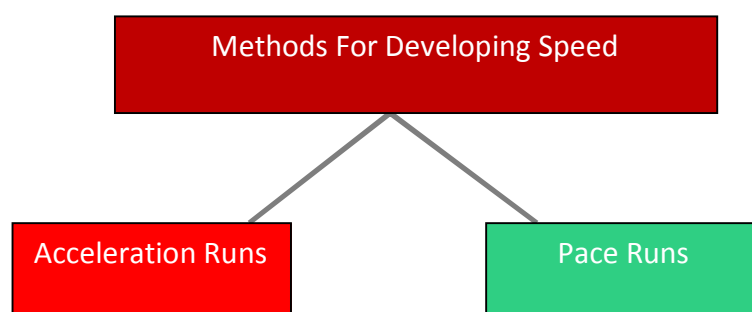


depends highly on the mobility of the nervous system. The chances of improving locomotor ability is relatively low.

5. **Speed Endurance:** Speed Endurance is a combination of two words speed and endurance. It is the ability to move at a high speed for a longer duration of time i.e., under the condition of fatigue. It depends highly on anaerobic capacity, technique and psychic factors.

### 10.3.2 Methods for Developing Speed

Speed is a motor ability that depends on genetic and environmental factors. Genetic factors, as we all know, cannot be manipulated. An individual having fast twitch fibres in a comparatively higher percentage than slow twitch fibres will have more speed. Whereas the individual who has a high percentage of slow twitch fibres will have better endurance. The ratio of these muscle fibres cannot be changed. Therefore, it can be said that the genetic make-up of an individual sets the limit on the speed of an individual, but the role of environmental factors on speed cannot be denied as well. The following are the most commonly used methods to develop speed of an individual.



1. **Acceleration Runs:** This method is generally used to develop speed while attaining maximum speed from a static position. In acceleration run, a sportsperson is required to run a specific distance. After the start, the athlete tries to gain maximum speed at the earliest and finishes the specified distance at that speed. These runs are repeated with sufficient rest between the runs. It usually takes 50-60 meters for a sprinter to attain maximum speed after the start. According to the researchers, it is observed that even well-trained athletes can maintain their maximum speed for 20 meters only.

The number of acceleration runs can be set according to the age, capacity and level of fitness of an athlete. It may vary from 6-12 repetitions with intervals for complete recovery in between. The acceleration runs must be done after proper warm up.

2. **Pace Runs:** Unlike acceleration runs, pace runs incorporate the method of running the set distance at a uniform speed. It usually includes races of 800 meters and above. It is







a fact, that an athlete can run a distance of 300 meters at full speed and in case of longer races he must conserve his energy by reducing speed. Therefore, in middle and long- distance races it is important to keep the pace in mind. In the beginning of such races the speed should not be too high and the pace should be maintained throughout the race. For this type of training the athlete should run at a maximum steady speed for a distance 10-20% more than the actual racing distance. Repetition for pace run training can be fixed as per the fitness level of the athlete with complete recovery in between repetitions.

### Do you Know?

Muscles are responsible for body movement. These muscles are made up of fast and slow twitch muscle fibres.

**Fast twitch fibres:** They execute fast movement for short distance also known as anaerobic muscle. It helps in short distance races, weight lifting, jumping etc.

**Slow twitch fibres:** They promote long duration activity in slow pace, also known as aerobic muscles. Example are long distance running, swimming, cycling etc.

### I. Tick the correct option.

#### Q1. Which is not a type of Speed

- (a) Reaction
- (b) **Sprinting**
- (c) Acceleration
- (d) Speed endurance

### II. Answer the following questions briefly.

1. What are acceleration runs?
2. Define Speed.

### III. Answer the following questions in 150-200 words.

1. Explain types of Speed and methods to develop speed.





### 10.4.1 Flexibility

Flexibility is also known as range of motion around a joint. It is the ability to execute a movement with greater amplitude or range. Flexibility is a motor component which is not clearly a conditional or a coordinative ability. In general usage, flexibility often corresponds to stretchability, elasticity, liveness, mobility, pliancy etc. But as a scientific term flexibility means much more than what is conveyed by any of these terms. Flexibility can be defined as the ability to execute movements with greater amplitude or range. Flexibility is affected by muscle strength, structure of the joint, tendons, ligaments and other factors. A person possessing a good degree of flexibility can perform daily tasks with greater ease and comparatively more efficiently and effectively. Moreover, the personality and posture of such individuals seems to be more attractive.

Flexibility is related to the genetic factors as well as physical activity programme. Tight joints affect smooth and efficient movements whereas flexibility ensures smooth and efficient movements. Therefore, it can be said that flexibility is helpful in many ways such as in preventing injuries, improving posture, reducing back pain, maintaining healthy joints, improving balance while making movements and in learning various skills easily, for example, backstroke in swimming.

### 10.4.2 Importance of Flexibility

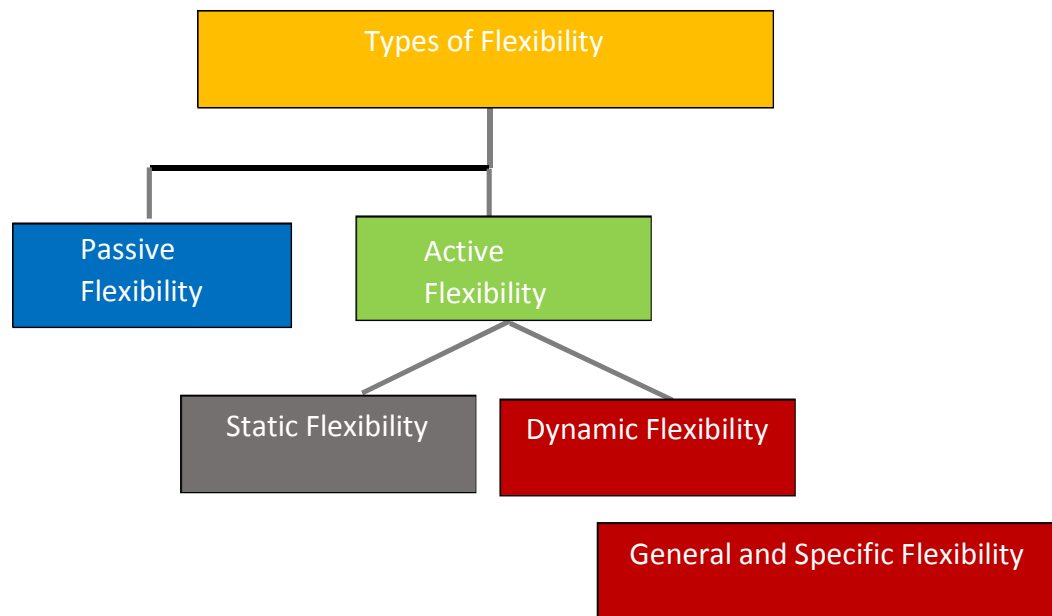
Flexibility has an important inter-relationship with other factors that improve performance. Hence, it is important in determining other factors to a lesser or greater extent. The importance of flexibility is briefly discussed below:

1. Greater range of motion ensures more force and speed developed by the muscles.
2. Greater flexibility helps the sportsperson to perform movements with minimum muscular tension, thereby facilitating higher movement economy.
3. It reduces stiffness in joints.
4. It reduces the risk of injuries as muscles are more pliable.
5. It helps in maintaining appropriate posture while performing.



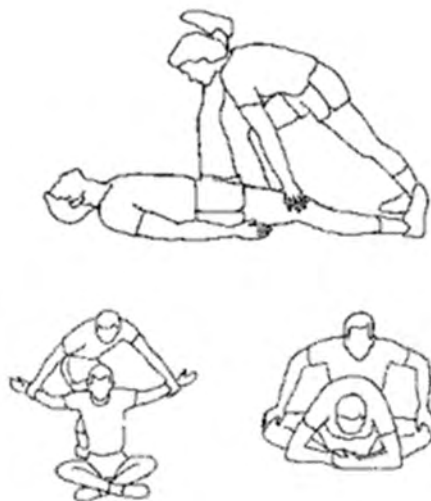


### 10.4.3 Types of Flexibility



Flexibility is of following two types:

1. **Passive Flexibility:** The ability to do movements with greater amplitude with external help is known as passive flexibility eg., stretching with the help of a partner, an accessory, or a prop. You can also use the floor or a wall. Passive flexibility allows you to stretch more than active flexibility and is determined largely by the structure of the joint and stretchability of the muscles and ligaments. Actually, passive flexibility is the base of active flexibility.



Picture Source<sup>13</sup>





2. **Active Flexibility:** The ability to perform a movement with greater amplitude without an external help is called active flexibility. It is the range of motion that you can achieve by using your muscles to put your joint there, eg., using your shoulder muscles to pull your arm back behind your ear as far as you can. Active flexibility is always less than passive flexibility and the difference between the two indicates lack of muscular strength or coordination or both. Active flexibility is further classified into following two categories:

- (a) **Static Flexibility:** it is required for movements done while the individual is in a static position i.e. standing, sitting or lying.
- (b) **Dynamic Flexibility:** it is required for executing movements when an individual is moving.

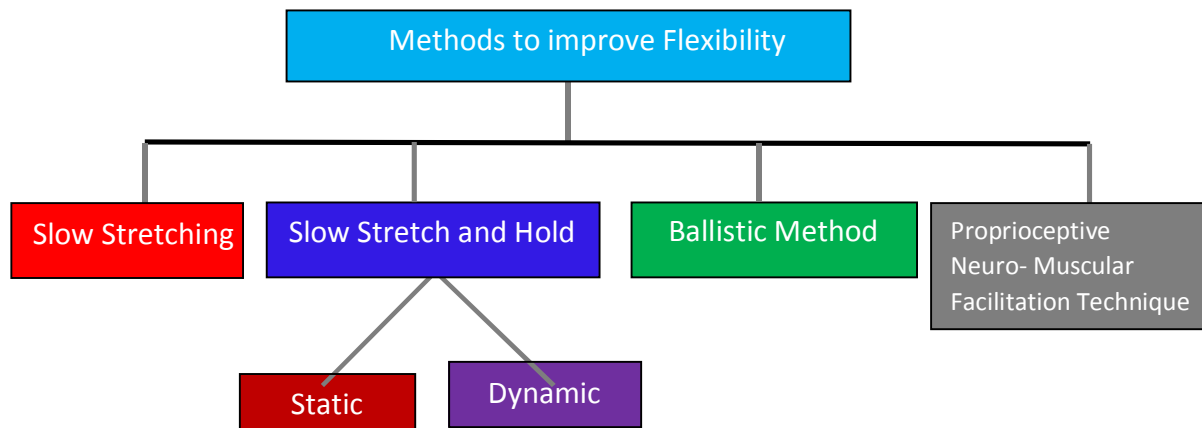


Picture Source <sup>14</sup>

#### 10.4.4 Methods of Improve Flexibility

In addition, the terms General and Specific Flexibility are also used often to refer to the types of flexibility. **General flexibility** refers to the level of flexibility of all the important joints of the body such as shoulder, hip and trunk. It is not used in reference to any sporting event or physical activity. However, **specific flexibility** should be understood to be the ability to perform specific movement or movements related to specific sports.





The various methods that can help to improve flexibility are discussed below.

1. **Slow Stretching:** The first and the foremost way to improve flexibility is stretching the muscles around the joint slowly. The key point to note here is the stretching should be slow and without any jerky movements.
2. **Slow Stretch and Hold:** The next stage after the stretching is to hold for about 6-8 seconds at the maximum stretching point. This method is considered to be the most commonly used methods in the field of games and sports.

\*Stretching can be done either in a **static** manner or in a **dynamic** manner.

**Static stretching** involves slowly easing into stretching and holding the position. The time period required for static stretch depends on the purpose. If it is for cooling down, the stretch should be held for about 10 seconds. If it is for improving flexibility, then the hold is recommended for about 30 seconds.

**Dynamic stretching** requires controlled movements, usually of legs and hands, and where the event requires dynamic movement, it is suitable to perform dynamic stretching exercises.

3. **Ballistic Method:** This form of stretching uses body's momentum in an effort to extend range of motion. In this method, the movement is performed with a swing and in a rhythmic way. As the stretching is done in a rhythmic manner, it is called Ballistic Method. Ballistic method was once quite popular but has now come under the scanner with many physical therapists condemning it as they believe that ballistic stretching can lead to injury.
4. **Proprioceptive Neuro-Muscular Facilitation (PNF) Technique:** This is also known as the post-isometric stretch and is based on the principle of proprioceptive neuro-muscular facilitation. This principle states that, if a muscle is contracted maximally for a few seconds, then after the contraction the muscle gains the maximum relaxation. Thus, the muscle is first contracted for 5-7 seconds and then gradually stretched to its





maximum limit and held in this position for about 8-10 seconds. The process is to be repeated 4-8 times for each muscle group.

### Do You Know?

#### Important Tips for Developing Flexibility

1. The right age for flexibility development is considered to be before puberty as it is hard to develop flexibility after puberty.
2. Flexibility tends to deteriorate once improved, if the stretching routine is not continued.
3. Stretching exercise performed in fatigue affects flexibility negatively. Hence, a person should perform such exercises when fresh. The ideal time to perform stretching exercise is after warm-up.
4. Flexibility exercise tends to work best after a proper warming up. If the warm up is not performed properly it may lead to overstretching of the muscles.
5. Flexibility training should aim for optimum flexibility and not for maximum flexibility. Too much flexibility results in less joint stability and therefore chances of injury increase.
6. A muscle group must be stretched several times for improving flexibility effectively. Usually 10-15 repetitions are recommended for a muscle group to gain flexibility.
7. A stretching exercise should be accompanied by a conscious effort to relax antagonist muscles.
8. It is important to avoid jerky movements while performing stretching exercise.
9. Age has an inverse relationship with flexibility. Therefore, do not compete with others while working on one's level of flexibility.
10. For faster improvement in flexibility, the routine can be followed daily or twice a day with involving variety of exercises for each joint.

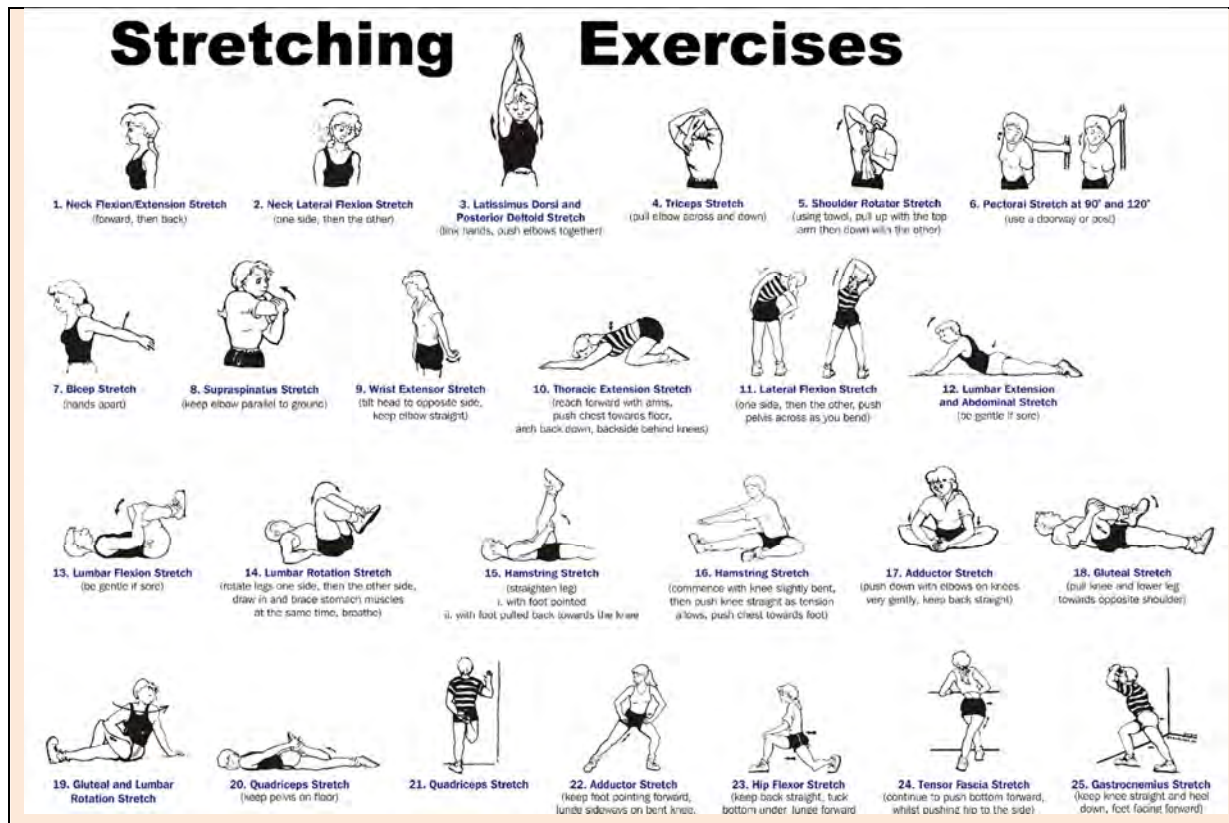
### Extension Activity

Good flexibility can improve sports performance and reduce risk of injury. Look at the following exercises for improving flexibility.

Do as many as you can, increasing the number of exercises and number of repetitions.

**Chart your progress.**





Picture source <sup>15</sup>

**I. Tick the correct option.**

Q1. Which is not a type of Flexibility?

- (a) Active
- (b) Passive
- (c) Ballistic
- (d) Stretch

Q2. In which method is stretching done in a rhythmic way?

- (a) Slow stretch
- (b) Slow stretch and hold
- (c) **Ballistic method**
- (d) PNF

**II. Answer the following questions briefly.**

1. Define flexibility.





2. What do you mean by Passive Flexibility?

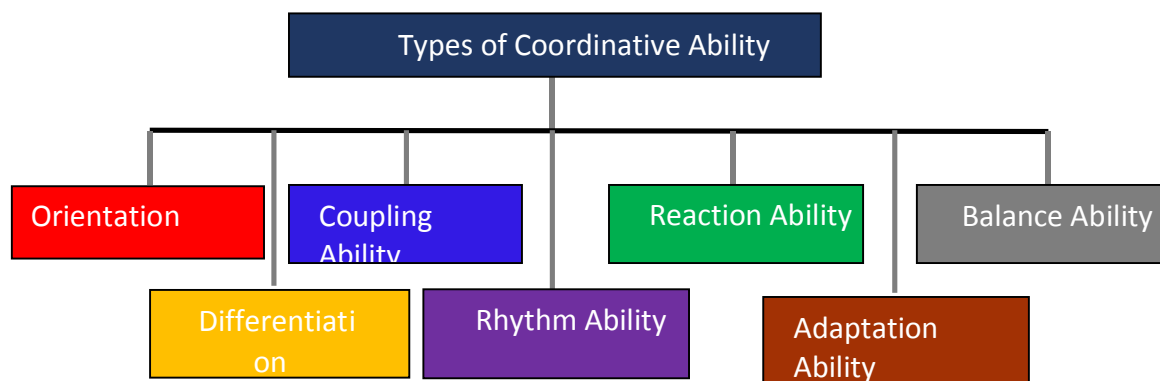
**III. Answer the following questions in 150-200 words.**

1. Explain types of Speed and methods to develop speed.
2. Discuss methods to improve flexibility.
3. **Define Flexibility. Explain its types and any two methods to develop flexibility.**

### 10.5.1 Coordinative Abilities

Zimmerman et al. state that “Coordinative abilities are understood as relatively stabilised and generalised patterns of motor control and regulation processes. These enable the sportsman to do a group of movements with better quality and effect.”

The term coordinative abilities has come into existence replacing the earlier used term agility. The concept of coordinative abilities should be understood as the ability expediently to form, coordinate and, link into an integrated whole the motive actions on one hand and secondly the ability to transform action already worked out under dynamic situations. Coordinative abilities are primarily dependant on the motor control and regulation process of central nervous system and of one of its properties which Ivan Pavlov called plasticity. For a coordinative ability, the control regulation processes are required to function in a particular manner, which is automatized to a great extent during skill performance. The coordinative abilities are those abilities of an individual which enable the individual to perform a variety of skill activities properly as well as efficiently



In sports, following seven types of coordinative abilities are important. The use of these abilities is however different in different games.

1. **Orientation Ability:** Orientation ability is the ability to determine and change the position and movements of the body in required time and available space in relation to a definite field of action (such as a volleyball court, skating rink, or football ground) and/or a moving object (like a ball, opponent, or partner). The use and demands on orientation ability is vast in sports. For example: in gymnastics, the body movement







and position is important for orientation. Whereas in team games, vision, especially peripheral vision, is decisive for orientation.

2. **Differentiation Ability:** Differentiation Ability is the ability to attain high level of fine tuning of movement phases. It is the ability to achieve high level of accuracy, perfection and economy of separate body movement and movement phases in a motor action. The high level of differentiation depends on movement experience and the degree of mastery over motor action. High differentiating ability is used in sports in sensing or implementing movement such as movement sense eg., in gymnastics differential ability enables highly precise and accurate movements according to a given set of movements, or in football, there needs to be coordination of head and feet.
3. **Coupling Ability:** Coupling ability is the ability to coordinate body part movements with one another and in relation to a definite goal-oriented body movement. Coupling ability is important in sports in which movements with a high degree of difficulty have to be performed with a great deal of accuracy and precision such as gymnastics and team games. In a team game like football foot movements for ball control or dribbling have to be coupled with the whole-body movement of running and jumping. Coupling ability depends on the functional capacity of kinaesthetic and optic sense organs.
4. **Rhythm Ability:** Rhythm ability is the ability to perceive the rhythm of a movement and to perform the movement with the required rhythm. It also denotes the ability to reproduce rhythm, stored in motor memory, in motor action. In some sports like gymnastics and figure skating the sportsperson has to perceive an external rhythm, music, and to express it in his movements. Sports in which rhythm is not given from outside, the sportsperson has to make use of the rhythm stored in his memory.
5. **Reaction Ability:** This is the ability to react quickly and effectively to a stimulus. Different games and sports have different types of signals like visual, auditory and tactile to name a few. And to respond to such signals accurately and as quickly as possible is known as reaction ability. It can be further classified into simple and complex reaction ability.
6. **Adaptation Ability:** Adaptation ability is the ability to adjust or completely change the movement programme on the basis of changes and anticipated changes in the situation. These situational changes may be expected ones or may take place suddenly. It depends considerably on the speed and accuracy of perception of changes in the situation.
7. **Balance Ability:** it is the ability to maintain equilibrium or balance throughout the movement and to regain balance quickly after balance disturbing movements. It is further classified into two types:





- (a) Ability to maintain balance during stationary position or slow movements. It depends on kinaesthetic, tactile and to some extent on vestibular sense organs.
- (b) Ability to maintain or regain balance during rapidly changing positions. It depends primarily on the functional capacity of the vestibular sense organs.

**I. Tick the correct option.**

Q1. Ability to coordinate body part movements with one another and in relation to a definite goal oriented body movement is known as:

- (a) Balance Ability
- (b) Adaptation Ability
- (c) Rhythm Ability
- (d) **Coupling Ability**

Q2. Ability to attain high level of fine tuning of movement phases is known as:

- (a) **Differentiation Ability**
- (b) Orientation Ability
- (c) Adaptation Ability
- (c) Coupling Ability

**II. Answer the following questions briefly.**

1. What do you mean by the term coordinative abilities?
2. What is coupling ability?

**III. Answer the following questions in 150-200 words.**

1. Write about coordinative abilities in detail.
2. What is coordinative abilities and explain different types of coordinative ability?

### 10.6.1 Circuit Training

According to **Adamson** and **Morgan**<sup>16</sup>, "Circuit training is the training method in which certain exercises of various kinds are performed with or without apparatus with given dosage."





Circuit training method was designed by Adamson and Morgan of Leeds University in the year 1957. It is a scientific arrangement of exercises performed systematically and repeatedly in such a way that it looks like a circuit. Therefore, it is called circuit training.

It is a method of training and conditioning that involves multiple stations that make a complete *circuit* (or circle). It usually consists of 10-12 training stations according to the need and intensity required for the training programme. Recovery period between the stations and between the circuits is controlled.

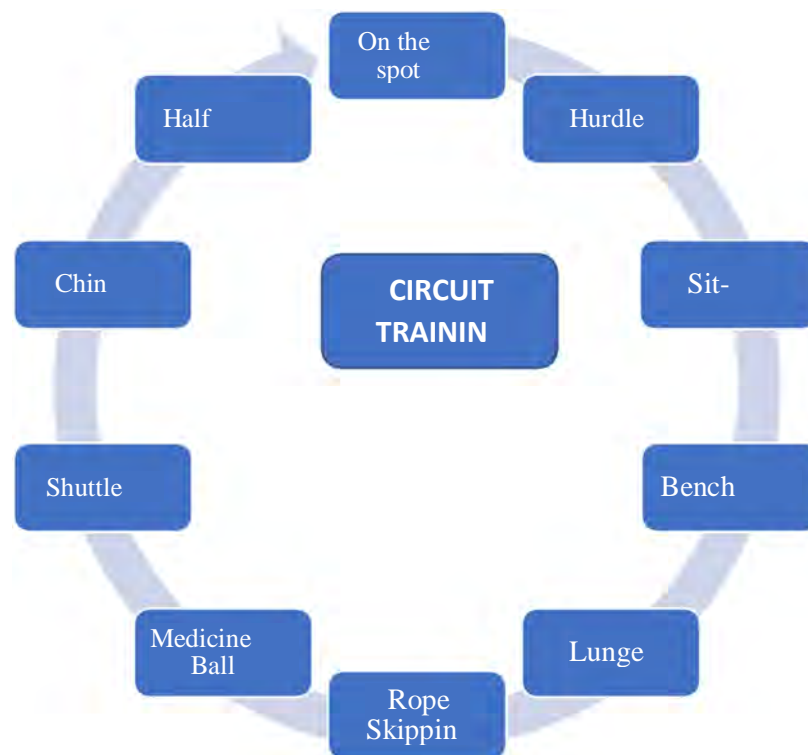


Fig. 1: A Circuit

**Description:**

- Purpose of the circuit training is to develop Muscular endurance. Activities include  
On the spot running: 1 minute  
Hurdles: 10 jumps over the hurdles  
Sit-ups: 10 repetitions  
Bench press: weight 60 % of 1RM x 10 repetition  
Lunges: 10  
Rope skipping: 50 skipping  
Medicine Ball Throw: 10 throws of 10 kgs weight ball  
Shuttle run: 10m x4





Chin ups: 10 repetitions

Half Squat: 10 repetitions

- No rest between exercises
- One minute rest after one cycle
- One to three cycles may be performed

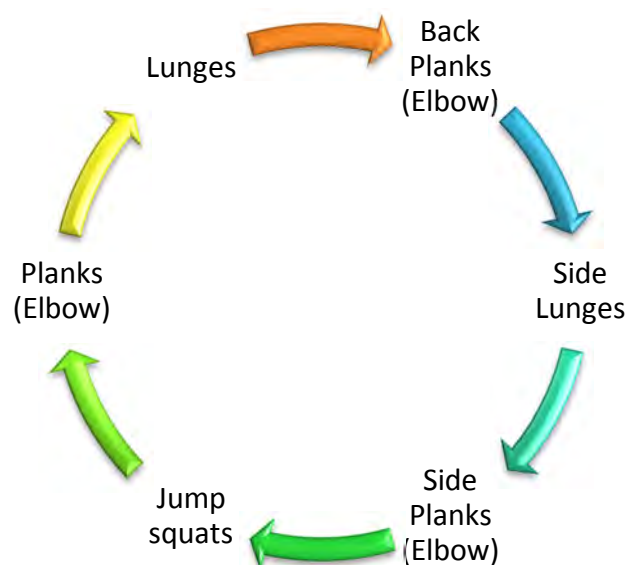


Illustration-2

**Description:**

- Purpose of the circuit training is to develop power of lower body.
- Duration of different Planks: one minute each
- Lunges and Squats jumps: 20 repetitions each
- No rest between exercises
- One minute rest after one cycle
- One to three cycles may be performed

### 10.6.2 Main Characteristics of a Circuit

1. Exercises in a circuit are simple to learn and execute.
2. Exercises are usually performed with medium resistance or medium weight.
3. Frequency or number of repetitions vary as per the need of the programme.
4. Aim of circuit training is to develop endurance and strength.
5. It takes into account exercises of the whole body.





6. It is generally given in the preparatory phase of developing basic endurance and strength.
7. The load must be gradually increased.

### 10.6.3 Impact of Circuit Training

1. It improves cardiovascular fitness of a sportsperson.
2. It improves general fitness by incorporating exercise that involves the whole body and, hence, improves a variety of motor components like strength, flexibility and endurance.
3. It enhances VO<sub>2</sub> max (maximal oxygen consumption) which means the body can take more oxygen to be utilized by muscles.
4. It further enhances consumption of oxygen by muscles.
6. It improves muscle strength. But it does not improve maximum strength or explosive strength.
7. It improves muscular endurance. However, circuit training alone cannot train a long-distance runner for the peak performance.

#### Case Study

After getting their fitness levels assessed, and with understanding of mechanical analysis of their movement, the three boys, Ram, Shyam and Vinay decide to improve the different components of fitness. Since they are in class XII, and involved in competitive sports, their focus is also admission to the top colleges and universities on the basis of their sports performance. Their physical education teacher has informed them that most of the colleges give importance to physical fitness and sports skill tests. Their teacher felt their current fitness level was not up to the mark and stressed on the need for implementation of scientific sports training methods. The students were eager to know how this was different from the way they were training earlier. Their teacher explained the concept of 'Sports training' as a planned and controlled process in which, for achieving a goal, changes in complex motor performance, ability to act and behaviour are made through measures of content, methods and organisation. He emphasised that, sports training is the basic form of preparation of sportsmen, and that the preparation of a sportsperson represents a multidimensional process of purposeful utilisation of the factors – means, methods and conditions – which help in enhancing the physical fitness levels of the sportsperson and ensure the required level of his sports performance ability. The boys started their training for speed, flexibility, coordination, strength with a scientific approach under the guidance of their teacher who created specialized and specific training plans for them along with periodization of their schedule for each of the three individuals. Maximal Strength, Explosive





Strength and Strength Endurance were planned through Isometric, Isotonic and Isokinetic exercises. Another essential component of training was specific endurance, for which continuous method, and Fartlek training methods were used. PNF stretching along with ballistic stretching method, static and dynamic stretching methods were also adopted in the training session. A training method with variety of exercises at multiple stations with controlled recovery period was also implemented with planned dosage, which was thoroughly enjoyed by the athletes and proved effective in developing aerobic capacity through increased Vo2 max and cardiovascular endurance.

- Q. Which method is best suited for developing strength?
- (a) Interval method
  - (b) **Isometric method**
  - (c) Ballistic method
  - (d) Continuous method
- Q. To develop muscular endurance; which method will be most suitable?
- (a) **Circuit training**
  - (b) Isokinetic training
  - (c) Repetition method
  - (d) Static method
- Q. Aerobic capacity can be increased by \_\_\_\_\_ method
- (a) **Circuit training**
  - (b) Isokinetic training
  - (c) Isotonic training
  - (d) Static method
- Q. Ballistic method can used to develop \_\_\_\_\_
- (a) Strength
  - (b) Endurance
  - (c) **Flexibility**
  - (d) Speed
- Q. Which is the training referred with 'multiple stations'?
- (a) Interval Training
  - (b) **Circuit Training**
  - (c) Continuous Training
  - (d) Fartlek Training





**I. Tick the correct option.**

Q1. Circuit Training Method was designed by:

- (a) **Adamson and Morgan**
- (b) Morgan and Morgan
- (c) Adamson and Adamson
- (c) None of Above

Q2. Ability to attain high level of fine tuning of movement phases is known as:

- (a) **Differentiation Ability**
- (b) Orientation Ability
- (c) Adaptation Ability
- (d) Coupling Ability

**II. Answer the following questions briefly.**

1. What do you understand by circuit training?
2. Write characteristic of circuit training.

**III. Answer the following questions in 150-200 words.**

1. **Write in detail about circuit training.**

**Art Integration**

Physical Education is a required program that is offered to every student in your school. The purpose of Physical Education is to promote lifelong learning in both the physical and cognitive domains. Physical Education is a sequential educational program that teaches students how to understand and participate in physical activities that can assist in developing and maintaining physical fitness throughout their lifetimes. It teaches students to understand and improve their motor skills. It encourages students to enjoy using their skills, knowledge and good decision- making abilities to establish a healthy lifestyle and to understand how their bodies work.

Physical Education ... it's about life.

Deliver a speech to students taking admission in Classes 6-11 about the importance of Physical Education in life and the expectations the school has of them in the daily PE programme.





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