UNIT 6

# TEST, MEASUREMENT AND EVALUATION

## Content

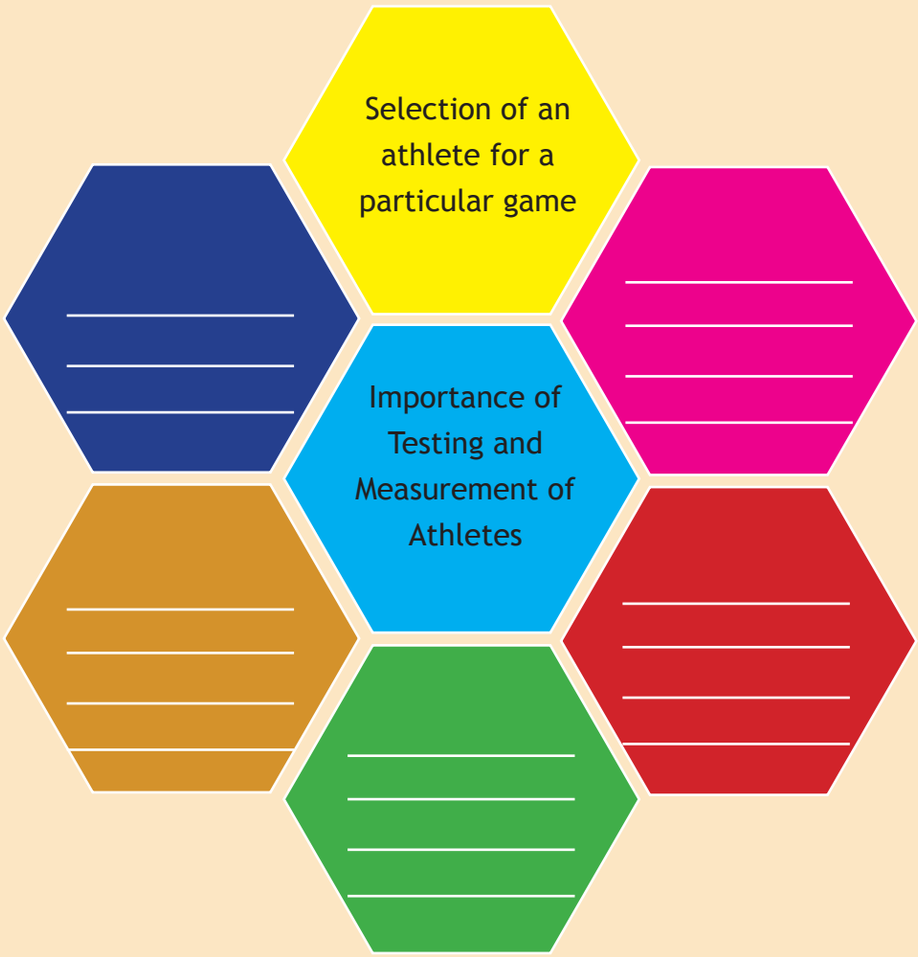
# Learning Outcomes

After completing this chapter, you will be able to:

- After completing this chapter, you will be able to:
- define the terms test, measurement, and evaluation,
- differentiate norm and criterion referenced standards,
- differentiate formative and summative evaluation,
- discuss the importance of measurement and evaluation processes,
- understand BMI: A popular clinical standard and its computation
- differentiate between Endomorphy, Mesomorphy & Ectomorphy
- describe the procedure of Anthropometric Measurement

**Discussion**

1. Working in groups, complete chart given below listing the importance of testing and measurement in sports.




2. What are the tests that could be administered to the athletes?

## 6.1.1 WHAT IS A TEST

Remember when you tried sit-ups for the first time. As a child, you probably did a number of sit-ups. You were performing sit-ups to improve your strength endurance. Do you remember your Physical Education teacher counted your sit-ups in your Physical Education class and said, "You were very good!" Numbers are a part of everyone's life and they can be used in measurement. Measurement is a way of giving meaning to numbers. Further, decision making is a daily task. Many people make hundreds of decisions daily; and to make wise decisions, one needs information. The role of measurement is to provide decisionmakers with accurate and relevant information to make informed choices.

**Do you know?**

**A test** is an instrument or tool used to make a particular measurement. This tool may be written, oral, a mechanical device (such as a treadmill), physiological, psychological, or another variation.

**Measurement** is the act of assessing. Usually this results in assigning a number to the character of whatever is assessed.

**Evaluation** is a statement of quality, goodness, merit, value, or worthiness about what has been assessed. Evaluation implies decision making.

Example 1: A physical education teacher records the 30 sit-ups that a student completes in 1 min and reports the score as Good. In this example, Test is Sit-ups, Measurement is 30 sit-ups and Evaluation is Good.

In our day-to-day life we all collect data and information before making decisions. e.g., you might gather information about your friend's marks, health, fitness, type of vehicle her/his family uses, number of the vehicle, number of students in a class etc. Physical Educationists collect data related to fitness characteristics because of the relationship between fitness, physical activity and quality of life. The variables measured might include the amount of physical activity, blood pressure, weight height, strength etc. Physical educationists might be interested in measuring different items for taking better decisions. Thus, to make qualified decisions, it is extremely important to measure and evaluate the components of the individual's physical fitness in an accurate manner. Making effective decisions depends on first obtaining relevant information, and then evaluating it. This is where testing and measurement enter the picture. The most basic principle of this text is that measurement and evaluation are essential to sound educational decision making.

## 6.1.2 TEST, MEASUREMENT AND EVALUATION

The terms test, measurement, evaluation, and assessment are occasionally used interchangeably, but most users make distinctions among them.

**Test** is usually considered the narrowest of the three terms; it implies the tools, instruments or set of questions to measure a dimension, quality or condition, of any person, object, event.

**Measurement** refers to the quantitative form of assessment and also refers to the scores obtained through test. Measurement is requisite for evaluation in a quantitative form of numbers or scores.

**Evaluation** is "the process of delineating, obtaining, and providing useful information for judging decision alternatives." Other definitions simply categorize evaluation as professional judgment or as a process that allows one to make a judgment about the desirability or value of something. Thus, measurement is not the same as evaluation. Two athletes may obtain the same measure (test score), but we might evaluate those measures differently because of the different criteria for evaluation available in terms of norms and criterion measures.

**Definitions**

A test is a tool to evaluate the skill, knowledge, capacities or aptitudes of an individual or a group.

- Webster's Dictionary

Test refers to any specific instrument, procedure or technique used by an administrator to elicit a response from the test-taker.

- H M Barrow and Megee

Test is the form of questioning or measuring used to access retention of knowledge, capacity or ability of some endeavour.

- Barry L Johnson and Jack Nelson

A test is an instrument or a tool used to make a particular measurement. The tool may be written, oral, mechanical, or an other variation. Measurement refers to the process of administrating a test to obtain quantitative data.

- H M Barrow

Measurement aids evaluation process in which various tools and techniques are used in collection of data.

- Barry L Johnson and Jack Nelson

An evaluation is an assessment, as systematic and impartial as possible, of an activity, project, Programme, strategy, policy, topic, theme, sector, operational area, institutional performance..

- United Nations Evaluation Group

Evaluation is the process of education that involves collection of data from the products which can be used for comparison with preconceived criteria to make judgement.

- H M Barrow and Megee

I. **Tick the correct option.**

1. Mohan's height is 3ft 11in. 3ft 11 in is an example of
   a. test
   b. measurement
   c. evaluation
   d. assessment
2. Test is a _____
   a. Tool
   b. Technique
   c. Adjustment
   d. Assessment

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

1. What is a test?
2. What is measurement?
3. What is Evaluation?

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

1. Describe the relationship between test, measurement & evaluation.

## 6.2.1 Importance of test, measurement & evaluation in sports

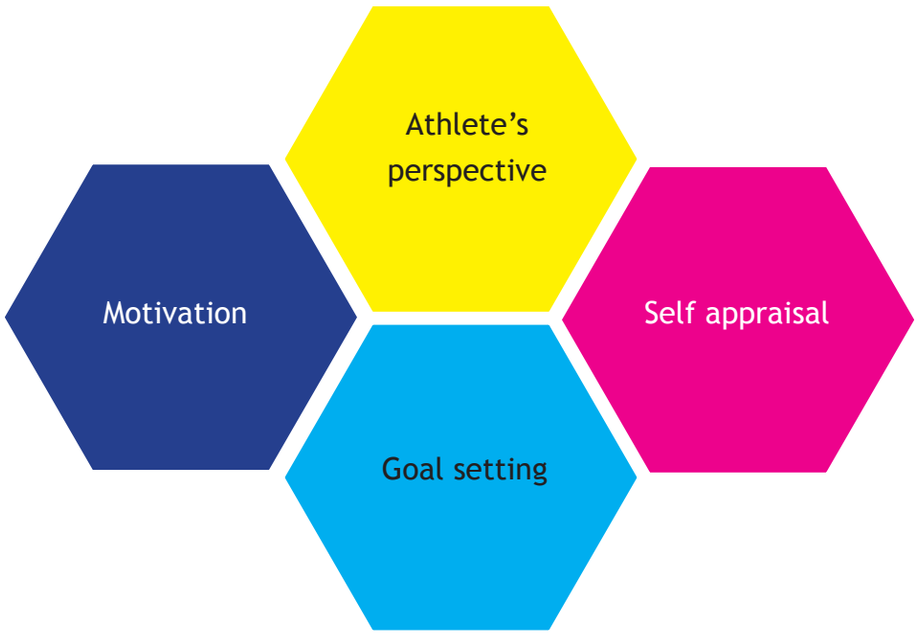
The importance of test, measurement and evaluation should be considered from three different perspectives,

i. from an athlete or participant's perspective;
ii. from the PE teacher/Coach/ Trainer's perspective; as well as
iii. from the Training programme's perspective.

Let's try to understand these three perspectives in detail.

**A. Importance of Test, Measurement and Evaluation from athlete's perspective**

i. Motivation of athletes for continuity.
ii. Self Appraisal of performance
iii. Goal Setting for performance enhancement




Tests, Measurement, Evaluation are of immense importance for athletes and sports participants. If there is an appropriate test being applied at an appropriate time and at an appropriate frequency, it will be a greatly motivating for the athletes to continue with their activity. It will also be a mode of self-appraisal of their own performance, and surely it will help athletes and participants to set up new goals for their performance enhancement.

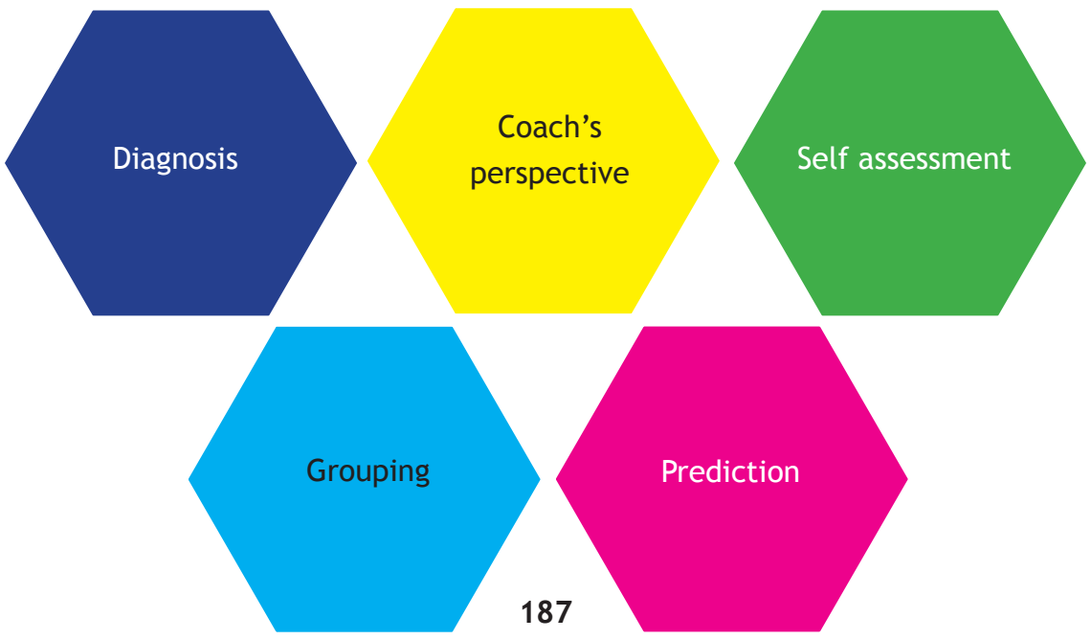
**B. Importance of Test, Measurement and Evaluation from coach/trainer's perspective**

i. Diagnosis of problems and errors in teaching-learning process

ii. Grouping or divisioning of athletes as per ability or skill.

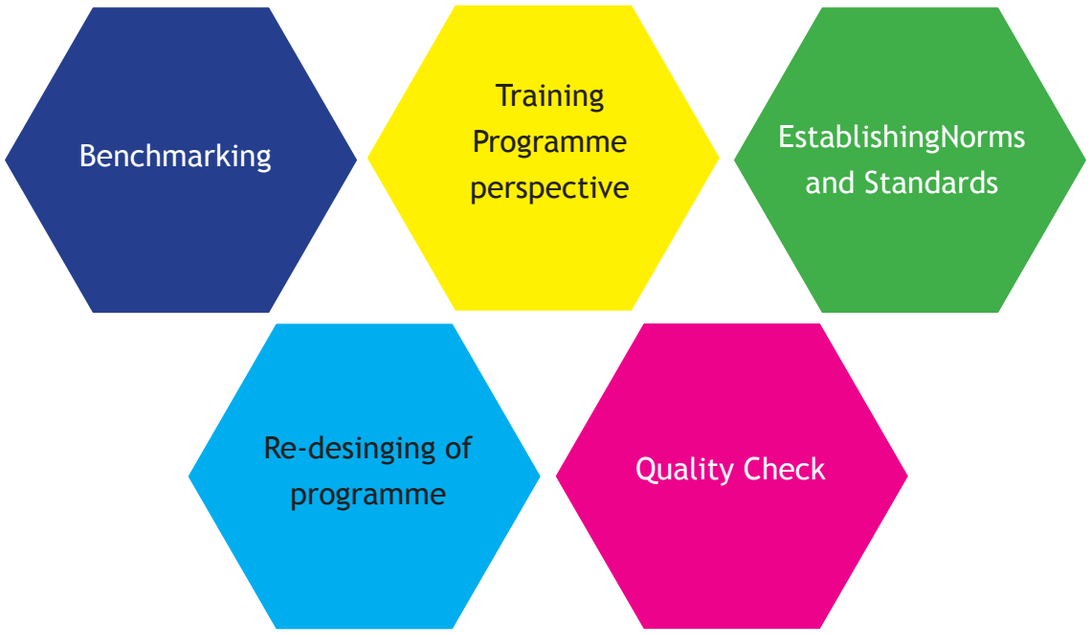
iii. Prediction of performance of athletes

iv. Self-assessment of teaching effectiveness



In addition to the student's perspective, another important dimension which needs to be discussed regarding importance of Tests, Measurement and Evaluation is from the Coach/ PE Teacher/ Trainer's perspective. Tests, measurement and evaluation have a lot of importance in helping them acquire adequate feedback about their pedagogy and student satisfaction, and identify areas for improvement. Without a reliable test, measurement and evaluation system, coaches may lack support of authentic feedback about their task and training methods. Tests can provide necessary feedback as these testing and evaluation processes help in diagnosing pedagogical issues and reasons to improve athletes' performance and satisfaction.

**C. Importance of Test, Measurement and Evaluation from the Training Programme perspective**




i. Benchmarking of training programmes or comparsion of training programme with desired objectives and outcomes of athletes.

ii. Norms and Standards can be established for future objectives related to skill, fitness or other abillites.

iii. Re-desinging of programme based on previous test results.

iv. Quality Check and control process of training system and athelte development programmes.

Along with the importance of tests, measurement and evaluation for athletes and coaches, it is also very important from the perspective of the training programme too. Training programmes in physical educaiton and sports are dynamic in nature which need regular updates and modifications based on the need of training and

competition demands. The desired modification should be based on scientific processes, for which testing of training programmes, benchmarking with other existing training approaches, developing quality control process and evaluating with norms and standards are essential.

I. **Tick the correct options.**

1. The term 'placement' refers to
   i. giving all students the same training programme
   ii. placing students into categories based on their skills
   iii. determining the strengths and weaknesses of individuals
   iv. predicting a student's future success in a particular sport
2. Test and measurement scores are NOT helpful in
   i. determining the strengths, weaknesses and limitations of a student
   ii. discouraging the student from participating in a particular activity
   iii. helping a student pick up the sports activity of his/her choice
   iv. predicting the student's future level of achievement

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

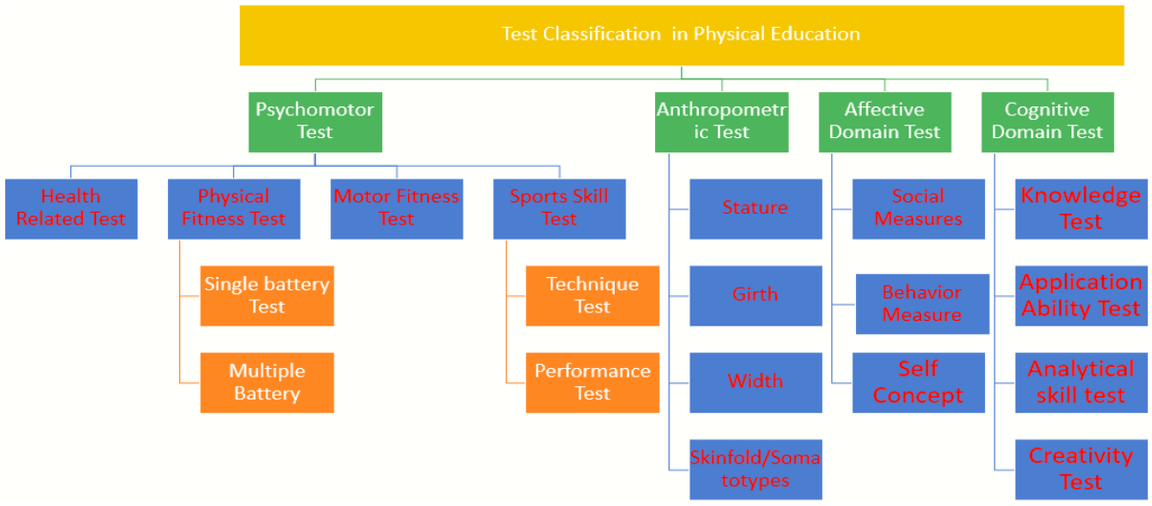
1. What is the role of tests and measurement in Diagnosis?
2. What is role of tests and measurement in Placement?

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

1. Distinguish between Test, Measurement and Evaluation. Highlight their importance in Sports.

## 6.3.1 Classification of Tests in Physical Education and Sports

In sports, exercise and physical activities there are various parameters of an athlete or a participant which need to be tested. As you know, the aim of different tests is to measure different types of traits and attributes. In sports and physical activities, skill and physical fitness tests alone do not perfectly classify, justify or validate the participants' ability and progress in performance. Other factors, such as anthropometric components, motivation and desire, concentration focus etc. could affect the ultimate performance. Therefore, a variety of tests need to be applied for sports skill and fitness level assessments. These tests are categorized according to their nature and purpose such as Psychomotor Test, Anthropometry test, Affective domain (emotional) test, Cognitive Domain test. These tests are helpful for a comprehensive assessment of an athlete or any participant in exercise and fitness program. Lets discuss the following classification of tests:




## 6.3.2 Psychomotor Tests

Psychomotor tests are to assesses the participant's ability to perceive instructions and perform motor responses often including measurements related to movements. In these tests, participants are required to perform motor activities to their best ability and neuro- coordination. There is a vast range of tests in this category which can be classified in numerous ways. Here we are dividing these tests into the following categories: Health Related Fitness Tests, Physical Fitness Tests, Motor Fitness Tests and Sports Skill Tests.

- Health Related Physical fitness is defined as a set of attributes that people have or achieve that relates to the ability to perform physical activity and demonstrates indications of a healthy lifestyle. These tests are performed to measure physical characteristics of an individual. Health related physical fitness tests only measure those components which require physical presence without involving any effort or physical activity from the participants. These tests include assessment of health status through BMI and other somato-type methods along with basic physiological elements like heart rate, lung capacity etc. which are essential for leading a healthy lifestyle and can be achieved through participation in regular physical activity.
- Physical Fitness is defined as a set of attributes that people have or achieve that relate to the ability to perform physical activity of moderate to vigorous (MVP) level and reflect reserve energy to work during any emergency needs. It is also characterized by (1) an ability to perform daily activities with vigour, and (2) a demonstration of traits and capacities that are associated with a low risk of premature development of hypokinetic diseases (e.g., those associated with physical inactivity). Physical Fitness Tests are designed to assess these attributes.

- Motor Fitness is defined as a set of attributes that people have or achieve that relates to the ability to perform physical actions engaging neuromuscular coordination which are associated with sports. Motor fitness tests include the components of physical fitness, but in addition, also include coordination abilities like hand-eye coordination, movement coupling, balance, agility and other coordination abilities specific to particular sports or activity.
- Sports Skill Tests are designed to evaluate the ability of a participant to perform physical tasks associated or related to particular sports and its related skills. Every sports has its own sports skill tests that are designed scientifically and have standard norms to evaluate the performance of an athlete's skill sets.

## 6.3.3 Anthropometric tests

**Anthropometric Testing** is the science of assessing the human body's surface measurements, anthropometric evaluation of an athlete's body is very important in order to assess the fitness of body to a particular type of sports. Different sports require different body specifications (like height, weight, body build, body composition etc.) which provide an extra aid to the athletes possessing ideal body structure. The anthropometrical variables that account for athletes' performance includes stature (height), girth (circumference). width, somatotype, through measurement of body mass, height, push-ups, and biceps girth.

**A. Body Measurements**

1. Body Weight.
2. Stature/Height.
3. Waist-Hip Ratio
4. BMI (Height-Weight Ratio)

**B. Skeletal Girth (Diameters)**

1. Bi-acromial Diameter (Shoulder Width).
2. Bicristal Diameter (Abdominal Width).
3. Bitrochanteric Diameter (Hip Width).
4. Humerus Bicondylar Width (Elbow Width).
5. Wrist Diameter.
6. Femur Bicondylar Diameter (Knee Width).
7. Ankle Diameter.

C. **Circumferences**

1. Chest Circumference.
2. Upper-Arm Circumference.
3. Fore-Arm Circumference.
4. Thigh Circumference.
5. Calf Circumference.

## 6.3.4 Physical tests

These tests are performed to measure physical characteristics of an individual. Physical tests only measure physical presence without involving any effort of the subject. It measures size or components of body or body parts. It requires a tester and a subject to be tested. Examples of tests are measurement of height, weight, circumference, diameter, skinfolds, blood test, X-rays etc.

## 6.3.5 Affective domain tests

Affective domain tests refer to sociopsychological area that deals with human feelings and relationship behaviour of individuals. There tests are to be measure behavior and emotions. In these tests subjects are required to perform mental activities with their best efforts by writing (pen-paper test) their responses, through interviews or projective methods. These tests deal with the techniques of measuring several aspects affective domains which is important for an athlete's performance. Social Behaviour Tests, Personality tests, Tests that assess stress, emotional aspects etc. are part of Affective Domain Tests. These tests are standard tests constructed and designed scientifically by experts.

## 6.3.6 Cognitive domain tests

Cognitive domain is concerned with mental performance or achievement. Tests concerned with cognitive domain involve testing of knowledge and various other mental achievements of athletes like attention span, concentration, focus, intelligence, creativity. Educational institutes teaching subjects like maths, science, literature assess cognitive aspects of students, but with physical education and sports cognitive domain is challenging to assess, as least importance is given to this domain. However, it is very essential that this be evaluated for effective performance and progress. To evaluate athletes and sports participants effectively, a PE Teacher, coach or trainer must have a clear understanding of the cognitive aspects associated with a particular sport or physical activity. It will help the person administering the

test to select and administer appropriate cognitive tests and measurements that are relevant to the training outcome. The cognitive test score can be compared with appropriate standards, and finally, determine grades for scientific judgement on athletes' cognitive abilities.

I. **Tick the correct options.**

1. BMI is an example of which of the following:
   i. Anthropometric Tests
   ii. Physical Fitness Tests
   iii. Psychomotor Tests
   iv. Written Tests
2. Which type of test may be used to test social behaviour?
   i. Anthropometric Tests
   ii. Physical Fitness Tests
   iii. Psychomotor Tests
   iv. Affective domain Tests

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

1. Explain Psychomotor test with an example.
2. Demonstrate with examples the difference between Physical and Psychomotor test.

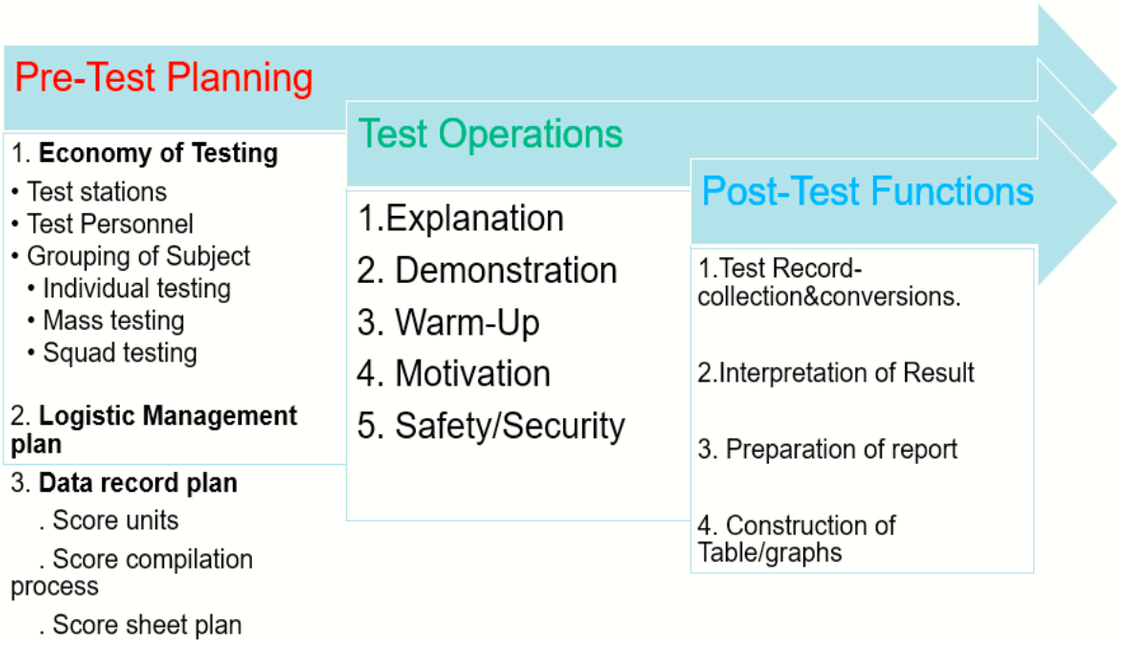
III. **Answer the following questions in 150-200 words.**

1. Discuss the classification of tests with suitable examples

## 6.4.1 Test Administration Guidelines in Physical Education and Sports

Administration of tests deals with the total organization, management, execution, supervision of tests along with proper follow-up function and adequate reporting and utilization of test results. Unsystematic, inefficient or inaccurate testing may be mainly due to ignorance of proper procedure of test administration. The person administering the test must prepare to avoid such situations in the process of test administration. The whole process may be divided into three parts:

i. Pre- planning
ii. Testing Operation
iii. Post- Test Functions




**Pre- Planning**

1. The test planning document must be prepared keeping in mind all stakeholders of the test.
2. Testing stations, score sheets/questionnaire, organization of group, test layout etc. must be prepared before the testing.
3. The information regarding testing purpose, scientific authenticity of test, group size, age, sex must be considered.
4. The test must be planned in such a way that it proves to be most economical in terms of cost of instrument/equipment, economy of time and number of personnel required.

**Testing Operation**

1. All the equipment and facilities to be carefully checked and placed in proper position before subject arrives.
2. All instructions, explanation, demonstration, layout plan illustration should be given to the subject well in advance.
3. Before administering a psychomotor test, a short warm-up is required to avoid injury and assure better performance.
4. Motivation strategies should be adopted for the subjects which help to perform best during the test.
5. The responsibility of the person administering the test and testing personnel is to ensure safety precautions during explanation and demonstration.

6. During testing period the person administering the test should cross check with all necessary points from the check list

**Post-Test Functions**

1. All answer sheets or score sheets must be complied in a safe place and raw scores should be converted into standard scores or may be comparted with norms.
2. Test scores must be interpreted as per standards and norms by applying appropriate statistics.
3. To illustrate the results, appropriate tables, graphs and profile may be prepared.
4. A report should be prepared after the event which indicates the nature, scope and objectives of the testing programme.

I. **Tick the correct options.**

1. Collection of score sheet is a_____ function.
   i. Pre-test
   ii. Testing
   iii. Post-test
   iv. None of Above
2. Testing of scientific authenticity of test is done in which phase?
   i. Pre-test
   ii. Testing
   iii. Post-test
   iv. None of Above

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

1. Write the guidelines of Testing operation phase.
2. Explain pre planning of test administration.

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

1. Discuss Test administration guidelines by giving suitable example

## 7.5.1 Body Mass Index (BMI)

Confusion surrounds the precise meaning of the terms overweight, overfat, and obese as applied to body weight and body composition. Each term often takes on a different meaning depending on the situation and context of use.

Medical literature infers the term overweight as being abnormal or excessive fat accumulation that presents a risk to health. While obesity refers to individuals at the extreme of the overweight continuum. The Body Mass Index (BMI) is the measure most often used for this distinction. The overweight condition refers to a body weight that exceeds some average for stature, and perhaps age, usually by some standard deviation unit or percentage. The overweight condition frequently accompanies an increase in body fat, but not always (e.g., male power athletes), and may or may not coincide with the comorbidities like glucose intolerance, insulin resistance, dyslipidaemia, and hypertension (e.g., physically fit overfat men and women).

When bodyfat measures are available (hydrostatic weighing, skinfolds, girths, bioelectrical Impedance Analysis [BIA], Dual energy X-ray Absorptiometry [DXA] it becomes possible to more accurately place body fat level on a continuum from ~~low to high, independent of body weight. Over fatness, then, would refer to a~~ condition where body fat exceeds an age- and/or gender-appropriate average by a predetermined amount. In most situations, "overfatness" represents the correct term when assessing individual and group body fat levels. The term obesity refers to the overfat condition that accompanies a constellation of comorbidities that include one or all of the following components of the "obese syndrome": glucose intolerance, type 2 diabetes, hypertension, increased risk of coronary heart disease and cancer.

**Extension Activity**

Record the height and weight of all students in your class.

- Find the BMI byapplying formula.
- Find the Waist Hip Ratio using the givenformula.

Clinicians and researchers frequently use the body mass index (BMI), derived from body mass and stature, to assess "normalcy" for body weight. This measure exhibits a somewhat higher, yet still moderate, association with body fat and disease risk than estimates based simply on stature and body mass.

**BMI Computation**

BMI computes as follows:

BMI = Body mass (kg) / stature (m2) Example

Male stature: 175.3 cm, 1.753 m ; body mass: 97.1 kg . BMI = 97.1 / (1.753)2

= 31.6 kg .m-2, or simply 31.6

| BMI | Classification |
|---|---|
| < 18.5 | Under weight |
| 18.5-24.9 | normal weight |
| 25.0-29.9 | Overweight |
| 30.0-34.9 | class I obesity |
| 35.0-39.9 | class II obesity |
| ≥ 40.0 | class III obesity |

## 7.5.2 Waist to Hip Ratio (WHR)

The waist to hip ratio determines the possibility of health risks and is an indication of whether you have an apple- or pear-shaped figure. The waist to hip ratio measurement is calculated by dividing the measurement of your waist by your hip measurement.

- **Aim:** the purpose of this test to determine the ratio of waist circumference to the hip circumference, as this has been shown to be related to the risk of coronary heart disease.
- **Equipment required:** tape measure
- **Procedure:** A simple calculation of the measurements of the waist girth divided by the hip girth.

Waist to Hip Ratio (WHR) = Gw / Gh, where Gw = waist girth, Gh = hip girth. It does not matter which units of measurement you use, as long as it is the same for each measure.

- **Scoring:** The table below gives general guidelines for acceptable levels for hip to waist ratio. Acceptable values are excellent and good. You can use any units for the measurements (e.g. cm or inches), as it is only the ratio that is important.
- **Target Population:** This measure is often used to determine the coronary artery disease risk factor associated with obesity.
- **Advantages:** the WHR is a simple measure that can be taken at home by anyone to monitor their own body composition levels.
- **Other Comments:** The basis of this measure as a coronary disease risk factor is the assumption that fat stored around the waist poses a greater risk to health than fat stored elsewhere in the body.

According to the World Health Organization (WHO), a healthy WHR is:

- 0.9 or less in men

- 0.85 or less for women giving from Tableno-1

e.g., A man who is183 cm tall, and weighs 95 kgs.

**Assessment:** As per Table No 1, ideal weight should be in between 72.6 - 88.9 kg, hence he is overweight.

Table No. 1: Height and Weight Table

| Adults Weight to Height Ratio Chart | | |
|---|---|---|
| Height - Ft. In. (cms) | Female | Male |
| 4' 6" - (137 cm) | 63 - 77 lb - (28.5 - 34.9 kg) | 63 - 77 lb - (28.5 - 34.9 kg) |
| 4' 7" - (140 cm) | 68 - 83 lb - (30.8 - 37.6 kg) | 68 - 84 lb - (30.8 - 38.1 kg) |
| 4' 8" - (142 cm) | 72 - 88 lb - (32.6 - 39.9 kg) | 74 - 90 lb - (33.5 - 40.8 kg) |
| 4' 9" - (145 cm) | 77 - 94 lb - (34.9 - 42.6 kg) | 79 - 97 lb - (35.8 - 43.9 kg) |
| 4' 10" - (147 cm) | 81 - 99 lb - (36.4 - 44.9 kg) | 85 - 103 lb - (38.5 - 46.7 kg) |
| 4' 11" - (150 cm) | 86 - 105 lb - (39 - 47.6 kg) | 90 - 110 lb - (40.8 - 49.9 kg) |
| 5' 0" - (152 cm) | 90 - 110 lb - (40.8 - 49.9 kg) | 95 - 117 lb - (43.1 - 53 kg) |
| 5' 1" - (155 cm) | 95 - 116 lb - (43.1 - 52.6 kg) | 101 - 123 lb - (45.8 - 55.8 kg) |
| 5' 2" - (157 cm) | 99 - 121 lb - (44.9 - 54.9 kg) | 106 - 130 lb - (48.1 - 58.9 kg) |
| 5' 3" - (160 cm) | 104 - 127 lb - (47.2 - 57.6 kg) | 112 - 136 lb - (50.8 - 61.6 kg) |
| 5' 4" - (163 cm) | 108 - 132 lb - (49 - 59.9 kg) | 117 - 143 lb - (53 - 64.8 kg) |
| 5' 5" - (165 cm) | 113 - 138 lb - (51.2 - 62.6 kg) | 122 - 150 lb - (55.3 - 68 kg) |
| 5' 6" - (168 cm) | 117 - 143 lb - (53 - 64.8 kg) | 128 - 156 lb - (58 - 70.7 kg) |
| 5' 7" - (170 cm) | 122 - 149 lb - (55.3 - 67.6 kg) | 133 - 163 lb - (60.3 - 73.9 kg) |
| 5' 8" - (173 cm) | 126 - 154 lb - (57.1 - 69.8 kg) | 139 - 169 lb - (63 - 76.6 kg) |
| 5' 9" - (175 cm) | 131 - 160 lb - (59.4 - 72.6 kg) | 144 - 176 lb - (65.3 - 79.8 kg) |
| 5' 10" - (178 cm) | 135 - 165 lb - (61.2 - 74.8 kg) | 149 - 183 lb - (67.6 - 83 kg) |
| 5' 11" - (180 cm) | 140 - 171 lb - (63.5 - 77.5 kg) | 155 - 189 lb - (70.3 - 85.7 kg) |
| 6' 0" - (183 cm) | 144 - 176 lb - (65.3 - 79.8 kg) | 160 - 196 lb - (72.6 - 88.9 kg) |
| 6' 1" - (185 cm) | 149 - 182 lb - (67.6 - 82.5 kg) | 166 - 202 lb - (75.3 - 91.6 kg) |
| 6' 2" - (188 cm) | 153 - 187 lb - (69.4 - 84.8 kg) | 171 - 209 lb - (77.5 - 94.8 kg) |
| 6' 3" - (191 cm) | 158 - 193 lb - (71.6 - 87.5 kg) | 176 - 216 lb - (79.8 - 98 kg) |
| 6' 4" - (193 cm) | 162 - 198 lb - (73.5 - 89.8 kg) | 182 - 222 lb - (82.5 - 100.6 kg) |
| 6' 5" - (195 cm) | 167 - 204 lb - (75.7 - 92.5 kg) | 187 - 229 lb - (84.8 - 103.8 kg) |
| 6' 6" - (198 cm) | 171 - 209 lb - (77.5 - 94.8 kg) | 193 - 235 lb - (87.5 - 106.5 kg) |
| 6' 7" - (201 cm) | 176 - 215 lb - (79.8 - 97.5 kg) | 198 - 242 lb - (89.8 - 109.7 kg) |
| 6' 8" - (203 cm) | 180 - 220 lb - (81.6 - 99.8 kg) | 203 - 249 lb - (92 - 112.9 kg) |
| 6' 9" - (205 cm) | 185 - 226 lb - (83.9 - 102.5 kg) | 209 - 255 lb - (94.8 - 115.6 kg) |
| 6' 10" - (208 cm) | 189 - 231 lb - (85.7 - 104.8 kg) | 214 - 262 lb - (97 - 118.8 kg) |
| 6' 11" - (210 cm) | 194 - 237 lb - (88 - 107.5 kg) | 220 - 268 lb - (99.8 - 121.5 kg) |
| 7' 0" - (213 cm) | 198 - 242 lb - (89.8 - 109.7 kg) | 225 - 275 lb - (102 - 124.7 kg) |

In both men and women, a WHR of 1.0 or higher increases the risk for heart disease and other conditions that are linked to being overweight.

## 7.5.3 Skinfold measures (3-site)

A skinfold is constituted by a double layer of skin plus underlying fatty tissue (subcutaneous fat). For measuring a skinfold thickness, the skinfold is lifted with the help of thumb, forefinger and middle finger of the left hand and the two jaws of the skinfold calliper are applied about half a cm below the picked fold at usually the pre marked level.

Since, the fatty tissue is quite compressible, therefore, the skinfold is measured at a standard pressure of 10 gm/mm square. Standard skinfold callipers are supposed to exert a pressure of 10 gm per millimetre square on the skin fold. The reading of the skinfold is read approximately 2 seconds after releasing the full pressure on the jaws of the calliper.

**Equipment :** The equipment used for measuring all skinfold widths is a standard skinfold calliper. A number of callipers are in use. But the most reliable are Harpenden, Lange and Lafayette skinfold callipers.

I. **Tick the correct options.**

1. Skinfold technique is used to measure
   - i. weight
   - ii. fat percentage
   - iii. girth measurement
   - iv. over fatness
2. WHR is calculate by
   - i. multiplying waist by hip measurement
   - ii. adding hip by waist measurement
   - iii. dividing hip by waist measurement
   - iv. subtracting waist from hip measurement

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

1. What is BMI?
2. What is WHR?
3. What is Overweight and obesity?

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

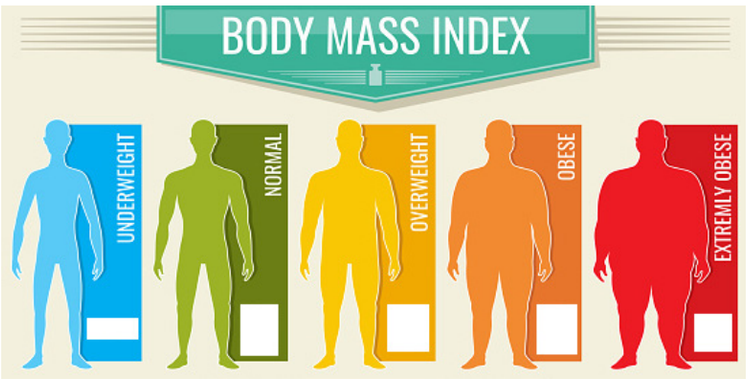
1. Vilas, a male person whose weighs is 90 kg and his height is 1.7 m. Calculate his BMI. Also state the category in which he falls.

IV. **Complete the diagram about some of the tests.**

| | Body Mass Index | Waist to Hip Ratio | Skinfold Measures |
|---|---|---|---|
| Purpose of test | | | |
| How the test is administered | | | |

V. **Case Study**

BMI is considered a very useful test for body composition. People with high BMI are advised to workout and pay attention to their weight with the help of workout and improvement in their dietary habits. Based on this answer the following questions:-




a) What is the range for Normal BMI?

b) 30-34.5 is the range for _____.

c) A person with BMI 26 is _____.

d) Calculate BMI for a male whose weight is 90kg and his height is 1.7m.

VI. **Art Integration**

Design Posters for the Physical Education Testing area, giving instructions and illustrations for each test.

**Suggested Reading:**


- Clarke, H. D. (1987). Application of Measurement to Physical Education. Englewood Cliffs, Prentic Hall.
- Kansal, D. (2008). Text Book of Applied Measurement & Evaluation & Sports. New Delhi: Sports & Spiritual Science Publications.
- Morrow, J. R. (2000). Measurement and Evaluation in Human performance. Human Kinetics.

UNIT 7

# FUNDAMENTALS OF ANATOMY AND PHYSIOLOGY IN SPORTS

## Content

# Learning Outcomes

At the end of this unit, you will be able to:

- identify the importance of anatomy and physiology.
- recognize the functions of the skeleton.
- understand the functions of bones and identify various types of joints.
- figure out the properties and functions of muscles and understand how they work.
- understand the anatomy of the respiratory system and describe it's working.
- identify and analyse the layout and functions of Circulatory System.

**Quiz**

I. Tick the correct answers.

1. Muscles are connected to bones by
   a. ligaments
   b. cartilage
   c. tendons
2. A flexor
   a. decreases the angle at a joint
   b. extends a limb
   c. moves a limb towards the midline
3. Shoulder and Hip Joints are an example of
   a. ball and socket joint
   b. hinge joint
   c. saddle joint
4. Histology refers to the study of the
   a. cells of the body
   b. history of anatomy
   c. tissues of the body
5. The membrane on the surface of a lung is called the
   a. pleura
   b. pericardium
   c. mucosa

## 7.1.1 Definition of anatomy and physiology

Anatomy is a science that deals with the structure of the body and the relationship between the body parts. Or, Anatomy is scientific study of the structure of human body.Early physicians and scientists used to dissect the corpse to understand the relationship between various parts of the body. That's how we came with the word anatomy which is derived from the Greek words Ana which means apart and tomy meaning to cut. Hence, the word anatomy refers to dissection and it can be defined as the science of the structure of a body learned by dissection. In other words, anatomy is the study of the shape and structure of human body and body parts along with their relationship to one another.

**Do you know?**

**Broad Categories of anatomy:**

**Gross anatomy/ Macroscopic anatomy:** It deals with the large structures of the body which can be seen with naked eyes for example digestive system.

**Microscopic Anatomy:** It deals with the structure which only be seen with the help of microscope. For example, cells of human body.

## 7.1.2 Physiology

Physiology is scientific study of the functions of human beings. Or, Physiology is the study of responses of human body to the physical activity.

Physiology is derived from the Greek words physio which means nature and logio which means the study of. The detailed functioning of the body and its part and the responses of the body to a given stimulus are the topics that are covered in physiology.

It can further be understood by the example that when we walk, we can see how our body and its part work in a synchronized fashion or how our heart is continuously working to supply oxygen and others nutrients of our cells.

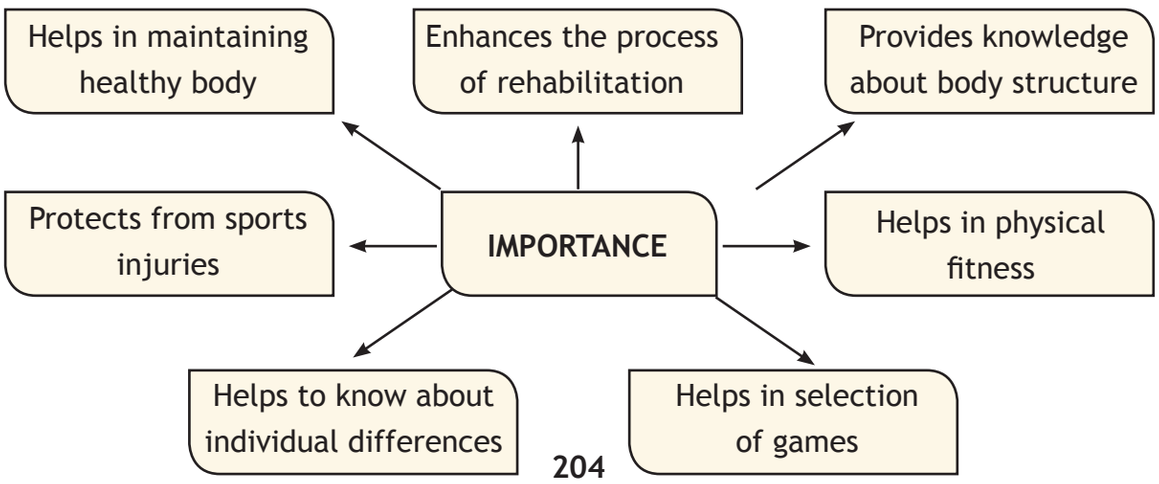
We can also say physiology is the detailed study of life, including the functioning of the smallest of cells, tissues, and other organisms.

Physiology is further divided into sub parts which are as follows:

**Human physiology:** This branch of physiology refers to the study of a specific organism, i.e., the human being.

**Cellular and systemic physiology:** Cellular physiology is the study of the function of cells while systemic physiology is the study of the function of the body's systems.

## 7.1.3 Importance of Anatomy and Physiology



1. **Helps in physical fitness:** Understanding the principles of anatomy and physiology can help a person learn about the body and its functioning which can further help a person to acquire a fit and healthy body. For example, building muscle strength, muscle endurance through appropriate exercises.

2. **Provides knowledge about body structure:** Every individual desires to have a fit body with strong muscles. With the help of anatomy and physiology we can assess our strengths and weaknesses and can work on improving our body. For example, designing an exercise routine based on the requirements and body structure of an individual.

3. **Provides knowledge about the functions of various organs of body:** Knowledge of anatomy and physiology equips us with important knowledge about our body and its systems which can help us train our body in a way that it functions at the optimal level and helps us to lead a healthy and active life. For example, knowledge of cardiovascular system can help us to understand the value of our heart and the importance of physical activity to keep it strong.

4. **Helps in selection of games:** Based on the knowledge of body structure, one can choose a game/sport. For example Basketball or volleyball is a good choice for a tall person and kho-kho is more appropriate for a person who has a short height.

5. **Protects from sports injuries:** Injuries related to sports such as sprain, contusion, fracture, dislocation of joints, etc., are common on the sports field. Sports equipment, based on knowledge of anatomy, is designed to ensure safety. Designing protective equipment in games and sports to provide protection to the soft and delicate organs requires appropriate knowledge about the functions of bones, muscles, tendons, and ligaments. For example, cricket leg pads or helmets are designed based on an understanding of the anatomy and physiology of a cricketer.

6. **Helps in the process of rehabilitation:** Many people suffer from injuries on the sports field, whether it is soft tissue injury or hard tissue injury and due to lack of knowledge of their body. It takes them a long time to recover from these injuries, and in many cases, people may not even recover fully. Anatomy and physiology help us to recover from injuries and attain the preinjury level. For example, suppose your friend twists his ankle while running, and you have a proper knowledge of the anatomy, can administer first aid, like applying ice on the ankle, before taking your friend to the doctor.

7. **Helps in maintaining healthy body:** By making some lifestyle changes and having knowledge about our body, we can attain an ideal weight and a healthy body. For example, knowledge of anatomy provides information about good and bad posture while sitting, standing, lying down, running.

8. **Helps to learn about individual differences between male and female athletes:** Understanding the basic physiological differences between the body of male and female sportspersons is essential because games and sports equipment is designed differently based on these differences. For example, the difference in the structure of shoulders among males and females is the reason for difference in the weights of sports equipment such as shotput, discus, hammer and javelin for males and females.

## 7.2.1 SKELETAL SYSTEM

The human skeletal system is the internal framework of the body which consists of bones, cartilages, joints, and ligaments. A human body has around 300 bones at the time of birth which decreases to 206 bones in a full-grown human as some bones get fused together.

**What makes up the Skeleton**

Skeleton system is an amalgamation of bones, joints, cartilages, tendons, and the ligaments

1. Bones are the rigid part of the skeleton. They provide support to the body and their different shapes help in different type of functions. For example, Metacarpals and phalanges helps your hand to form a fist.
2. Cartilage is more flexible than the bones. It gives shape and flexibility to the body to perform various kinds of movement. For example, it gives shape to our ears and nose, it also helps us to expand our chest while breathing.
3. Tendons and Ligaments are strong bands of fibrous connective tissues. Tendons connect muscles to bone, whereas ligaments connect one bone to another bone.

**Do you know?**

**joint:** a point where two or more bones are connected in the body in a manner that permits movement.

**cartilage:** a form of connective tissue that is semi-rigid yet flexible. It is found in the joints and other places such as the nose, throat, and ears.

**tendon:** a strong piece of tissue in the body connecting a muscle to a bone

**ligament:** fibrous cords that bind the bones together at joints

## 7.2.2 Functions of the SKELETAL SYSTEM

The human skeleton is divided into two functional parts:

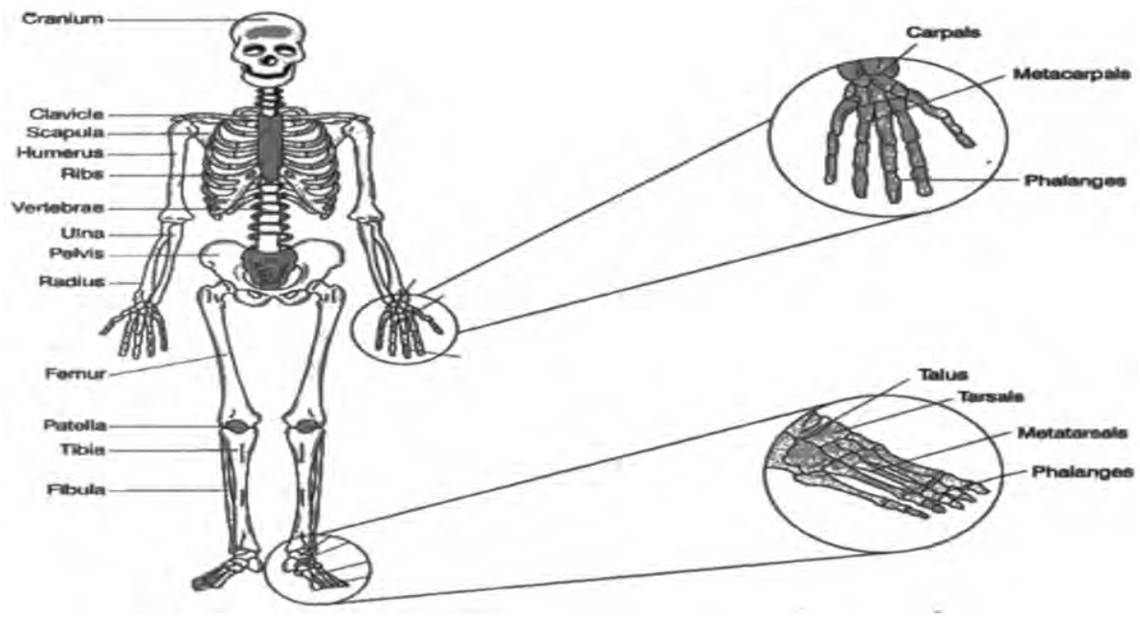
**Axial skeleton** - consists of the vertebral column, the rib cage, the skull, and the vertebra.

**Appendicular skeleton** - is attached to the axial skeleton. It is formed by the shoulder girdle, the pelvic girdle, and the bones of the upper and lower limbs.

**Functions of the Skeleton**

The functions of the skeleton include the following.

1. This skeletal system provides shape and support to the body.
2. It allows the body to create movement by forming the framework of the body, to which the muscles are attached. The movement of the body happens due to the contraction and relaxation of the muscles.
3. Skeletal system provides protection to the soft internal organs. For example, our ribcage protects our heart and lungs, same way our skull protects our brain.
4. The hard substance of the bones also serves as a store house of minerals.
5. Blood cells are also formed within the cavitation of the skeleton which is known as haemopoiesis.




**Extension Activity**

Working in groups of five draw and label the bones of the following parts:

1. Skull
2. Clavicle
3. The kneecap
4. Bones of the fingers and of the palm
5. Bones of the toes and of the feet.

## 7.2.3 CLASSIFICATION OF BONES

Bones can be classified based on different categories:

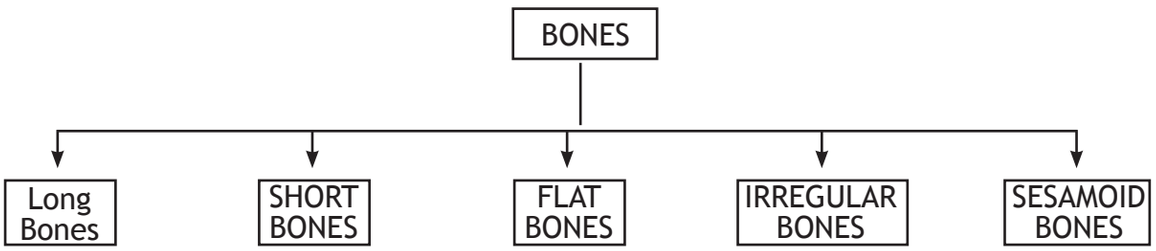
- Classification is based on bone tissue.
- Classification is based on shape and size.

**Classification based on bone tissue.**

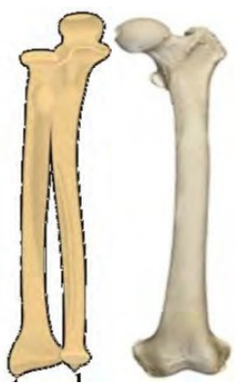
**There are 2 Basic types of bone tissue**

| **Compact Bone** | **Spongy Bone** |
|---|---|
| It is dense, smooth small and homogenous | Compound of needle like pieces of bone |

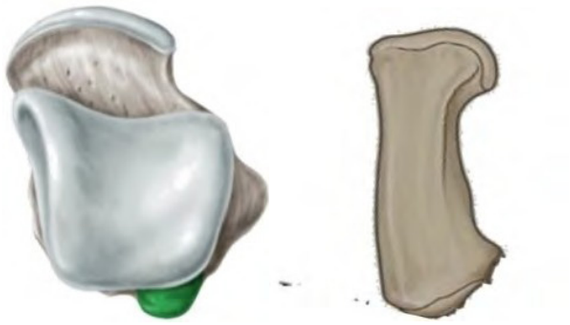
**Classification of bones based on shape and size.**




1. **Long Bones:** Long bones are hard, dense bones that provide strength, structure, and mobility to the body. They are named for their shape bone and not their size. These bones are cylindrical in shape and they have more length than width. The long bone is covered with a fibre sheet except where it joins with another bone. Where the long bone joins with other bone it is covered with a thin sheet of cartilage. Examples of long bones are: upper and lower arm (Humerus, Radius and Ulna), thigh and leg (Femur, Tibia and Fibula), metacarpals and phalanges in toe and fingers. Long bones contain both yellow bone marrow and red bone marrow, which produce blood cells.

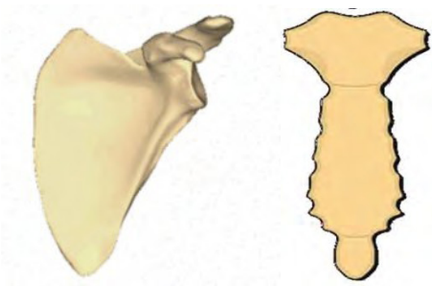


2. **Short Bones:** Short bones have a cube like shape with equal length, width and thickness. A short bone is composed of central spongy bone which is covered with a thin layer of compact bone. The motion of short bones is limited, and they glide on one another. The carpals in the wrist and the tarsals in the ankles are examples of short bones.



Capital (carpal) Bone Talus

3. **Flat Bones:** Flat bones are thin and usually curved. They are composed of a central layer of spongy bone between two outer layers of compact bone. They form a bony cage and help in the protection of soft internal organs. Flat bones are found in cranial bones, ribs, sternum, scapula, and hipbone.



Scapula Sternum

4. **Irregular Bones: Irregular bone**s vary in shape and structure and therefore do not fit into any other category (flat, short, or long). They often have a complex shape, which helps protect internal organs. e.g., the vertebrae. Irregular bones of the vertebral column, protect the spinal cord. Some bones of the skull are also irregular bones.

Vertebra

5. **Sesamoid bones**

- Small and round bones embedded in the tendons. Its shape looks like a sesame seed.
- Its number varies from person to person.
- There is only one type of sesamoid bone known as patellae.

**Extension Activity**

Working in groups of five draw and complete the following table:

| Bone | Type | Where it is found in the body |
|---|---|---|
| Radius | | |
| Patella | | |
| Metatarsal | | |
| Femur | | |

**Do You Know?**

The shortest Bone in the human body is the STAPES found in the middle ear.

## 7.2.4 JOINTS

A joint or articulation (articular surface) is the point where the two or more bones meet and muscles act on them to cause movement.

Though a joint is usually considered movable, but it's not necessary in all the cases. There are many joints which show limited movement and some that are completely immovable.

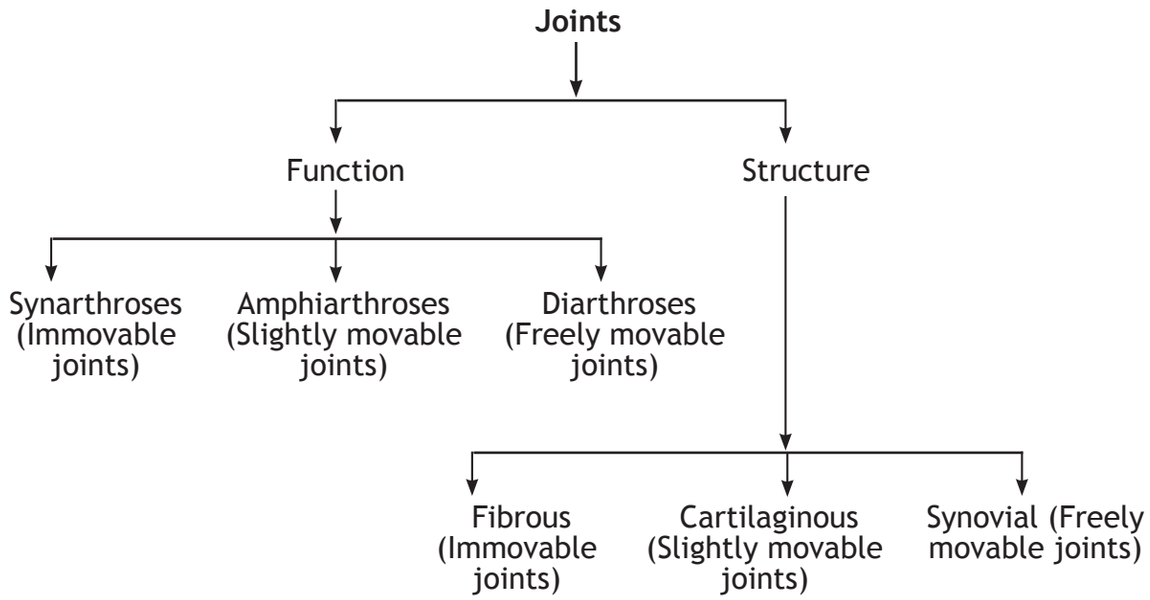
Joints are further classified on the basis of their functions and structure.

**Extension Activity**

Working in pairs, locate the joints in your

- Shoulder
- Arms
- Wrist
- Fingers
- Hip
- Legs
- Toes

Can you identify the movement in these joints?



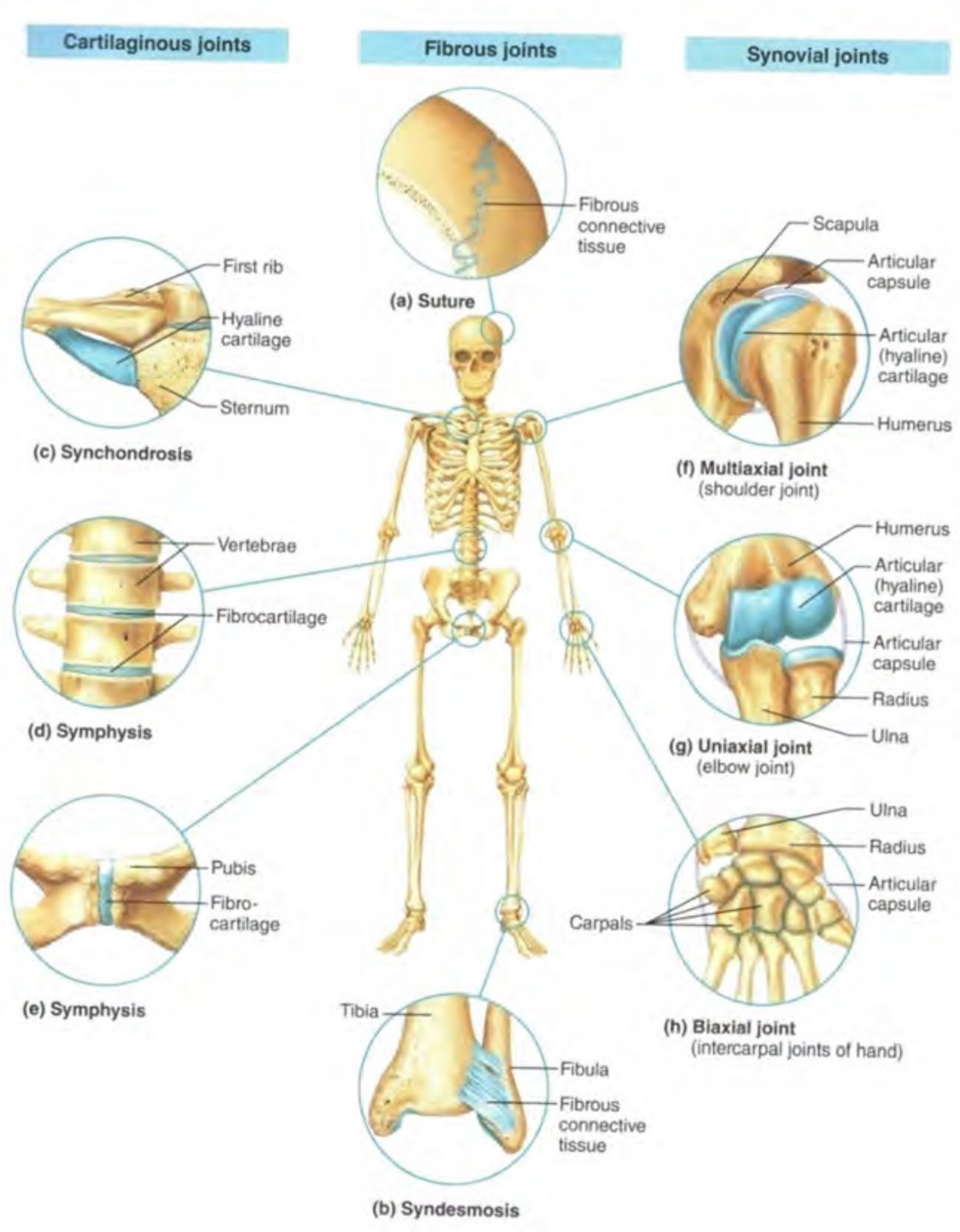

**The functional classification of joints** focuses on the amount of movement permitted by the joint. Based on this:

- Synarthroses or they may be called immovable joints
- Amphiarthroses which are also known as slightly movable joints
- Diarthroses or the freely movable joints.

The freely movable joints are majorly found in the limbs, where movement and mobility are of utmost importance. The immovable or slightly movable joints are mostly found in the axial skeleton where the priority is protection of internal organs and firm attachments.

**In the structural classification** mainly there are fibrous, cartilaginous, and synovial joints. This type of classification is based on whether fibrous tissue, cartilage, or a joint cavity separates the bony regions at the joint.

Fibrous joints are generally immovable and, synovial joints are freely movable joints. Cartilaginous joints have a combination of both immovable and slightly movable joints.

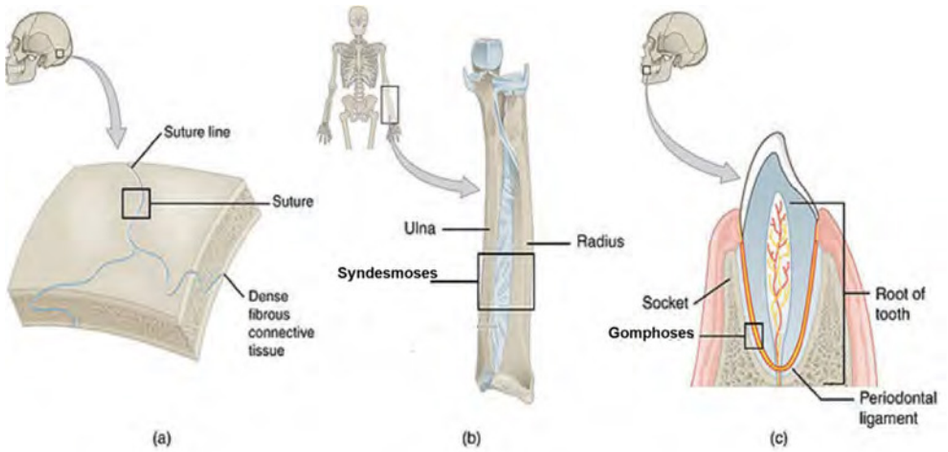



1. **Fibrous Joints** - In this type of joint, the bones are united together by fibrous tissue and show little or no movement. They are again further classified based on structure of the sutures, syndesmoses and gomphoses.

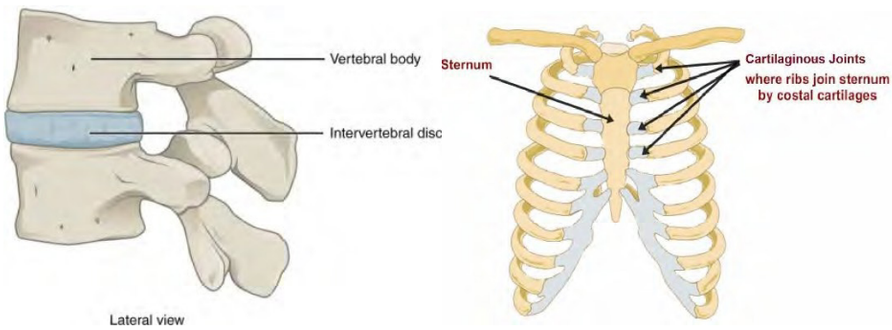
   i. **Sutures** - A suture is a type of fibrous joint forming a tight union between the bones that prevents any movement between them. Sutures are only found between the bones of the skull or the cranium. The skull bones of a foetus are unfused but after birth, the bones slowly begin to fuse to become fixed, making the skull bones immovable to protect the brain from impact.

ii. **Syndesmoses** - Syndesmosis is a fibrous joint in which the bones are separated by some distance and united together with the help of ligaments. e.g., fibrous membrane connecting maximum distal parts of the radius and ulna. Due to the lack of flexibility in these joint structures, ligament injuries in syndesmoses joints are common, particularly at the wrist and ankle.

iii. **Gomphoses**- Agomphosis mostly consists of a peg attached into a socket and held by ligaments. The best example of this is the joint between a tooth and its socket.

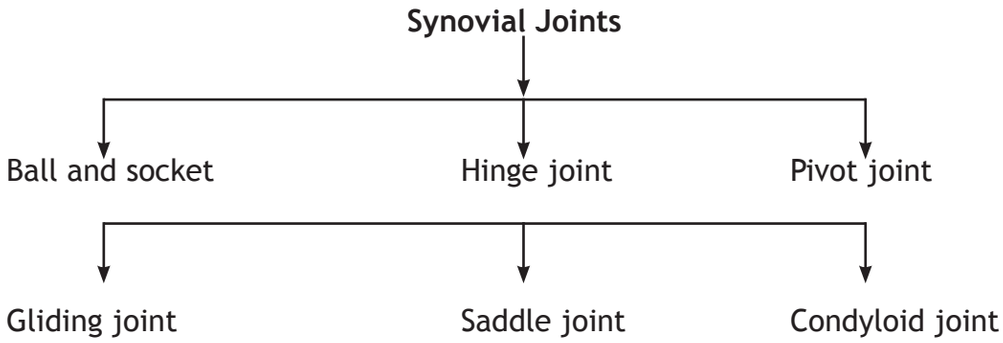



2. **Cartilaginous Joints** - This type of joint unites two bones by the help of a cartilage. Very slight movement can occur at these joints. Another characteristic of this type of joint is that the articulating bone surfaces are connected by pads (discs) of fibrocartilage. For example, cartilage of the growing long bones and the cartilage between the ribs and the sternum.




3. **Synovial Joints -** These are freely movable joints. These joints contain synovial fluid. They are mostly found in the limbs.

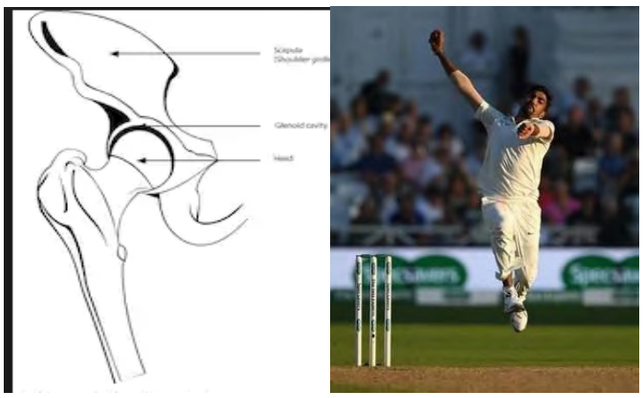
- All synovial joints consist of four distinguishing features.
- Articular cartilage
- Articular capsule
- Joint cavity
- Reinforcing ligament



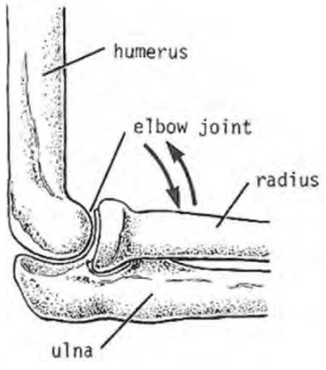

**Types of synovial joints:**

Synovial joints are classified according to the shape of the articulating surface. As you know, they can further be subdivided into the following categories.

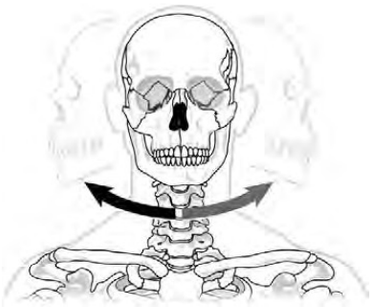
i. **Ball and socket joint:** The ball and socket joint is a type of synovial joint. It is formed when the ball-shaped head of one bone fits into the cup-like socket or depression of another bone. The ball and socket joint allows the greatest range of movement. These multiaxial joints permit movement in all axes including rotation. e.g., hip joint and shoulder joint. This joint allows movement like an overhead clear in badminton or bowling in cricket.



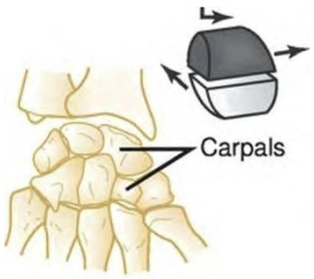
ii. **Hinge joint:** The cylindrical end of one bone fits into a rough shaped surface of another bone. It allows a back-and-forth movement like a hinge in the door. The bones are restricted to do an angular movement. For example, movement of elbow and knee is the example of hinge joint. The extension and flexion movement are essential for building biceps, triceps and quadricep muscles.



iii. **Pivot joint:** Pivot joint, also called rotary joint, is a freely moveable joint that allows only rotary movement around a single axis. The moving bone rotates within a ring that is formed by a second bone and adjoining ligament. For example, the joint between the first and the second cervical vertebrae which allows the turning of the head from side to side.

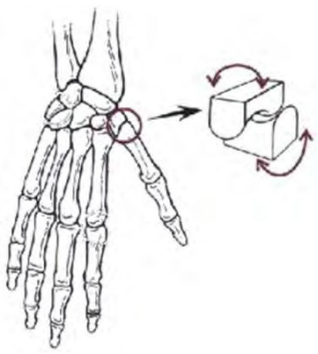


iv. **Plane or Gliding joint:** A gliding joint, also known as a plane joint, is a type of synovial joint that is formed between bones that meet at flat or nearly flat articular surfaces. Gliding joints allow the bones to glide past on one another in any direction along the plane of the joint — up and down, left and right, and diagonally. The movement in this joint is nonaxial which indicates that gliding does not allow rotation around any axis. For example, inter carpals or joints of the wrist.



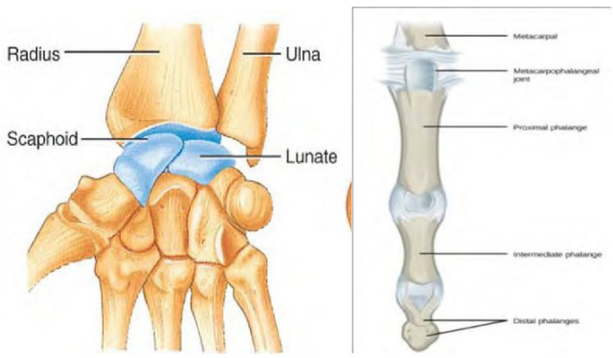

**Plane joint**

v. **Saddle joint:** In the saddle joint, the articulating surface is shaped like a saddle, having both convex and concave areas. The bones in a saddle joint can rock back and forth and from side to side, but they have limited rotation. These biaxial joint sallow very limited movement like the condyloid joints. For example, thumb joint.



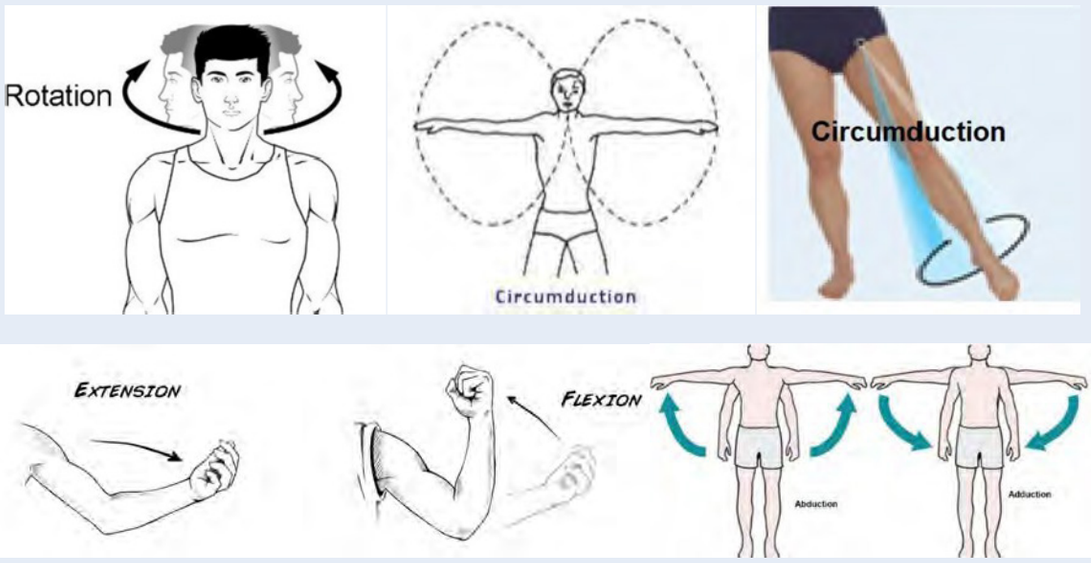
Example of a saddle joint used in sport is in a thumb war. The thumb moves side to side and back and for a thumb war.

vi. **Condyloid joint:** Condyloid joints are a type of synovial joint where the egg-shaped articular surface of one bone fits into an oval cavity in another. This joint allows the moving bone to travel from side to side, back and forth but it does not allow it to rotate. Movement occurs only around two axes so they may be also called biaxial. For example, wrist joint, metacarpal, phalangeal joint. This joint is useful when players use their wrist for dribbling the ball in basketball.




**Extension Activity**

Practice the following movements. Can you identify the joint used?




I. **Tick the correct option.**

1. The short bones are generally
   - i. flat
   - ii. cube-shaped
   - iii. curved
   - iv. thin

2. One of the functions of the skeletal system includes haematopoiesis which refers to

   i. provision of support to the body

   ii. formation of blood cells

   iii. production of minerals

   iv. protection of delicate organs

3. A child has_____bones.

   i. 206

   ii. 213

   iii. 270

   iv. 300

4. Bones serves as a store house for

   i. potassium

   ii. phosphorus

   iii. calcium

   iv. nitrogen

5. According to the functional classification of joint which focuses on the amount of the movement of the joint, synarthroses are also known as:

   i. immovable joints

   ii. slightly movable joints

   iii. freely movable joints

   iv. combination of immovable and slightly movable joints

6. The sutures of the skull are the best examples of:

   i. cartilaginous joints

   ii. synovial joints

   iii. fibrous joints

   iv. freely movable joints

7. The synovial joints in which angular movement is allowed in just one plane is called

   i. hinge joint

   ii. saddle joint

   iii. plane joint

   iv. pivot joint

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

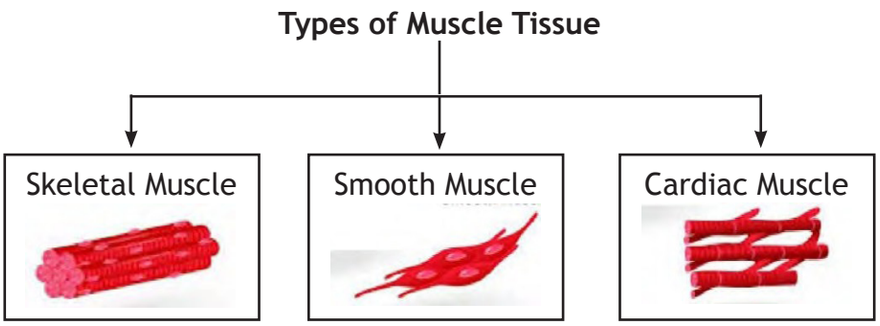
1. Name the longest and the shortest bones in the body.
2. List at least two functions of the skeletal system.
3. Name the four main classification of bones.
4. What are the two basic classifications of a joint?
5. What is the major difference between a fibrous joint and a cartilaginous joint?
6. Name two ball and socket joints of the body.

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

1. Elaborate the functions of the skeletal system.
2. Describe the types of bones found in the human body and discuss their functions.
3. Write about the types of synovial joints in details with suitable examples

## 7.3.1 PROPERTIES AND FUNCTIONS OF MUSCLES

Muscles in our body are responsible for all movement as the movement in our body is either done by the relaxation or the contraction of muscles. The movement of the muscles can be voluntary or involuntary. The pumping of blood by heart is an example of involuntary movement and running or walking is an example of voluntary movement.



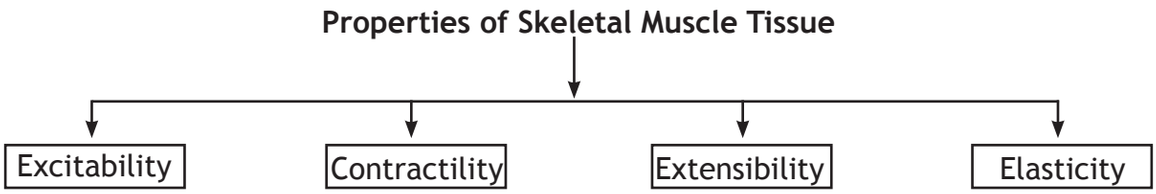

1. **Skeletal Muscles**- Skeletal muscles comprise 40% of the body weight. These muscles are attached to the skeletal system with the help of tendons. These muscles have the ability to exert force. They are also called striated muscles as their striations can be seen when observed under the microscope. These muscles are voluntary in nature which means we can control them at will. For example, walking, running, smiling, eating etc. These muscles can contract most rapidly but not for a long periods, as that results in tiring of the muscle.

2. **Smooth Muscles**- Smooth muscles have elongated, slender, spindle shaped cells. These muscles do not have striations. They are also called involuntary muscles as their expansion or contraction is not under our control. These muscles contract much more slowly as compared to skeletal muscles and cardiac muscles. They are found mostly in hollow organs such as stomach, urinary bladder, and respiratory passages. Smooth muscles are also present in the eyes, where their function is to change the size of the iris and alter the shape of the lens; and in the skin where they cause hair to stand erect in response to cold temperature or fear.

3. **Cardiac Muscles**- Cardiac muscles are found only in the heart where they form the walls of the heart. They are long and striated but not as clearly striated as skeletal muscles. The rate of contraction of cardiac muscles is intermediated between smooth and skeletal muscles. Cardiac muscles are involuntary in nature.

## 8.3.2 PROPERTIES OF SKELETAL MUSCLES

Skeletal muscles have four major functional properties:




**Excitability** is the ability to respond to a stimulus, which may be delivered from a motor neuron or a hormone.

**Contractility** is the ability of muscle cells to forcefully shorten themselves, or the ability for self- contraction.

**Extensibility** is the ability of a muscle to stretch or the capacity to lengthen themselves.

**Elasticity** is the ability to recoil or bounce back to the muscle's original length after being stretched.

## 8.3.3 FUNCTIONS OF MUSCLES

1. **Movement:** Muscles gives strength to the body which helps in contraction and relaxation of the muscle for any kind of movement. Movement can be largely divided into two categories gross movement like walking or fine movement like writing.

2. **Maintenance of posture:** Muscles helps us to maintain our body posture whether it is a sitting posture or a walking posture. Good and strong muscles help us to have a good posture and weak muscles don't have the strength to hold a good posture.

3. **Heat generation:** Our muscles help us to maintain the body temperature. Whenever the body heat falls, skeletal muscles start contractions to bring it to normal. For example, when we shiver the body's mechanism brings our temperature to normal.

4. **Respiration:** Our lungs have a muscle called diaphragm where exchange of gases takes place. When it contracts our chest cavity gets bigger and fills with air and then our diaphragm muscles relax our chest cavity pushes the air out.

5. **Constriction of organs and blood vessels:** Nutrients move through our digestive tract, urine is passed out of the body, and secretions are propelled out of glands by contraction of smooth muscles.

6. **Pumping blood:** Our heart pumps the blood and the smooth muscles in our veins and arteries bring the blood to heart from the cells and vice versa.

**Do You Know?**

The gluteus maximus is the largest muscle in the human body as it has the job of keeping the trunk of the body in an erect posture.

I. **Tick the correct answer.**

1. How many types of muscle tissue are there?

   i. 1

   ii. 2

   iii. 3

   iv. 4

2. Locomotion and facial expression are one of the important responsibilities of

   i. Cardiac muscles

   ii. Skeletal muscle

   iii. Smooth muscle

   iv. cardiac and skeletal muscles

3. The ability of a muscle to shorten forcefully is known as

   i. extensibility

   ii. contractility

   iii. elasticity

   iv. excitability

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

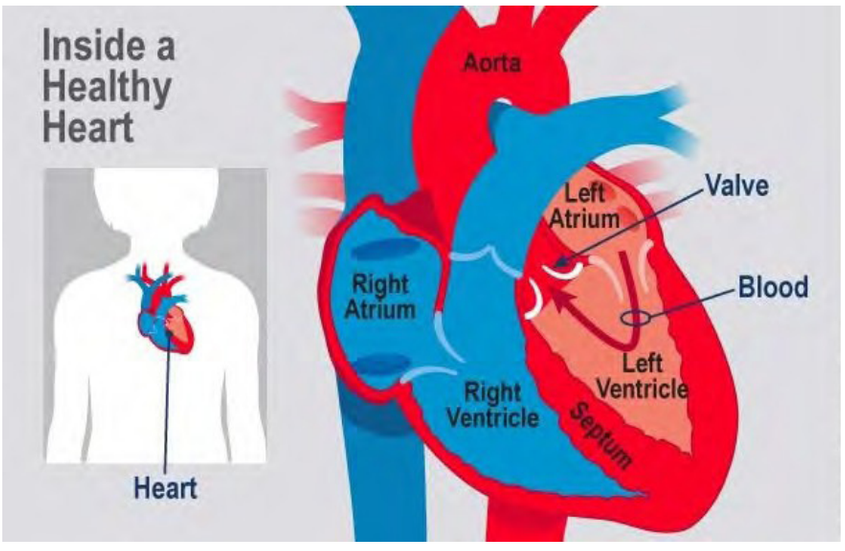
1. What is a muscle? List the major types of muscles.
2. Enlist the four major functional characteristics of the skeletal muscles.
3. Write down the properties of cardiac muscles.
4. How are smooth muscles different from cardiac muscles?
5. Where are smooth muscles found?
6. How do cardiac muscles differ from skeletal muscles?

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

1. What do you understand by the muscular system? Explain the structural classification of muscles.
2. Write down the functions of muscles in detail.

## 8.4.1 STRUCTURE AND FUNCTIONS OF THE CIRCULATORY SYSTEM AND HEART

The circulatory system is responsible for the transportation of the gases i.e., oxygenated blood from heart to the body cells and deoxygenated blood back to the heart, and then deoxygenated blood from heart to lungs and oxygenated blood back to the heart with the help of arteries and veins.



The Circulatory system consists of.

1. **Heart:** It is divided into four parts i.e., two pumping chambers known as ventricles and two receiving chambers known as atria. The two sides of heart is separated by a thick muscular wall called the septum.

2. **Blood vessels:** Blood vessels include veins, arteries, and capillaries. Veins brings deoxygenated blood from the cells to the heart. Arteries take the oxygenated blood from heart to the cells. Capillaries are the thin blood vessels where exchange of nutrients and oxygen takes place.

3. **Blood:** Blood is the bodily fluid which carries all the nutrients and oxygen which have to be transported throughout the body. It consists of red blood cells, white blood cells, plasma and platelets. Blood has red colour because of a red pigment called as Haemoglobin present in it.

There are two parts of circulatory system:

1. **Pulmonary circulation:** In the pulmonary circulation the heart pumps deoxygenated blood from its first pumping chamber i.e., left ventricle through pulmonary artery towards the lungs. The blood flows by touching the diaphragm of the lungs where exchange of gases takes place. After the exchange, the oxygenated blood comes back to the heart in its first receiving chamber i.e., right atrium through pulmonary veins. In the entire body there is only one artery which carry deoxygenated blood – the pulmonary artery and there is only one vein that carries oxygenated blood – the pulmonary vein, and they both are the part of pulmonary circulation.

2. **Systematic circulation:** Once the right atrium receives the oxygenated blood, it sends it to the heart's second pumping chamber i.e., the right ventricle and from their it is pumped to the entire body through aorta which is the body's biggest artery, it looks like a tree supplying water to every branch. At each body part there is a network of thin blood vessels known as capillaries which connect arteries and veins. Capillaries have a very thin layer which helps in exchange of gases and other nutrients. The waste product and deoxygenated blood goes to smaller veins, and then to bigger veins and finally reaches back to the heart. From the heart, blood is pumped into the lungs where it is re-oxygenated and returned to the heart. where it is received by the heart in its second receiving chamber i.e., leftt atrium. And then the cycle is completed. Both the circulations happen simultaneously and the heart controls the whole movement depending upon the requirements of the body. For example, you may have experienced when you run fast your heart beats very fast. That is because your heart is trying to meet the oxygen requirement of your body.

3. **Coronary circulation:** The heart works tirelessly from the day we are born till we die. It also needs oxygen to carry out its function. There are coronary arteries that transport the oxygenated blood to the heart and coronary veins takes the deoxygenated blood back to the right atrium.

**THE HEART:**

The heart is a cardiac muscle which does an alternating movement of contraction and relaxation. When the heart contracts, the term used is systole and when the heart relaxes, the movement is known as diastole. Systole is that movement when the ventricles pump the blood out of the heart and the atrium is ready for the movement of diastole. Whenever blood overflows in the atrium it gives an electronic signal to the brain and the ventricles pump the blood outside the heart and atrium pumps the blood into the ventricles. The amount of blood pumped out of the ventricle in each contraction is known as stroke volume and the amount of blood pumped out in one minute is known as the cardiac output.

**Do you know?**

**Arteries -** blood vessels that carry oxygenated blood from the heart.

**Arterioles -** a small branch of an artery leading into capillaries.

**Capillaries -** any of the fine branching blood vessels that form a network between the arterioles and venules.

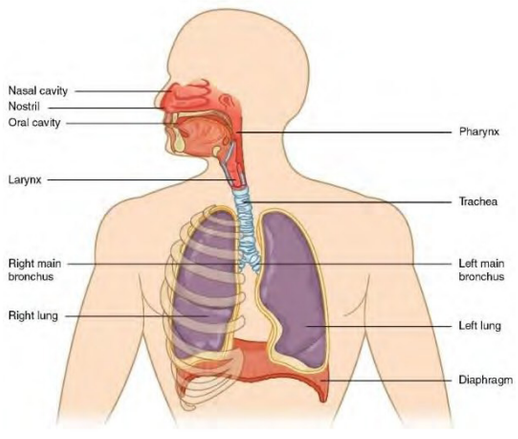
**Venules -** a very small branch of a vein, especially one collecting blood from the capillaries.

**Veins -** blood vessels that carry deoxygenated blood back to the heart

## 7.5.1 STRUCTURE AND FUNCTIONS OF THE RESPIRATORY SYSTEM

Respiration is made up of two phases called inspiration and expiration: You inhale (breathe in) oxygen during inspiration. You exhale (breathe out) carbon dioxide during expiration. Respiration includes the following processes

- Ventilation, the movement of air into and out of the lungs
- Gas exchange between the air in the lungs and blood, sometimes called external respiration
- Transport of oxygen and carbon dioxide in the blood.
- Gas exchange between the blood and the tissues, sometimes called internal inspiration.




**Structure of Respiratory System:**

The respiratory system consists of

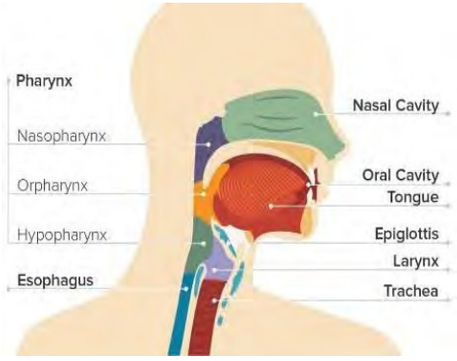
- The nose
- The nasal cavity
- The pharynx

- The larynx
- The trachea
- Bronchi
- The lungs
- Bronchioles
- Alveoli
- Diaphragm

**The Nose:** The term nose usually refers to the visible structure that forms a prominent feature of the face and refers to the internal nasal cavity.

**The Nasal Cavity:** It extends from the external opening in the nose to the pharynx, and it is divided by the nasal septum into right and left side.

**Pharynx:** The pharynx is the common passageway of both the digestive and respiratory systems.




The pharynx can be divided into three regions

**The nasopharynx:** It is the superior part of pharynx and extends from the internal nares of nasal cavity to the level of uvula.

**The oropharynx:** The oropharynx is a passageway for both air and food. It extends from the uvula to the epiglottis. The oropharynx is bordered superiorly by the nasopharynx and anteriorly by the oral cavity.

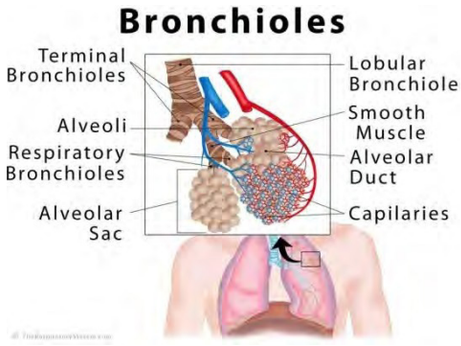
**The laryngopharynx:** The laryngopharynx extends from the epiglottis to the lower margin of the larynx. It continues the route for ingested material and air until its inferior end, where the digestive and respiratory systems diverge.

**Larynx:** The larynx consists of an outer casing of nine cartilages that are connected to each other by muscles and ligaments. It is also known as Voice box.

**Trachea:** The trachea, also known as the windpipe, is a membranous tube that consists of connective tissues and smooth muscles.

**Bronchi:** The trachea divides into the left and right primary bronchi. The main function of the bronchi, like other conducting zone structures, is to provide a passageway for air to move into and out of each lung. In addition, the mucous membrane traps debris and pathogens.

**Bronchioles:** Bronchioles, which are about 1 mm in diameter, further branch until they become the tiny terminal bronchioles, which lead to the structures of gas exchange. There are more than 1000 terminal bronchioles in each lung.



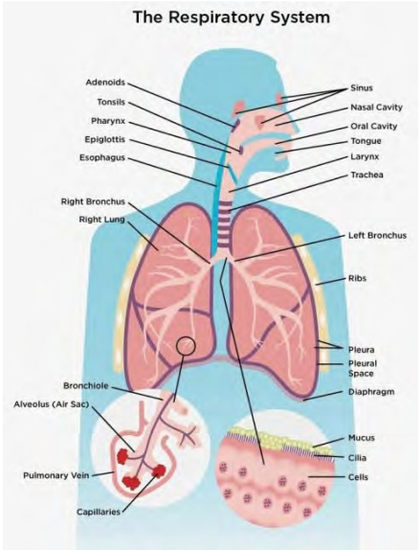

The muscular walls of the bronchioles do not contain cartilage like those of the bronchi. This muscular wall can change the size of the tubing to increase or decrease airflow through the tube.

**Alveoli:** An alveolar duct is a tube composed of smooth muscle and connective tissue, which opens into a cluster of alveoli. An alveolus is one of the many small, grape-like sacs that are attached to the alveolar ducts.

**Lungs:** The lungs are the principal organs of respiration. These spongy, pinkish organs look like two upside-down cones in your chest. Lungs are divided into two parts

**Right lung:** The right lung is made up of three lobes

**Left lung:** The left lung has only two lobes to make room for your heart.



Diaphragm: The diaphragm is a thin skeletal muscle that separates the abdomen from the chest. It contracts and flattens when you inhale. This creates a vacuum effect that pulls air into the lungs. When you exhale, the diaphragm relaxes, and the air is pushed out of lungs.

I. **Tick the correct answer.**

1. Trachea is also known as
   a. Windpipe
   b. Voice box
   c. Pharynx
   d. Nose
2. The movement of air into and out of the lungs
   a. External respiration
   b. Ventilation
   c. Internal respiration
   d. Respiration
3. The principal organ of respiration is
   a. Nose
   b. Larynx
   c. Trachea
   d. Lungs
4. The heart is made up of
   a. Connective tissue
   b. Epithelial tissue
   c. Cardiac tissue
   d. Muscle tissue
5. The heart has_____chambers
   a. Three
   b. Four
   c. Five
   d. Six

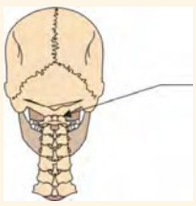
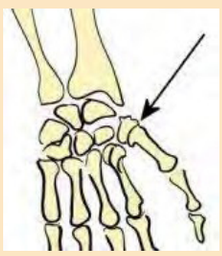
II. **Answer the following questions briefly.**

1. Define respiration.
2. Write a short note onpharynx.
3. Explain the function of the diaphragm in breathing.
4. Define circulatory system
5. Write a brief note on the heart.
6. What is the difference between Arteries and Veins?

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

1. What are the functions of respiratory system?
2. What are the functions of the heart?
3. Describe the circulatory system.

IV. **Identify the bones given below and mention the type of Joint that is formed by them. Also mention its function.**

| Bones | Type of Joint | Functions |
|---|---|---|
|  | | |
|  | | |
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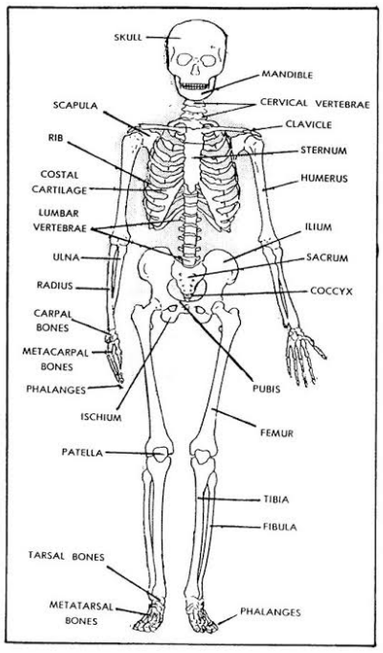
## V. Case Study




On the basis of given picture answer the following questions:-

a. Name any four long bones?

b. How many bones are there in the vertebral column?

c. Scapula is an example of _____.

d. How many carpals are there?

e. Shoulder joint is an example of _____ joint.

## VI. ART INTEGRATION

Working in groups, prepare a 3D model of any one of the systems of the human body that you have studied.

**Suggested Readings :**


- Dhananjay Shaw (2000), Mechanical Basis of Biomechanics, Sports Publication, Delhi,
- Lutlegen, & Nancy, H. (1997). Kinesiology: Scientific Basis of Human Motion. Mc Graw Hill.
- Physical Education and Yog (373). (n.d.). Retrieved 11 25, 2020, from National School of Open Learning:
- https://www.nios.ac.in/online-course-material/sr-secondarycourses/physical- education-and-yog-(373).aspx
- Thompson, & Floyd. (2017). Manual of Structural Kinesiology. Mc Graw Hil.

UNIT 8

# FUNDAMENTALS OF KINESIOLOGY AND BIOMECHANICS IN SPORTS

## Content

- Definition and Importance of Kinesiology and Biomechanics in sports
- Principles of Biomechanics
- Kinetics and Kinematics in Sports
- Types of Body Movements - Flexion, Extension, Abduction, Adduction, Rotation, Circumduction, Supination & Pronation
- Axis and Planes – Concept and its application in body movements

# Learning Outcomes

Students are able to

- understand Kinesiology and Biomechanics with their application in sports.
- explain biomechanical principles and their utilization in sports and physical education.
- illustrate fundamental body movements and their basic patterns.
- learn about the Axis and Planes and their application with body movements.

## Usain Bolt Is Still the World's Fastest Man

Usain St. Leo Bolt, or Usain Bolt as he is popularly known (born August 21, 1986, Montego Bay, Jamaica), is the Jamaican sprinter who won gold medals in the 100-meter and 200-meter races in an unprecedented three straight Olympic Games and is widely considered the greatest sprinter of all time.

At the 2008 Olympic Games, Bolt became the first man since American Carl Lewis in 1984 to win the 100 meters, 200 meters, and 4 × 100-meter relays in a single Olympics and the first ever to set world records (9.69 sec, 19.30 sec, and 37.10 sec, respectively) in all three events. (However, a failed drug test by one of his 4 × 100 teammates led to Bolt's having his gold medal in that event stripped.) His 0.66-sec winning margin in the 200-meter race was the largest in Olympic history. His 0.20-sec edge over the second-place finisher in the 100 meters, despite beginning his victory celebration about 80 meters into the race, was the largest since Lewis won by the same margin. At the 2009 world championships, Bolt shattered his 100-meter record, winning the event final in 9.58 sec. Four days later, he broke his 200-meter record by the same 0.11-sec margin to win a second gold medal at the world championships.

After Usain Bolt's victories with World Records in the Olympic Games in Beijing and then in the World Championship in Berlin, our desire to understand the reasons and the basis of his phenomenal running prowess is quite natural. Even an amateur is able to spot a noticeable difference in the running of Usain Bolt and his rivals. Bolt's running is light, playful, relaxed, and at the same time, impressively powerful.

What is it that defines the superiority of this talented sprinter? What does he do better than others, and what parameters of the environment is he using those others don't?

The analysis of Usain Bolt's running technique with the help of biomechanics, kinesiology, anthropometry, and other related sciences provides us with the supporting factors to understand the phenomena that contribute to such remarkable performance.

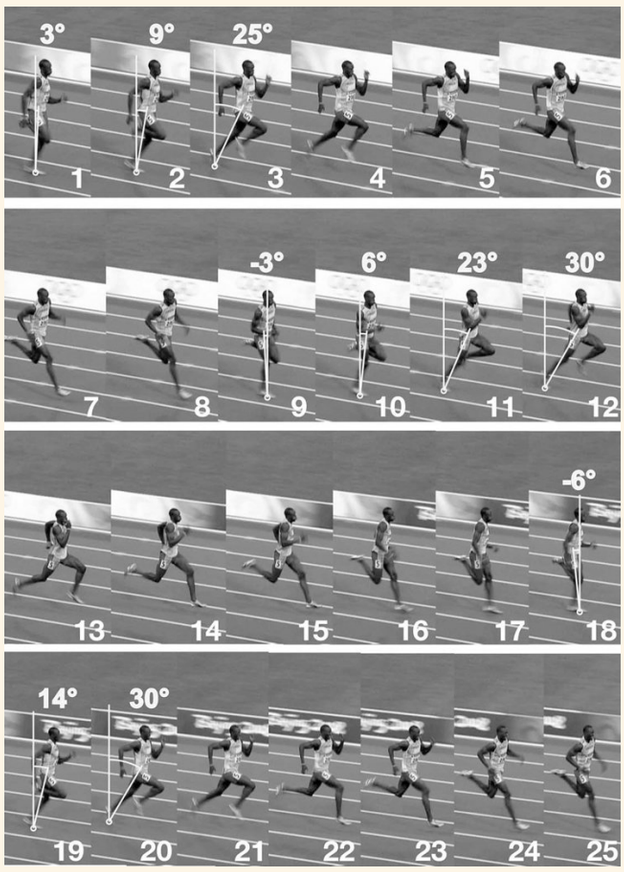
With his height of 6'5", Bolt is practically the tallest athlete in the World's sprinting history. To some extent, though not directly, it is reflected in the length of his running step. In the final heat on 100m in World Championship in Berlin, Bolt made 41 steps with an average length of 2.44m. His closest competitor Tyson Gay (height 5'11''), made 45.45 steps with an average length of 2.20.

The most crucial factor is that Bolt uses gravity, to be more exact, gravitational torque, as the leading factor that allows him to more effectively involve all other forces, working as a whole and highly effective system for horizontal repositioning

the athlete with high velocity.

Simply speaking, in his running, he uses the body's rotation around the point of support under the action of gravitational torque, which in essence is a free-falling of the body forward.

Therefore, Bolt is more effective as a sprinter. Using a unique speed table (developed together with professor A. Pianzin), which takes into account individual anthropometrical data of the athlete, his step frequency (cadence), etc., We got an average data of angles of falling of Usain Bolt and Tyson Gay in the final 100m of World Championship in Berlin. Bolt's calculated average angle in 100m with the time of 9.58 seconds was 18.5 degrees with an intermediate step frequency (cadence) of 4.28 steps per second (257 steps per minute), and Gay's, with the time of 9.71 seconds – 18.4 degrees, and step frequency (cadence) 4.68 steps per second (281 steps per minute).




Running sequence of Usain Bolt, please disregard the degrees and markers.

Image courtesy of Russian Track and Field Magazine.

At the fastest 20m segment of the distance between 60-80m, where Bolt had the highest speed of 12.42 m/s with the step frequency (cadence) of 4.4 steps per second (264 steps per minute), his angle of falling was reaching 21.4 degrees, the same as Gay's with the average speed 12.27 m/s and the step frequency 4.8 steps

per second (288 steps per minute).

All of this makes sense, i.e., speaking in the language of physics, Bolt just more effectively transforms the rotational (angular) velocity of the body into horizontal. At the end of the day, it is not essential how – consciously or accidentally – Bolt came to this technique; the main thing is that his talent allowed him to perform very well. This technique allows him to use his genetic potential and natural gifts to the fullest and develop his psycho-emotional and mental abilities to the highest level.

Some prognosis about his possible progress. If he manages to increase his average step frequency of running to the level of his rivals, just to something around 4.5 steps per second (270 steps per minute) having the same average angle of falling, his result on 100m could be 9.11 seconds. Isn't it impressive? But he, so far, is dreaming "only" about 9.4 seconds!

**Extension Activity**

In the sprinting events, there is a need to have an efficient start; look at the different types of start used by the sprinters in short-distance track events. Read the content below and discuss.

**Discuss in group**

- Identify different types of start in the short sprints.
- Why do different athletes use specific techniques?
- What are the scientific bases for specific techniques?
- Which technique is the best according to you and why?
- What are the kinesiological and biomechanical advantages of different techniques?

*Note: Study of kinesiology and biomechanics will help you answer the following questions, and you will also be able to correlate the techniques and the human movements.*

## 8.1.1 Concept of Kinesiology and Biomechanics

Sports activities are good for health, and everyone wants to remain fit, but only some people know the logic and facts involved in these fitness activities, or you can say

the technical points behind the same. Biology and Physics play a vital role in defining the technicalities behind movement. Coaches and teachers have been engaged with these technicalities and put them to best use in improving the performance of athletes. Knowledge of physical activity is learned through experience, scholarly study, and professional practice. In today's world of sports, knowledge of kinesiology and biomechanics plays a significant role in identifying, designing, and applying a training programme to achieve the best performance. So, insight into kinesiology and biomechanics will always help teachers, coaches, doctors, and sports professionals have the upper hand in their specialty areas.

Kinesiology is the scholarly study of human movement, and biomechanics is one of the many academic subdisciplines of kinesiology. Biomechanics in kinesiology involves the precise description of human activity and the analysis of human movement causes. The study of biomechanics is relevant to professional practice in many kinesiology professions. The physical educator or coach teaching movement techniques and the athletic trainer or physical therapist treating an injury use biomechanics to analyse movement qualitatively.

Kinesiology is 'the science of movement' or 'the study of movement.' It includes the study of movement through anatomy and mechanics, whereas Biomechanics is the 'analysis/ study of forces' and the 'application of the principles of physics and their effect on the human body. In short, we can say that biomechanics is the central part of kinesiology.

## 8.1.2 Meaning of Kinesiology in Sports

Kinesiology is derived from the Greek word kinesis, which means movement, and logos which means to study. Thus, kinesiology is a discipline that studies movements. It is a study of human movement and muscular function. The study of kinesiology seeks to understand the impact of muscle function on health. It draws upon the concepts for several sciences, including biomechanics, anatomy, physiology, and neuroscience. The study of Kinesiology seeks to understand the mechanism of human movement and pinpoint the specific muscle involved in a particular movement. The science of kinesiology views the human body as a machine that functions in a very purposeful way.

Kinesiology, or human kinetics, is a scientific study of human movement. Kinesiology addresses physiological, mechanical, and psychological mechanisms. Applying kinesiology to human health includes strength and coordination, sports psychology, methods of rehabilitation, such as physical and occupational therapy, and sports and exercise.

**Do you Know**

**Aristotle (384-322 BC)** is called "father of kinesiology." Aristotle wrote about three centuries before Christ, "the animal that moves makes its change of position by pressing against that which is beneath it. Hence, athletes jump further if they have the weights in their hands than if they have not, and runners run faster if they swing their arms, for in extension of the arms there is a kind of leaning upon the hands and wrists." Hart said, "from the point of view of mechanics, we may regard Aristotle's work as the starting point of a chain of thought which played an important part in the evolution of the subject."

Aristotle was the first to analyse and describe the complex process of walking, in which rotatory motion is transformed into translatory motion. Aristotle's treatise, Parts of Animals, Movements of Animals and Progression of Animals, described for the first time the actions of the muscles and subjected them to geometrical analysis. The ideas expressed by Aristotle were the forerunners of the ideas of Newton, Borelli, and others. His concepts of leverage, gravity, and laws of motion were remarkably accurate.

## 8.1.3 Definitions of Kinesiology

"Kinesiology refers to the whole scholarly area of human movement study, while biomechanics is the study of motion and its causes in living things."

"Kinesiology is a term formed by the combination of two Greek words, Kinesin, meaning to move, and logos, meaning to discourse." (Rasch & Burke, 1978). When viewed as a discipline, "kinesiology can be defined as studying the movement behaviour of all living organisms." (Burke R.K 1977).

## 8.1.4 Importance of Kinesiology in Sports

1. **Analysing human motion:** The knowledge of kinesiology offers future coaches/ trainers/ physical education teachers a clear insight into the analysis of human movement and helps them understand how motor skills and techniques can be improved to ensure successful participation in various physical activities. Example: analysing fundamental movements with reference to sports skills performed.
2. **Learning and improvement of motor skills:** With the knowledge of kinesiology, a coach or teacher learns the nature and effects of each physical activity. This enables him to select intelligently the exercise which will contribute to achieving the targeted aims for an individual, thereby improving the motor skills to the level of perfection. Example: Teaching and applying correct walking and running patterns for trainees and athletes.

3. **Applying anatomic background will help to prevent injuries:** With the knowledge of kinesiology, one can understand the nature and mechanism of most common musculoskeletal injuries. The appropriate preventive conditioning flexibility and muscle-strengthening exercises help prevent athletic injuries. Applying kinesiological principles to the acts of landing, falling, catching, etc., also, to some extent, prevents injuries on the sports fields. Similar know-how of the muscles will help design appropriate activities and exercises for re-educating the weak muscles during the treatment and rehabilitation of the injuries.

4. **Ensuring economy of movement:** Kinesiology helps analyse the physiological relation, energy utilization, and muscular contraction timing of the physical activity and exercises. The structure and mechanics of human performance are also not ignored in the financial world. Example: minimizing the body movement to regulate energy utilization and improve timing in long-duration activities.

5. **Ensuring effectiveness of movement:** Knowledge of the principles of kinesiology assists in recognizing and analysing the quality of awkward and skilful movements and correcting irregular movements so that movement efficiency can be achieved. Example: Analysing body positioning during snatch and correcting the technique to minimize the change of error in competition.

6. **Aiding clinical purposes like postural analysis, corrective exercise, and rehabilitation:** Kinesiology also helps to identify errors in posture through posture analysis and helps to correct them with the help of corrective exercises and rehabilitation. Example: Analysis of posture among students in school and correcting them if required, with the help of corrective exercise.

7. **Designing and teaching exercise and conditioning:** The importance of kinesiology is to aid the improvement of human structure through intelligent activities and efficient use of the body. The human system improves with the service provided it is used per the principles of kinesiology and efficient human motion. Kinesiology helps improve the individuals' general physical condition and fitness through routine exercise and conditioning design. Example: Teaching students the correct position during sit-ups while training and assessment of physical fitness.

8. **Discovering and recognizing the underlying principles of movement:** Kinesiology is the fundamental science in preparation of professionals in the area of human motion, whether they are in physical education, physical therapy, athletic training, or any other related profession. It provides us knowledge about various parts of the locomotor system. In kinesiology, we get to learn about the particular muscles, bones, and joints that are involved in a particular movement, and to what extent; what principles of mechanics are involved in

the exercises or the activities; what is the effect of gravity and other forces on the muscular system; and how the bones serve as the anatomic levers in the human body and how the muscles provide the necessary force to move the body levers. Kinesiology thus helps us learn and analyse all these aspects and the movements of the human body and discover their underlying principles to improve performance.

9. **Designing and teaching fundamental movements:** Physical educators and coaches apply the knowledge of kinesiology mainly to the movements of the normal body. However, physical educators and the therapists, have one common application in studying kinesiology; they are both concerned with posture and body mechanics of daily life skills and analysing the anatomical and mechanical basis of movement.

10. **Acquiring self-realization about own performance:** Since each sports person has his abilities and potentialities kinesiology helps the coaches and selectors match the performer to the activity and the activity to the performer. Example, basketball players can analyse if they need to correct to improve their jumping ability, which can improve their performance.

11. **Enables effective teaching of motor skills (fundamental motor and specialized motor skills):** Kinesiology helps prepare the physical educator to teach effective performance in both fundamental and specialized motor skills. Perfecting the performance refers to mastery and perfection in the technique and defining standards of skill. On the other hand, perfecting the performer means that an individual sportsperson is made perfect in the given act. The intelligent selection of the methods, skills, and activities help perfect the performer and performance.

12. **Ensures evaluation of exercise and activity and their effect on the human structure:** Physical educators or coaches, who deal with physical development or motor skills, are aided in their job by the knowledge and understanding of kinesiological principles. These help them assess and evaluate the extent of effect produced by exercise and movement to achieve the purpose for which these were prescribed.

13. **Providing benefit to physiotherapists and physical medicine professionals:** Knowledge of kinesiology has a three-fold purpose both for the professionals of physical education and physical medicine in the analysis and modification of human movement. Kinesiology enables them to help their trainees or clients perform with optimum "safety," "effectiveness," and "efficiency." "Safety" should be a significant concern for all the movement professionals while designing or selecting movements or activities to avoid doing any harm to the body

## 8.2.1 Meaning of Biomechanics

The word biomechanics (1899) and the related biomechanical (1856) come from the Ancient Greek bios that means life and mechanike or mechanics refers to the study of the mechanical principles of living organisms, particularly their movement and structure.

Biomechanics is the study of the mechanics related to the functional and anatomical analysis of biological systems, mainly of humans. Study of biomechanics is necessary to study the body's mechanical characteristics and principles and to understand its movements.

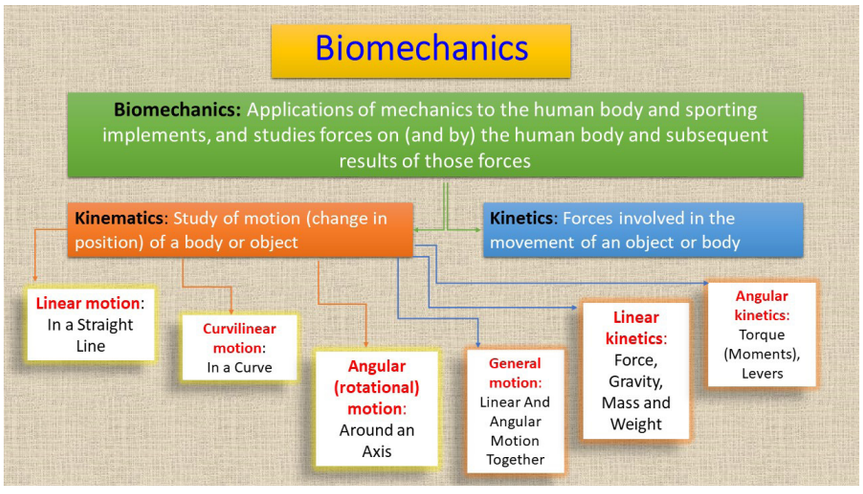
Within "mechanics" there are two sub-fields of study. One is statics which is the study of systems that are in a state of constant motion either at rest (with no motion) or moving with

a constant velocity; and the second one is dynamics, which is the study of systems in motion in which acceleration is present, which may involve kinematics and kinetics.

Kinematics is the study of the motion of bodies with respect to time, displacement, velocity, and speed of movement either in a straight line or in a rotary direction. Whereas, Kinetics is the study of the forces associated with motion, including forces causing motion and forces resulting from motion.

Sports biomechanics is a quantitative-based study and analysis of professional athletes, sportspersons and sports activities in general. In simple terms, it describes the physics of sports. In this subfield of biomechanics, the laws of mechanics are applied to sporting events through mathematical modeling by means of computer simulation, and measurement in order to gain a greater understanding of athletic or sporting performance.

In simple words, sports biomechanics can be expressed as the science of explaining how and why the human body moves in the way that it does



**Do you Know**

Do you know how much strain you put on your body when pushing, pulling, or lifting to move and handle patients with manual aids? Musculoskeletal disorders continue to be an issue among health personnel, and it is more important than ever that we realize that patient transfers present a serious risk of work injuries.

A biomechanical calculation is a method that calculates how large the load on the musculoskeletal system is in any given situation. For example, it is possible to calculate how much strain is on the discs in the lumbar region if a person is standing with a straight back tilted forwards 45 degrees.

To calculate that, we need some values first:

- Height and weight of the person performing the transfer
- How many degrees the person is bending forwards during the transfer
- How much the patient being transferred weighs
- And how far the reaching distance is

**For example,** we might have a situation with a person who weighs 80 kilos, is 186 cm tall, and is bending 45 degrees forward, lifting a weight, weighing 10 kilos, at a reaching distance of 30 cm. This case will result in a strain of approx. 255 kg on the disc in the lumbar region (or the weight of the object).

## 8.2.2 Definitions of Biomechanics

Biomechanics has been defined as studying the movement of living things using the science of mechanics (Hatze, 1974).

"The area of study wherein knowledge and methods of mechanics are applied to the structure and function of the living human system."

"Biomechanics is the science concerned with the internal and external forces acting on a human body and the effects produced by these forces". James. G. Hay

## 8.2.3 Importance of Biomechanics in Sports

1. **Basis for analysing the efficient structure of competitive performance:** Human movement performance analysis can be done in many ways; biomechanics is essentially the science of movement technique and tends to be most utilized in sports where technique is a dominant factor rather than the physical structure or physiological capacities (Analysis the performance of 9.63 at the 2012 London Olympics by Usan Bolt). Following are some of the areas where biomechanics is applied to analyse the efficient structure of competitive performance are given below:

- GAIT Analysis
- Cinematography,
- Videography,
- Electromyography (EMG),
- Accelerometer,
- Dynamometry,
- Electrogoniometry
- The analysis of sport and exercise equipment, e.g., shoes, surfaces, and rackets.

2. **Practical organization of the process of the sport's technical profession:** Sports professionals use technology that helps assess an athlete's performance, using data to track performance, health, and leveraging visual tools that can show how athletes at all levels can improve. Knowledge of Biomechanics helps them apply such tools and obtain data in training, treatment and achieving optimum performances.

3. **Essential for the effective organization of the development of motor abilities:** Sports and games focus on reaching maximum efficiency in motor abilities connected to a particular sports discipline. Motor abilities can be described as relatively stable sets of inner genetic presuppositions needed to carry out locomotive activities. They include force, speed, endurance, coordination, and flexibility. Knowledge of biomechanics helps a coach and teacher understand and apply systematic training for development.

4. **For Diagnostic teaching:** Diagnostic teaching is the process of discovering an athlete's individual abilities, needs, and objectives and prescribing requisite learning assessments. Instructors monitor the trainee's understanding and performance before, during, and after teaching a lesson. Reviewing can inform instructors of their efficacy when conducting assessment and guide them towards areas they need to emphasize in class to aid the athlete's understanding of the material for better learning.

5. **For diagnostic coaching:** Training diagnostics examines and evaluates training and organizational performance through systematic assessments, analysis, and data collection. Knowledge of biomechanics helps a coach and a trainer design training schedule.

6. **For self-evaluation of athletes:** The ultimate aims of an athlete – optimal athletic performance, and reduced risk for injury – go hand-in-hand. The better an athlete's technique through each movement, the better she/he is likely to perform and the more she/he will avoid injuries. Using biomechanics, athletes can look at every tiny detail of how they run, jump, throw, change directions,

and many other related tasks. The information is invaluable. Example: if an athlete is not optimally bending her/his knees during a jumping or landing task, she/he can focus their training to improve their performance through motor learning and improved strength and balance training.

7. **Designing and accepting equipment:** Advances in sports equipment have revolutionized athletic competition with engineers developing equipment that can enhance performance. Biomechanics not only helps in designing new equipment but also tends to measure the efficiency and effectiveness of equipment as per training requirements. Example: T-shirts, studs, spikes, swimming costumes, hockey sticks, different-sized footballs, and low-weight helmets for protection.

8. **Evaluate and change the rules and regulations:** Biomechanics is the study of the structure and function of biological systems using the methods of "mechanics," which is the branch of physics and mechanics involving analysis of the actions of forces. Thus, the laws of mechanics are applied to human biomechanics to have a better understanding of athletic performance through mathematical modelling, computational simulation, and experimental measurement. During such analysis, rules and regulations can be modified for the athlete's safety and performance enhancement.

9. **Evaluate new techniques:** The most common method for improving performance in many sports is to improve an athlete's technique. The application of biomechanics to improve technique may occur in two ways: Teachers and coaches may use their knowledge of mechanics to correct actions of a trainee or athlete to improve the execution of a skill, or a biomechanics researcher may discover a new and more effective technique for performing a sport skill by introducing new technologies. In the first instance, teachers and coaches use qualitative biomechanical analysis methods in everyday teaching and coaching to effect changes in old techniques with the new ones. In the second instance, a biomechanics researcher uses quantitative biomechanical analysis methods to discover new techniques, which then must be communicated to the teachers and coaches who will implement them.

10. **Select techniques about their suitability to the athletes:** Likewise, biomechanics help in developing new techniques in different games and sports; it also helps in selecting techniques for an athlete based on the one most suitable for them which will help them to improve their technical efficiency and bring performance in competition. Example: For a sprinter who is short, a bullet start is preferable in short-distance sprinting events as it helps them to have an efficient start with effective block clearance time and force impulse on the front and rear starting blocks as well as take-off velocity and acceleration

11. **Selection of players:** Biomechanics helps in understanding the complete human body. Knowledge of biomechanics provides the teachers and coaches with a better understanding of the human body in terms of structural and functional qualities as also the various internal and external forces that affect movement. This understanding helps a teacher and coach to select the players according to the requirements of the sport. Example: short players for gymnastics and tall players for Volleyball etc.

12. **Design and develop exercises for the best outcome:** Employing the principles of Biomechanics enhances performance by utilizing mechanical principles to improve an individual's technique, decide the exercise they use, and modify specific training protocols that the coach or trainer implements to help an individual achieve their utmost potential. Biomechanics is used to develop an exercise that improves performance and reduces the chance of injury since it is designed based on how the body is going to adapt to the biomechanical stress placed upon it. Example: Instead of a full-squat an athlete can perform a half-squat with less stress on the knee joint and lower back muscles.

13. **Prevention and rehabilitation of injuries:** Injuries are fairly common on the sports field. However, a good knowledge of biomechanics helps in preventing injury in various ways. Example, analysis of the runner's style of running, her/his arm swing, foot strike, and even trunk leaning will determine the cause of injury. In fact, just as biomechanics is useful in identifying what forces may have caused an injury, it also helps determine how to prevent the injury from recurring. It also helps in the process of rehabilitation of injuries by helping determine the exercises that may help in the process of rehabilitation. Biomechanics is used to provide the basis for changes in techniques, equipment, and training to prevent injuries.

I. **Tick the correct options**

1. The science that deals with the movement aspect of the human body is known as

   a. Physiology

   b. Anatomy

   c. Botany

   d. Kinesiology

2. The scientific study of the human or non-human body movements it is known as

   a. Physiology

   b. Anatomy

c. Biology

d. Kinesiology

3. Sports biomechanics can be described as-

a. Mechanics of sports

b. Kinesiology

c. Physics of sports

d. Sports dynamics

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

1. Define Kinesiology.

2. Define Biomechanics.

3. List the importance of Kinesiology in sports.

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

1. Explain the importance of Biomechanics in the field of sports.

2. Explain the importance of Kinesiology in the field of sports.

3. 'Knowledge of biomechanics helps in the selection of players', Discuss in the context of any one game of your choice.

4. 'Knowledge of kinesiology help to design and teach fundamental movements', justify.

5. What do you understand by the concept of sports biomechanics? Write in your own words with suitable examples from sports?

**Extension Activity**

Working in groups, identify the activities in you school, among yourself, where you can relate biomechanics and kinesiology, and list any five below.

| S. No. | Activities | Relationship |
|---|---|---|
| 1. | | |
| 2. | | |
| 3. | | |
| 4. | | |
| 5. | | |

## 8.3.1 Principles of Biomechanics in Sports

The nine principles of biomechanics constitute the minimum number of core principles that can be applied to all human movements. The principles can be organized into

ones dealing primarily with the creation of movement (process) and ones dealing with the outcome of various projectiles (product). These principles are based primarily on the work of several bio-mechanists (Norman, 1975; Hudson, 1995) who have developed generic biomechanical principles for all human movements. Many biomechanics books have proposed general principles for all movements (Meinel & Schnabel, 1998); various categories of human movements like throwing, catching, and running (e.g., Broer & Zernicke, 1979; Dyson, 1986; Kreighbaum & Barthels, 1996; Luttgens & Wells, 1982); or specific movements (e.g., Bunn, 1972; Groves & Camaione, 1975). Some bio-mechanists believe that general principles applicable to all sports are difficult to identify and have limited practical application due to unique goals and environmental contexts of skills (Hochmuch & Marhold, 1978).

## 8.3.2 The Nine Biomechanics Principles are:

1. Force-Motion
2. Force-Time
3. Inertia
4. Range of Motion
5. Balance
6. The Coordination Continuum
7. Segmental Interaction
8. Optimal Projection
9. Spin

1. **Principle of Force-Motion:** The Force-Motion Principle states that it takes unbalanced forces (and the subsequent torques they induce) to create or modify our motion. Unbalanced forces act on our body, or an object, creating or modifying movement. A free-body diagram is a simplified model of any system or object drawn with significant forces acting on the object. Forces must act first before changes in motion can occur. Force-Motion Principle suggests that muscle groups that primarily contribute to interest motion should be trained. Example: Standing still- forces acting on a person are equal and because of this there is no movement.

2. **Principle of Force-Time :** The Force-Time Principle states that modification of movement depends on the timing of force application as much as the size of the forces used to create it. It is not only the amount of force that can increase the motion of an object, as also the amount of time over which power can be applied to affect the resulting motion. Increasing the time to use force is also essential in slowing down objects (catching) and landing safely. (Impulse = Force x Time. The greater the time of which force is applied the greater

the resulting motion.) Example: Using the sweep shot in hockey wherein more force and time are applied giving it much more power than a hit.

3. **Principle of Inertia :** Inertia can be defined as the property of all objects to resist changes in their state of motion. The linear and angular inertia measures are mass (m) and moment of inertia (I). We will see that inertia can be viewed as a resistance to motion in the traditional sense, but this property can also be used to an advantage when modifying movement or transferring energy from one body segment to another. Example: To stop a shotput or a netball travelling through the air a force must be applied to it. The force is much higher to stop a shotput because it is heavier than a netball. Therefore, the shotput has more inertia.

4. **Principle of Range of Motion:** Range of Motion is the overall motion used in a movement; it could be linear or angular motion of the body segments. The purpose of some movements might require that somebody segments limit range of motion, while others requiring maximum speed or force might require more extensive ranges of motion. Increasing the range of motion in a movement can effectively increase speed or gradually slowdown from a high speed. Since moving through a range of motion takes time, this principle is related to the force-time principle. The Range-of-Motion Principle states that less range of motion is most effective for low-effort (force and speed) and high-accuracy movements. In contrast, a more excellent range of motion favours maximum efforts related to rate and overall force production. Example: Reduced Range-of-Motion (R.O.M) = Throwing a dart and Increased (R.O.M) = Throwing a javelin

5. **Principle of Balance:** Balance is a person's ability to control their body position relative to some support base. Stability and mobility of body postures are inversely related. In other words, the degree of control over stability or instability depends on several biomechanical factors. It relates to centre of gravity, stability, and equilibrium. To increase stability, increased base of support and lower centre of gravity increases mass of the body. Line of gravity should fall in the middle of your base of support for maximum stability. Example: Sumo wrestlers have a very wide and low stance to maximise their stability when wrestling. They also train to have an extremely large mass.

6. **Principle of Coordination Continuum:** How the muscle actions and body segment motions are timed in a human movement is usually referred to as coordination. The Coordination Continuum principle says that determining the optimal timing of muscle actions or segmental motions depends on the movement's goal. More simultaneous muscle actions and joint rotations are usually observed if high forces are the movement's goal. Low-force and high-speed movements tend to have more sequential muscle and collective efforts. These strategies (simultaneous/sequential) can be viewed as a continuum,

with the coordination of most motor skills falling somewhere between these two strategies. Example: Simultaneous = weight lifting and Sequential= Base Ball Pitcher

7. **Principle of Segmental Interaction:** The principle of Segmental Interaction says that the forces acting in a system of linked rigid bodies can be transferred through the links and joints. Muscles usually work in short bursts to produce torques that are precisely coordinated to complement the effects of torques created by forces at the joints. (Transfer, summation, sequential). Example: In Golf and Tennis shots, the player uses his body parts in order to create maximum power. (Begins with the largest, slowest, and strongest segments and works through to the slowest and fastest segments).

8. **Principle of Optimal Projection:** The biomechanical principle of optimal projection says an optimal range of projection angles for a specific goal for most human movements involving projectiles. There is an optimal angle of projection to achieve a specific goal. Maximum speed/distance of an optimal angle=45 degrees. Example: maximum distance can be achieved by hitting a golf ball on a level plane this causes the golf ball to be hit at exactly 45 degrees.

9. **Principle of Spin:** The principle of Spin or rotations applies largely to projectiles, and particularly sports balls. Spin is desirable on thrown and struck balls because it stabilizes flight and creates a fluid force called lift. This lift force is used to create a curve or counter gravity, which affects the trajectory and bounce of the ball. Spin stabilizes the orientation of the ball, which ensures aerodynamically efficient flight. Example: A tennis player putting a top spin on a ball to make it drop quicker.

**Extension Activity**

**Discuss with your group**

- How can the study of sports biomechanics help a coach to train their trainee in a better scientific manner?

Design a poster to show the importance of sports biomechanics in Physical Education and Sports

I. **Tick the correct options**

1. _____ is a person's ability to control their body position relative to some support base.

   a. Inertia

   b. Balance

   c. Spin

   d. None form above

2. Simultaneous = weight lifting and Sequential = Base Ball Pitcher is an example of

   a. Inertia

   b. Balance

   c. Spin

   d. Coordination Continuum

3. Using the sweep shot in hockey, wherein more force and time are applied, gives it much more power than a hit and is an example of which Principle of Biomechanics.

   a. Force-Motion

   b. Force-Time

   c. Range of Motion

   d. Segmental Interaction

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

1. Define principle of optimal projection.

2. Define principle of force-time.

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

1. List down the principles of biomechanics and explain any 2 in detail.

## 8.4.1 Kinetics and Kinematics in Sports

The human body has evolved to its present form through many mutations. It may be unique concerning its anatomy and physiology, but the same laws and principles that govern all other animate and inanimate objects in the universe are also applicable to humans. All motor skills are performed with an implement (bat or racket) or without being influenced by one. In most instances, a number of these physical laws and principles are commonly considered mechanical laws and principles, and they may be classified as static or dynamic involving, on the one hand, objects in a state of static equilibrium and, on the other, objects in motion. Dynamics is further subdivided into Kinematics and Kinetics.

Sports biomechanics is traditionally divided into the study of kinetics and kinematics. Kinetics is the study of the relationships between the forces acting on the body and how those forces affect motion. Kinematics is the geometry of objects' motion, including displacement, velocity, and acceleration. In simple terms, kinetics studies the muscles that cause movement (gravity, friction, etc.), while kinematics describes the motion (velocity, acceleration, etc.)

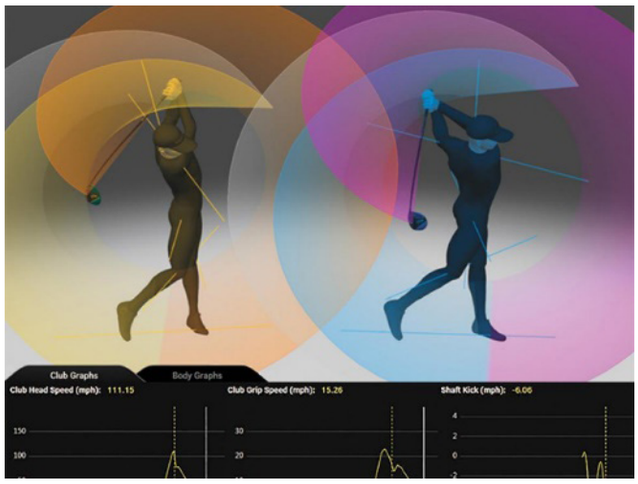
Kinematics analyses motion in terms of time, displacement, velocity, or acceleration. In the language of science, it is the geometry of motion, describing the above four states of motion as they occur either in a straight (linear) line or in a rotary (angular) direction. Thus, we can sat that Kinematics is the mechanics of motion without reference to the forces causing that motion – so only from a geometrical point of view. This is the displacement and velocity of your body's segments and joints.

Kinetics is the action of forces in producing or changing motion. This considers the influence of various interacting objects and how they react with one another. Therefore, we can say that Kinetics is that aspect of dynamics that considers the force that causes objects or bodies to move. Force may be a pull or a push. All levers in the human body are pull-type machines, but in performing skills, the element of inspiration becomes a mechanical part of the actual skill, like the hand's force that 'pushes' the shot. Human levers produce force to overcome resistance, and this action is working. Kinetics considers the forces which cause motion and includes Newton's three 'Laws of Motion. For example, in the study of the golf swing, kinematics focuses on details of the swing 'motion' such as the shape of the clubhead, its path, position of the body and club at various swing events, velocities of the body parts and club, and the timing of slow-down of the body for speed-up of the club. To accurately describe the swing motion, it is essential to measure it accurately. Therefore measurement of motion is one of the central aspects of kinematics.

**Do you Know?**

Kinematics and kinetics are sub-areas of biomechanics. Kinematics is the study of the description of motion, while kinetics is the study of the explanation of motion. In kinematics, the focus is on the object's motion, while kinetics focuses on the cause of motion dealing with the 'why.'

Fundamental kinematic quantities include time, position, displacement (distance), velocity (speed), and acceleration. In addition to these, shapes of trajectories of various points on the body, club, and orientation of motion planes of multiple body segments and clubs are also kinematic issues. A complex motion of an object can be resolved into the linear motion of the centre of mass (COM) of the body and the angular motion of the body about its COM, which is also a kinematic issue. The kinematic sequence plot is based on the angular velocity patterns of body segments, lines, and clubs.




Picture source: https://www.golfdigest.com/story/stuff-gears-golf

**Do you Know?**

**The Fundamental Differences Between Kinetics and Kinematics**

| S.No. | Attributes | Kinetics | Kinematics |
|---|---|---|---|
| 1. | Definition | Kinetics is the study of motion considering the mass and external forces as well. | Kinematics is not dependent upon the mass of the object. |
| 2. | Relation | It attempts to determine the relationship between the motion of bodies caused by inertial force and the mass of a body. | Kinematics is about simply describing motion. Such as velocity, displacement, time, and acceleration. |
| 3. | Study | Study of the motion caused by forces, gravity, friction, torque | To determine the "how" of motion. |
| 4. | Nature | It attempts to get at the cause. | It is descriptive and based on observation |
| 5. | Treated | Treated in terms of energy transformations | Treated geometrically |
| 6. | Example | A person sitting inside the train. A child running around in the house, running fan | A Moving Train Parabolic locus traced by a football. A stone hitting the ground. |
| 7. | Uses | Concept of gas laws, fluid dynamics, physical chemistry | Classical mechanics in terms of engineering. |

I. **Tick the correct options**

1. The kinematics analyses motion in terms of
   a. Time
   b. Displacement
   c. Velocity
   d. All of the above
2. Sports biomechanics is traditionally divided into the study
   a. Kinetics
   b. Kinematics
   c. Both a and b
   d. None of the above

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

1. Define Kinetics.
2. Define Kinematics.
3. List the importance of Kinesiology in sports.

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

1. List down the difference of kinetics and kinematics.

## 8.5.1 Movement

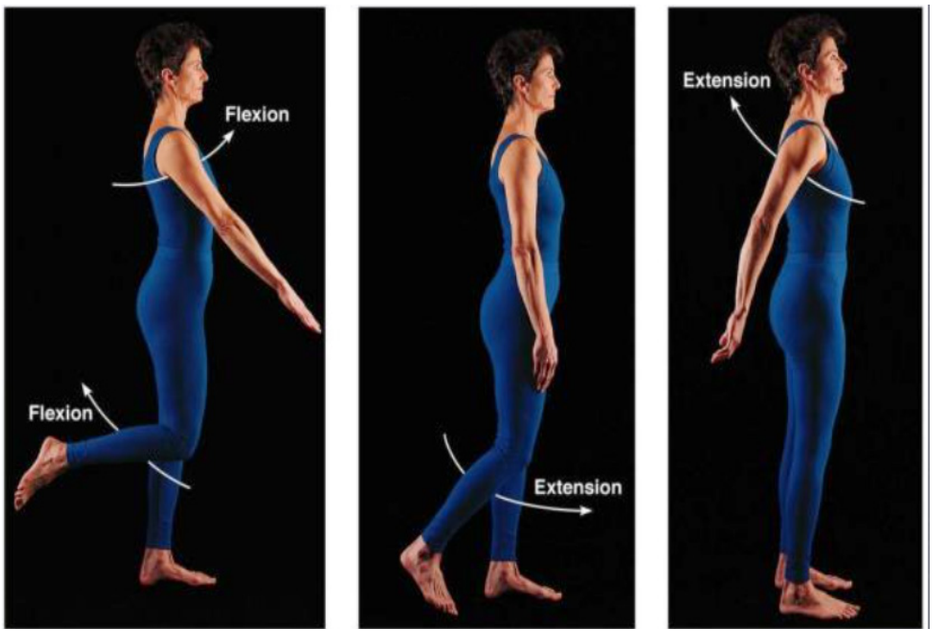
Movement or motion is the act of moving, change of place or posture, or transference, by any means, from one situation to another. Humans can move from one place to another through coordinated movements and postures. The movement produced by the human body due to the contraction of muscles and bending of bone joints is called human movement. Human movements are controlled by the nervous system. Hence, human movement incorporates the use of muscles, ligaments, joints, and bones.

Movement is one of the things that differentiates a living thing from a non-living thing. As referred to earlier, movement is the change in the position of an object. In the human body, it takes place when the living organism moves a body part or a combination of parts to bring about a change in position. We use the term locomotion to describe the movement which results in the change of position of the whole organism. It is important to understand the difference between the two – movement and locomotion – in relation to living things.

There are a variety of movements that happen in the human body, e.g., the movement of eyelids, heart muscles, jaw, and teeth. In addition, more complicated movements are performed in sports and games. To understand such basic to complex movement let's discuss the fundamentals of movement first.

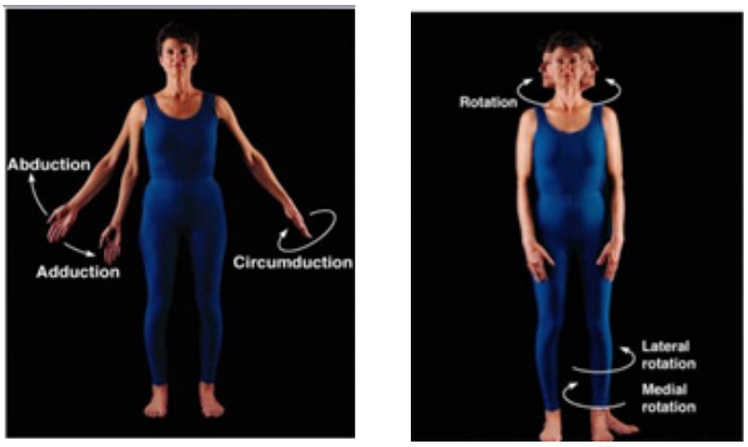
## 8.5.2 Types of Body Movements

1. **Flexion-** it is the bending of flexing a limb. Closing/ decreasing the angle at the moving joint.
2. **Extension-** it is straightening or extending a limb. Opening/ increasing the angle at the joint. It is the opposite movement of flexion.




Picture source: https://www.slideserve.com/garan/body-movements

3. **Abduction: -** Moving a Limb away from the body's centreline.
4. **Adduction: -** Moving a Limb towards the body's centreline is called adduction.
5. **Rotation:** It is the movement around the long axis.

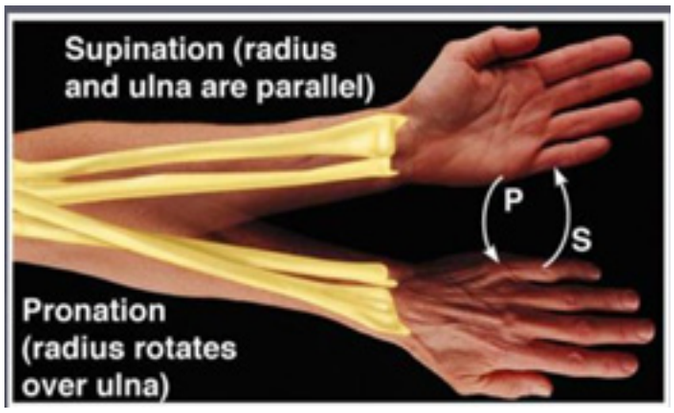



Picture source: https://www.slideserve.com/garan/body-movements

6. **Circumduction:** It combines flexion, extension, abduction and adduction. Usually this movement occurs at ball and socket joints like shoulder joint, hip joint, etc.

7. **Pronation:** It means turning the palm down.

8. **Supination:** It means turning the palm up.




Picture Source: https://www.slideserve.com/garan/body-movements

## 8.5.3 Axis and Planes

In kinematics, the limbs or segments of the body are assumed to rotate about the joints, with no translational, or sliding, movement. While this is not strictly correct, it offers a usable approximation of the actual joint motion. The joint serves as an axis (a line around which something can rotate), and associated with the axis is a plane, (like a sheet of paper perpendicular to the axis), in which the rotational movement takes place.

For a better understanding of the axis and planes of movement, we must know the following terminologies:

- Anterior/ Ventral- towards the front of the body
- Posterior/Dorsal- towards the back of the body
- Superior/Cranial- towards the head of the body or upper part of the body.
- Inferior/Caudal- towards the lower part of the body.
- Medial- towards the midline of the body (inner side).
- Lateral- away from the midline of the body (outer side).

## 8.5.4 Plane

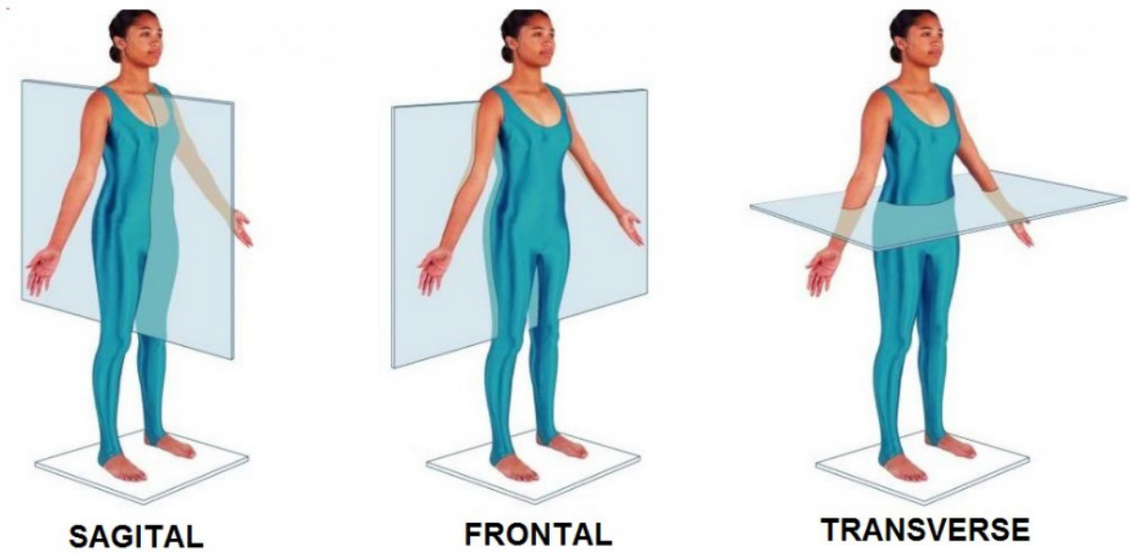
A single plane divides the entire body into two parts. There are three planes of motion in which our body moves. Most of our moments are not straight up or down or side to side or in a single direction etc., especially in sports.

a. **Sagittal plane (Median plane): -** It lies vertically and divides the body into right and left parts. Flexion and extension types of movement occur in this plane. Example: kicking a football, chest pass in netball, walking, jumping, and squatting.

b. **Frontal plane (lateral or coronal plane): -** It also lies vertically and divides the body into anterior/ Ventral- and posterior/ Dorsal- parts. Abduction and adduction movements occur in this plane. Example, jumping jack exercises, raising and lowering arms and legs sideways, and cartwheel.

c. **Transverse plane (horizontal plane): -** It lies horizontally and divides the body into superior and inferior parts. Rotation types of movement occur in this plane. Example, hip rotation in a golf swing, twisting in a discus throw, pivoting in netball, and spinning in skating.

*"The centre of gravity may be defined as the point at which the three planes of the body intersect each other".*

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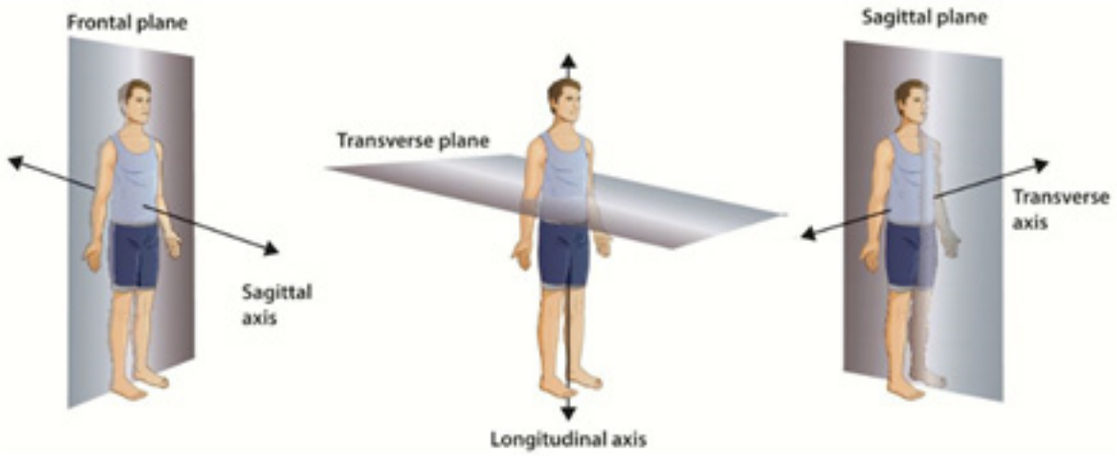
## 8.5.5 Axis

An axis is a point or straight line around which an object moves or moment of the body segments occurs. There are three axes of rotation, and each axis is perpendicular to the plane.

a. **Sagittal axis: -** It is also called the anteroposterior axis. It passes horizontally from posterior to anterior. It is perpendicular to the frontal plane. The movements that occur in this axis are abduction and adduction.

b. **Frontal axis (transverse axis): -** It is also known as the horizontal and mediolateral axis. It is perpendicular to the sagittal plane. It runs from side to side. Flexion and extension are the movements taking place in this axis.

c. **Vertical axis (longitudinal axis): -** It is perpendicular to the transversal plane. It passes vertically from inferior to superior. Typically, rotation types of movement take place on this axis.

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## 8.5.6 Concept and its application in Body Movements

Movement is generally referred to by the particular plane it occurs in. An example of this would be a description of walking as a sagittal plane movement. In reality, this is only a description of the gross direction of movement. At the individual joint level, movement will occur in all three planes, not solely in the sagittal plane. Example, during walking, the hip will be flexing/extending in the sagittal plane, adducting/abducting in the frontal plane, and internally/externally rotating in the transverse plane.

The same concept applies to all the individual joints in the lower limbs. The movement that you effectively "see" does not represent what is occurring in terms of motor control and force absorption within all three planes. Example, the most apparent hip movement is expressed in the sagittal plane during gait. Still, there is an interplay between eccentric force absorption and concentric force production in all three planes at the joint. The hip subtly decelerates internal rotation and adduction and accelerates external rotation and abduction.

This simultaneous movement can be seen as one motion with three components – it can be termed tri-planar motion. The exercise professional must be comfortable with the concepts of tri-planar motion and the fact that all functional movements

are three-dimensional. However, it is biomechanically understood that description in single plane terms is most useful when generalizing gross movement patterns.

Examples of dominant planes, motions, and axis in gross movements

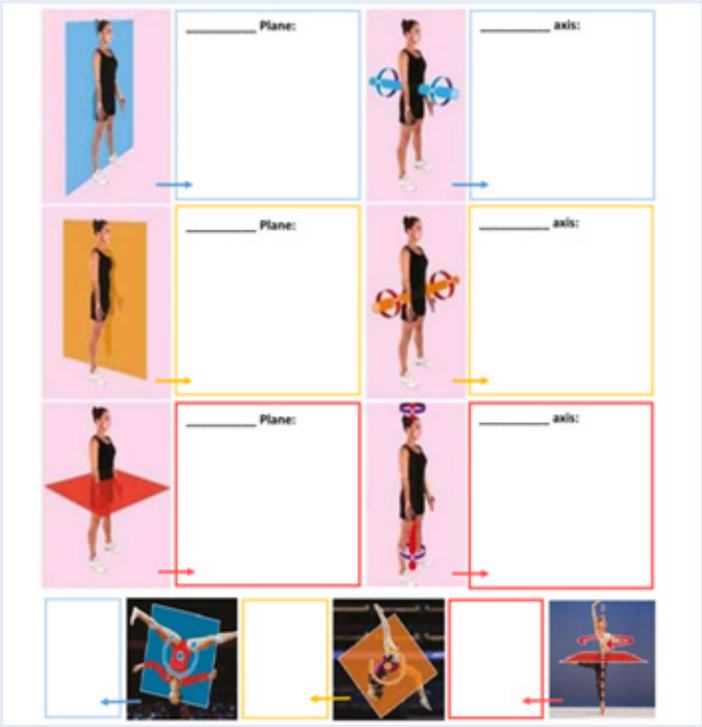
| Plane | Motion | Axis | Example |
|---|---|---|---|
| Sagittal | Flexion/extension | Frontal | Walking Squatting Overhead press |
| Frontal | Abduction/abduction Side flexion Inversion/eversion | Sagittal | Star jump Lateral arm raises Side bending |
| Transverse | Int-rotation/ ext-rotation Horizontal flexion/extension Supination/pronation | Vertical | Throwing Baseball swing Golf swing |

**Do you know?**

All body movements occur in different planes and around different axes. A plane is an imaginary flat surface running through the body. An axis is an imaginary line at right angles to the plane, about which the body rotates or spins.

**Extension Activity**

Now identify the plane and axis in the picture below:




Or

Perform front-roll, back-roll, and cartwheel. Write on which plane and axis these movements took place.

| Movements | Axis | Planes |
|---|---|---|
| Front-roll | | |
| Back-roll | | |
| Cartwheel | | |

I. **Tick the correct options.**

1. The term flexion refers to
   a. bending
   b. turning
   c. twisting
   d. straightening
2. Extension is
   a. bending
   b. turning
   c. twisting
   d. straightening
3. Moving away from the reference axis is known as
   a. Flexion
   b. Extension
   c. Abduction
   d. Adduction
4. Bringing the body part closer to the reference axis is called
   a. Flexion
   b. Extension
   c. Abduction
   d. Adduction
5. The plane which divides the body into a left and a right is called
   a. Coronal plane
   b. Sagittal plane
   c. Vertical plane
   d. Transvers plane

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

1. What is plane of movement?
2. Which plane and axis is involved while we kick a football.
3. Differentiate between flexion and extension.

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

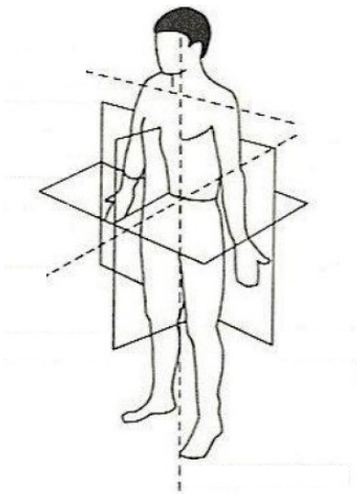
1. Differentiate between abduction and adduction.
2. How does knowledge of movement and its type contribute for graceful movement?

IV. **Working in groups, complete the following table on biomechanics and sports.**

| What is sports biomechanics? | How do we apply biomechanics in sports? | What are the principles of bio-mechanics? | What are the advantages<br>a) for coaches<br>b) for sportspersons |
|---|---|---|---|
| | | | |

V. **Case Study**

Fundamentals of kinesiology and Biomechanics in Sports.



On the basis of given picture answer the following questions

(a) Identify and label the planes and axis

(b) A vertical plane that divides the body into left and right side is known as _____.

(c) _____ axis runs from left to right through the centre of the body.

(d) Sagittal axis is also known as_____axis.

(e) _____ plane passes through the middle of the body and divides the body horizontally in the upper and lower half.

VI. **Art Integration – Making Powerpoint Presentation**

The mechanics of physical activity during dance include all the fundamental movements, which help us in full-body coordination. Keeping in view the importance of fundamental movement, make a PowerPoint presentation on the topic "Fundamental Movements and Dance Moves" and present it in your classroom.

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**Suggested Readings:**


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UNIT 9

# PSYCHOLOGY & SPORTS

## Content

- Definition & Importance of Psychology in Physical Education & Sports;
- Developmental Characteristics at Different Stages of Development;
- Adolescent Problems & their Management;
- Team Cohesion and Sports;
- Introduction to Psychological Attributes: Attention, Resilience, Mental Toughness

# Learning Outcomes

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

- Identify the role of Psychology in Physical Education and Sports
- Differentiate characteristics of growth and development at different stages.
- Explain the issues related to adolescent behavior and Team Cohesion in Sports
- Correlate the psychological concepts with the sports and athlete specific situations

**Discussion**

Read the newspaper clipping given below regarding the role of Sports Psychology in an athlete's performance.

**In a First, Psychologist on Tour with India's Women's Hockey Team**

BENGALURU: In a much-appreciated move, the Sports Authority of India has assigned a psychologist to travel with the Indian women's hockey team as they head to Spain, and for subsequent matches.

A career in sports can be incredibly stressful, and not just because there's a pressure to perform. Players often experience homesickness, loneliness, the mental effects of incapacitating injuries, and the after tremors and competitive failure, to name a few. Unaddressed, these things could wreak havoc in a player's life.

A psychologist off the pitch can certainly work on improving group dynamics and addressing individual concerns. But a psychologist who's on the pitch can, in chief coach Sjoerd Marjine's words, "analyse how the group dynamics are when we play consecutive matches and how the players react to victory and defeat." This opportunity, which had been missing previously, can now provide a better understanding of the team and what issues to work on.

**Discuss in your group**

- Think of a sports team from your school/state/country.
- Are they confident of winning, and often win over teams said to be stronger than them?
- Is the team repeatedly making the same mistakes/ losing constantly?
- Are athletes more at risk of mental health issues than the general public? Why/why not?
- Do all athletes have similar problems, or do they differ according to their age or gender?

Based on the news clipping and your discussion above, can you think how a sports psychologist can help improve the performance of athletes?

Present your ideas to the class.

Sportspersons often display different behaviour on the field. Let us consider the following cases.

**Case 1:** Luis Suarez, an International soccer player, began his career in Europe with Groningen in Holland. In the career of this Barcelona striker there have been three biting incidents on the sports field. The first occurred while he played for Ajax Amsterdam in a game against PSV Eindhoven. Suarez bit midfielder Otman Bakkal. The second incident was when Suarez bit Branislav Ivanovic while playing for Liverpool against Chelsea in 2013. The third incident was when Suarez bit Giorgio Chiellini during the World Cup in Brazil in 2014 while Uruguay played Italy.

In his book, Crossing the Line, Suarez attempted to justify the action by saying, "The adrenaline levels in a game can be so high; the pulse is racing and sometimes the brain doesn't keep up. The pressure mounts and there is no release valve……. I was frustrated because we were drawing what was a very important game, and we were on a bad run. I wanted to do everything right that day, and it felt as though I was doing everything wrong. The pent-up frustration and feeling that it was my fault reached a point where I couldn't contain it anymore."

**Case 2:** MS Dhoni, popularly known as Captain Cool, has always remained composed under pressure and carried India out of delicate situations single-handedly. Whether he was chasing or defending a total in a cricket match, Dhoni, unlike others, was usually seen to be cool and unflappable, concentrating on guiding his teammates to deal with pressure. Unlike the brash aggression of some of the other players, Dhoni did not lose his cool on the field. In an interview Dhoni revealed that he, too, experienced the same emotions as the other players frustration, anger, disappointment, but he rather focused his energy into thinking what should be done. "Whatever the format may be, I get into the process of what can be done now, depending on the situation. In Test cricket, you get a slightly longer duration to chalk out your plan. In one-day cricket, you do have some time constraints and in T20s, everything happens very quickly. So the demands are very different," Dhoni explained. "I would say I feel equally frustrated, angry and times, disappointed as well. But for me, none of these are very constructive and what is more important for me is that what needs to be done right now, that mostly matters. And once I get into that process of thinking I manage to handle my emotions in a much better way. I am like everyone else, but I tend to control my emotions better than others," Dhoni added.

Games and sports have always occupied an important place in human life and have flourished in all cultures since times immemorial. However, even a non-trained sportsperson, who is not involved in competitive sports, needs a psychological commitment to participate in regular physical exercise. It is this involvement eeps her/him physically and mentally healthy and helps her/him pursue day-to-day tasks with confidence. This sense of well-being and and enhanced confidence provides the intrinsic motivation to the individual to participate in physical activities. Sports psychology not only benefits an individual or a sportsperson but also benefits a group, a mass and the whole society.

## 9.1.1 DEFINITION AND CONCEPT OF PSYCHOLOGY IN PHYSICAL EDUCATION AND SPORTS

| Extension Activity<br>Choose any two sports of your interest and complete the table below | | | | |
|---|---|---|---|---|
| Names of Athletes | Name of the Sports | Region they belong to | International Competitions/ Medals won | Factors that led to their success |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Knowledge of psychology helps not just athletes to achieve optimal performance but also addresses the needs, objectives and quality of action to achieve excellence and highest performance in any competition.

Let us first try and understand the meaning of the terms sport and psychology. The term Sport can be described as physical activity for the purposes of recreation, health, competition and education. The term Psychology, on the other hand, is derived from the Greek word psyche meaning soul and logas meaning study. So, psychology was considered as study of soul.

So, psychology was considered as study of soul. This concept was promoted by Greek philosophers under the branch of Philosophy as they believed that the soul was the essence of a person, and it decided how the individual behaved. It was during the late 19th century, that philosophers shifted their interest towards trying to understand how the body is influenced by what is "inside the body" – the mind, and by the events "outside the body" – the environment. They started inquiring about the link between the body and the mind. Psychology, then, came to be explained as a study of the mind.

Later, this description of psychology as 'a study of mind' had to be rejected due to lack of observational experiences under controlled conditions. This initiated a new pathway for psychology which is scientific in nature, and includes those behaviours which can be observed and measured. Thus, J.B.Watson explained psychology as a study of observable and overt behaviours that can be measured scientifically. The concept was further challenged after the introduction of computers, which promoted expansion of research opportunity with precision. It led to the new concept of psychology as a study of memory, reasoning, problem solving and other cognitive process. Therefore in the modern context, psychology is a science about "understanding of behaviour and cognitive processes".

Psychology as a scientific study of behaviour and mental processes has three important aspects to be discussed.

- Firstly, it is scientific in nature; this means it has a scientific approach to acquiring knowledge involving certain key values and standards which are universally accepted and reliable.
- Secondly, it is the study of behaviours which are observable actions and reactions.
- Thirdly, it also includes study of cognitive processes, which involve different aspects of mental life, like memory, reasoning, intelligence, attention etc.

The European Federation of Sports Psychology defines sports psychology as "the study of the psychological basis, processes and effects of sport."

Sport psychology, therefore, is an interdisciplinary science that draws on knowledge from the fields of Kinesiology (the scientific study of movement) and Psychology. It includes the study of the manner in which psychological factors affect performance and the way in which participation in sport and exercise affect psychological and physical factors. Sport psychology is used for team sports as well as individual fitness endeavours.

It was in 1925 that Coleman Griffith, often called the "Father of Sports Psychology" in North America, set up the Athletic Research Laboratory at the University of Illinois. The field of Sports Psychology became an area of proficiency that uses psychological knowledge and skills to address performance and well-being of athletes, developmental and social aspects of sports participation, and systemic issues associated with sports settings and organizations. Sports Psychology is the study of psychological factors that affect the learning and performance of motor skills. Due to its important role in the enhancement of performance in the sports field, it is necessary for us to understand the broader meaning and scope of Sports Psychology.

**Do you know?**

American Psychology Association in 1986 created a new division for Sports Psychology referred as Div.47. According to APA the field of sports psychology focusses on two main areas:

a. helping athletes use psychological principles to achieve optimal mental health and to improve performance (performance enhancement).

b. understanding how participation in sport, exercise and physical activity affects an individual's psychological development, health and well-being throughout the lifespan.

Exercise and Sports Psychology is the scientific study of the psychological factors that are associated with participation and performance in sport, exercise, and other types of physical activity.

APA (2009)

A field of study in which the principles of psychology are applied in a sports setting.

R Cox (2007)

Sports Psychology is concerned with the psychological foundations, processes and consequences of the psychological regulation of sports related activities of one or several persons acting as the subject(s) of the activity. Richard. H. Cox (2012)

Sports and exercise psychology is the scientific study of people and their behaviours in sports and exercise activities and the practical application of that knowledge.

Weinberg and Gould (2011)

## 9.1.3 APPLICATION OF PSYCHOLOGY IN PHYSICAL EDUCATION AND SPORTS

Many strategies and procedures are used to address problems faced by athletes and other sports participants. Some of the applications of psychological concepts and theories in physical education and sports are:

**Cognitive and behavioural skills training for performance enhancement**

**Counselling and clinical interventions**

**Consultation and training**

1. Cognitive and behavioural skills training for performance enhancement include
   - Concentration and attention control strategies
   - Goal setting

- Imagery Training
- Cognitive-behavioural self-regulation techniques

2. Counselling and clinical interventions include support for managing:
   - Athletic motivation
   - Over-training and burnout
   - Eating disorders and weight management
   - Substance abuse
   - Grief, depression, loss and suicide
   - Sexual identity issues
   - Aggression and violence
   - Athletic injury and rehabilitation
   - Career transitions and identity crises.
3. Consultation and training include
   - Team building programmes for sports teams and organisations.
   - Sports organization consultations for behaviour economics
   - Systems interventions with parents and families involved in youth sports participation
   - Education of Physical Educators, Coaches and Trainers regarding role of interpersonal and leadership skills for talent development
   - Education of Physical Education and sports professionals towards early identification and prevention of psychological difficulties.

## 9.1.5 IMPORTANCE OF PSYCHOLOGY IN SPORTS AND EXERCISE

**A. Benefits of Exercise and Physical Activity:**

i. **Cognitive Aspect:** The benefits of physical activity go beyond health and wellness of the body. Research suggests that physical activity positively impacts the brain and improves cognition, mood, attention, problem-solving abilities, strategic planning and academic achievement in students.

ii. **Emotional Aspect:** Physical Activity provides positive feelings and counters negative mood state, depression and anxiety because of increased engagement in recreational, health-related and competitive activities. Sports psychology enhances physiological capacities such as strength, speed, flexibility, etc. as motivation plays a major role in the enhancement of the physical capacity of sportspersons. Acute bouts or

short duration of exercise are also beneficial, but chronic or regular exercise is required for maintaining long term benefits.

**Extension Activity**

Choose a sport or activity in which you regularly participate. Explain the motivational forces that have driven you when you have achieved your best.

Are the motivators you chose the same as for all your class mates? Why/ why not?

Think of times when you have been anxious and nervous when facing a challenge. What strategies did you employ to overcome your anxiety? Do you think athletes utilize similar strategies? Why/why not?

**Share your ideas with the class.**

iii. **Social Interaction:** Exercise as an activity provides opportunity for people to participate in both group as well as individual exercise programmes. e.g., participating in a team event, group exercise programme or an individual activity in a social structure. Group Exercise experience is pleasurable for participants; hence it is good for mental health and social wellbeing. However, choice of individual exercise is preferable and beneficial for people low with self-esteem or for those suffering from anxiety related to body image and physical self-concept. In addition, spectators and fans at a match or sports activity also bond socially.

iv. **Distraction Ability:** Exercise provides opportunity for distraction from the current mood state. Acute dose or short duration of exercise is helpful in reducing anxiety through the distraction ability of exercise; regular exercise has long term benefits.

**B. Psychological Advantages of Sports Participation**

**i. Life skills:** Sports participation and competitions help to develop sense, sensitivity and sensibility among participants which helps them to approach and tackle the issues and challenges of life with positivity.

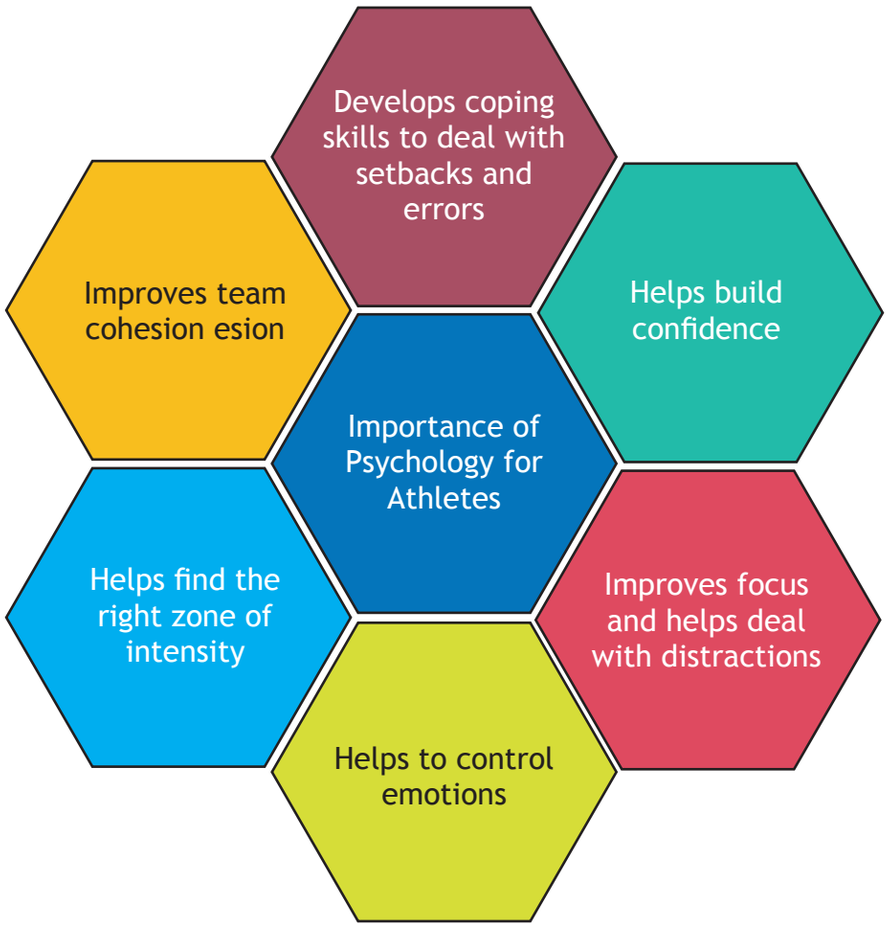
**ii. Developmental aspects:** Sports participation experience provides opportunity among the participants to develop social relationships including making friends and enjoying team atmosphere; it also helps in developing a spirit of healthy competition.

iii. **Behaviour modifications:** Sports participation increases perceived competence and self-efficacy. Positive sports experience enhances intrinsic motivation

iv. **Cognitive and Motor Skill acquisition:** Repeated training and playing sports helps in:

- improving attention deficit disorder
- developing memory
- developing reasoning ability
- developing decision making skills

**C. Performance enhancement of athletes through sports psyphology**




**D. Exercise adherence through psychological interventions**

Regular exercise is an essential component for a healthier lifestyle and the concept of following a culture of exercise and physical activity throughout life is appreciated uniformly across the world. However, there may be still a large population whose exercise level must be low or some of those who have begun exercise, but may not continue for long, and many who may lose steam in

between. Psychological theories and research understand the determinants of exercise adherence and non-adherence to help participants maintain a lifelong commitment to regular exercise, and may also be used to identify potential drop outs.

I. **Tick the correct option.**

1. Psychology as study of behaviour was defined by
   - i. JB Watson
   - ii. Plato
   - iii. Skinner
   - iv. Pavlov
2. Who known as father of experimental psychology?
   - i. Wilhelm Wundt
   - ii. John B Watson
   - iii. Richard H Cox
   - iv. Sigmund Freud

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

1. Define psychology?
2. Define sports psychology?

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

1. In what ways could knowledge of sports psychology benefit athletes?

## 9.2.1 DEVELOPMENTAL CHARACTERISTICS OF GROWTH AND DEVELOPMENT

Growth and development are multidimensional requiring integration and coordination between the various aspects. To understand the growth and development of an individual, it is helpful to understand the four main areas of development.

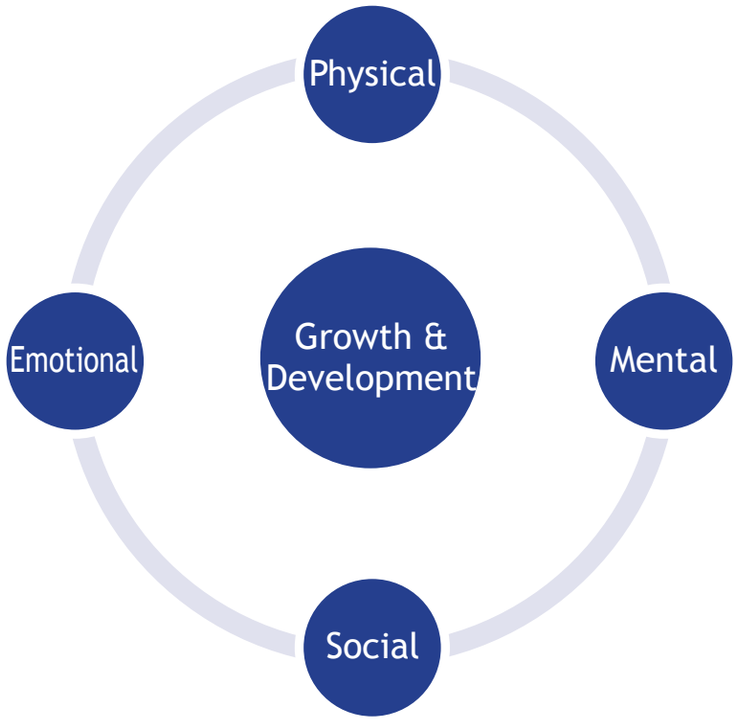



Figure-1: Schematic illustration of the interaction between the four main areas of development

| S. No. | Areas of Growth and Development | Characteristics |
|---|---|---|
| 1. | Physical | height and weight |
| 2. | Mental | thinking and understanding |
| 3. | Social | interacting with others |
| 4. | Emotional | feelings and attitudes |

As is illustrated in Figure 1, the overall development of an individual is influenced by a constant interaction between the four areas of development. Growth and development of an individual is the result of interaction between physical, mental, emotional as well as social aspects of development.

**What is physical development?** Development of physical aspects includes of the various physiological changes occurring to an individual starting from birth till death. Measurement and assessment of physical aspects of development includes factors such as height, weight, strength, flexibility and other motor abilities. Changes in body composition due to change in age influences various other aspects of development. Most of the physical developments are quantifiable and measurable in terms of size, shape and weight, therefore have standard tools to assess them.

**What is cognitive development?**

Cognitive, or its extended term mental development, is an essential aspect of an individual's development. It includes abilities such as memory, perception, language,

information processing, and thinking which influence decision-making abilities. According to change in biological age, these abilities keep changing along with growth and maturation. There is a general pattern of mental development, but each individual develops their mental abilities in a unique pattern which is influenced by genetic factors, social environment and experience available to an individual during different stages of growth. The important aspect about cognitive aspect is that, all the abilities are inter-related and they develop as a unit.

**What is social development?**

Social development refers to the aspects wherein an individual interacts with the society and which results in development in various aspects of an individual at different stages of life. Social development is also the ability to communicate effectively with the members of the society and to observe societal norms of the community according to one's age group.

**What is emotional development?**

Emotion refers to responses consisting of physiological reactions and expressive behaviours which may be subjective in nature. Emotional development is part of a person's personality development and it refers to the ability to express and control one's emotions. It includes control over psycho-physiological reactions of the body with respect to the conditions, environment and situations surrounding them. From childhood to old-age, individuals acquire new skills to manage feelings and emotions as it is highly affected by the environment and conditions around an individual. A wide variety of emotions are expressed by individuals at different stages of growth and display. Age and gender along with quality of emotional experiences are major factors affecting the emotional decisions an individual.

## 9.2.2 STAGES OF GROWTH AND DEVELOPMENT

Change is the one inevitable thing in life. Change could be visible, as in physical aspects, involving weight, height gain or muscle and fat mass reduction and increase etc., or it could be related to cognitive abilities, i.e., the ability to understand, the emotional ability to respond to different stimuli, or the ability related to social aspects and the capability to choose groups and individuals, or the ability to evaluate the moral aspects and to value and respect people and happenings with rationale regarding ethical and moral principles. These changes are commonly described according to various stages of development based on different age groups. If we observe the behaviour of people living around us, we see they are not similar in their behaviour. Most of the changes or differences are because everyone is in different stages of development. The developmental stages are considered to be temporary and consist of characteristics which are dominant at a particular stage. Individuals

differ with respect to time and rate of development, but they are expected to attain these developments within their stages. Thus, these accomplishments become social expectations which are known as developmental milestones.

From the perspective of physical education and sports, these changes influence participation and performance in physical activities, exercise and sports. Therefore, a detailed understanding of the changes which occur at different age groups or different stages of growth and development is very essential and critical for optimal growth and development of an individual.

While there is no consensus in classification of different stages of growth and development, broadly speaking, the stages of human life span can be divided into:

- Infancy (birth to age 2)
- Childhood (2-11 years)
  - Early childhood ( 2 to 6years)
  - Middle childhood ( 6 to 11years)
- Adolescence (11 years to about 20 years)
- Adulthood (20 –65 years)
  - Young Adulthood (20 to 40 years)
  - Middle Adulthood (40 to 65 years)
  - Late Adulthood ( 65 years and above)

| Stages | Developmental milestones |
|---|---|
| Infancy : 0-2 yrs | Physical: The child's body weight increases to almost triple the birth weight, and increase in height is about one-third during the first year alone. Growth of brain size is also rapid during first 18 months.<br>Linguistics: Children start developing language ability and learn through their sense organs. They explore the world in their own ways and express their intellect by making various sounds like gurgling, cooing, etc.<br>Social & Emotional: Expressing joy, anger, sadness is achieved by 6 months.<br>Motor skills: The infant first controls his head and trunk, then lifts his chest, sits upright, crawls, creeps, stands with help, stands holding some objects and starts walking. |

| | |
|---|---|
| Early Childhood: 2-6yrs | Physical: The child develops athletic appearance and loses baby chubbiness. Brain and head grows rapidly during this period.<br>Cognitive: The child develops ability to classify objects, people or events. They are imaginative, animated and create their own hypothetical world.<br>Psycho Social: He/She is able to express his/her feelings and emotions and communicate needs and feelings with others.<br>Linguistic: The child develops the ability to speak in complete sentences.<br>Motor skills: The child has better control of his/her physical movement and can have better coordination of body parts. |
| Late Childhood (Pre-Adolescence) 6-11yrs | Physical: There is an increase in strength as body parts become stronger.<br>Cognitive: By this age children develop concrete thinking abilities, in which they develop ability to think logically and use mental operations to solve problems. However, they still lack abstract thinking ability.<br>Psycho Social: The child develops gender identification and social comparison to identify themselves from others.<br>Motor skills: They have developed the ability to use body parts with appropriate speed. |
| Adolescence (11-20 years) | Physical: Boys and girls develop height, weight, muscles and achieve maturity but in growth is in spurts. The onset of this stage is marked by the onset of puberty.<br>Psycho Social: At this stage boys and girls are argumentative and they have a tendency to find fault with the authority figures. They are self- conscious and influenced by their peer group.<br>Cognitive: Boys and girls become innovative and take great interest in learning various skills. They also develop the ability of abstract thinking.<br>Motor skills: They develop strength, speed, endurance, flexibility, coordination at a rapid rate. |
| Early Adulthood (20 -40 years) | By the time they reach adulthood, individuals are responsible, mature, self-supporting and well-integrated into society. |

| | |
|---|---|
| Middle Adulthood (40-65 years) | This period is characterised by strong social networking, relatively stable personality, and life is dominated by work and family. |
| Old Age (65 and above) | This period is marked by decline of health and faculties, and individuals often plan to retire. It is marked by inactiveness and people are prone to various physical limitations. |

**Developmental Characteristics and Stages of Growth and Development: A Sports Model**

In sports, an athlete's growth and development at different stages of life is an essential component to be considered while planning training, selection of activity, grouping of athletes according to abilities etc.

The growth and development stages of athletes can be grouped into four categories:

- below 9 years — Fun Phase
- 10-12 years — Foundation Phase
- 13-15 years — Formative Phase
- 16-19 years — Final Phase

By identifying and understanding the main characteristics of each of these developmental stages, athletes' needs can be better taken care off.

**Key Features**

**Fun Phase: Below 9**

| Elements | Physical | Motor Skill | Cognitive | Psycho-social |
|---|---|---|---|---|
| Characteristics | Slow but steady increase in height and weight | Learns basic motor skills | Short attention span. | Sensitive to criticism |
| Teaching/ Coaching Pedagogy | Add minimal physical conditioning | Plan fun-oriented activities to develop motor skills | Add variation and variety in drills | Create stress free atmosphere |

Foundation Phase: 10-12 years

| Elements | Physical | Motor Skill | Cognitive | Psycho-social |
|---|---|---|---|---|
| Characteristics | Growth spurt and changes due to puberty | Motor skill development at different rate | Increased perception and Logical | • High Self-Confidence<br>• Tendency to self- evaluate and compare oneself with others |
| Teaching/ Coaching Pedagogy | Plan low intensity physical conditioning | Focus on skill refinement and development | Introduction of Small Sided Games (SSG); Allow guided discovery | Avoid winning and losing; Give positive feed backs |

Formative Phase: 13-15 Years

| Elements | Physical | Motor Skill | Cognitive | Psycho-social |
|---|---|---|---|---|
| Characteristics | Physical and hormonal changes | Increase in adaptation | Development of ability for abstract thinking | • Sensitive to peer pressure<br>• High level of criticism<br>• Self-centred |
| Teaching/ Coaching Pedagogy | Plan Training at match speed Add fitness component | • Practise in Real match situations<br>• Add tactics and strategy | Schedule long and intense playing hours | Allow increased decision making |

Final Phase : 16-19 Years

| Elements | Physical | Motor Skill | Cognitive | Psycho-social |
|---|---|---|---|---|
| Characteristics | All round development (Automatic capacity).<br>Specified gym drills prerequisite | Autonomic phase of skills acquisition | Abstract reasoning skills | • Emotional autonomy<br>• Able to take positives/ negatives |
| Teaching/ Coaching Pedagogy | Prepare for High intensity match-related drills | Develop Motor perceptual abilities; Develop tactical and actual game scenarios. | Involve and allow decision making during scheduling of training | Assign Individual roles and responsibilities |

*The phases may differ slightly between males and females as females tend to mature more quickly than males, thus reaching adolescence at an earlier age.*

I. **Tick the correct option.**

1. Infancy stage is for the age group
   - i. 0-2 years
   - ii. 2-6 years
   - iii. 6-11 years
   - iv. 11-20 years
2. Change in memory and perception are indicators of
   - i. social development
   - ii. physical development
   - iii. mental development
   - iv. emotional development
3. Peer interaction and relationship reflects
   - i. group dynamics
   - ii. physical growth
   - iii. moral values
   - iv. emotional development

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

1. Define concepts of Growth and Development?
2. Explain characteristics of Growth and Development?
3. Which type of activities can be undertaken in early childhood? Why?

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

1. Discuss the developmental characteristics of early childhood and their impact on learning.

## 9.3.1 ADOLESCENT PROBLEMS AND THEIR MANAGEMENT

Adolescence as defined by WHO includes individuals between the age group of 10-19 years, a period of transition from childhood to adulthood. It is marked by the onset of puberty, which now occurs earlier, on an average, than in the past. This age group is considered critical because it marks the developmental transition of an individual from childhood to adulthood, which involves physical, psychological, social and neuro- developmental changes.

Raman is a 14-year-old who has just entered Class 9 in his Secondary School. He has noticed that his body is going through some physical changes. As a result, he has become self-conscious about his physical appearance. He has also begun taking measures to insure more privacy at home. For example, he locks the door every time he enters the bathroom, and he always takes his phone calls in his room with his door closed. He also values his relationships with his friends and has begun spending more time with them. He has started valuing his freedom, thus gets aggressive or irritated with restrictions by family members on certain tasks. His parents understand the behaviour changes, thus creating space for him at home and listening to his thoughts and ideas. They involve him in sports and outdoor activities to channelize his energy. Raman's behaviour and physical changes are common during adolescence.

Adolescence stage is a critical time of life, when a child transforms into an independent individual, develops new relationships, enhance social skills and acquires behaviours which will be everlasting throughout life. Due to these various changes, adolescents need explicit attention and support to help them contribute positively to society.

Physical growth and development during adolescence is marked by changes in height and weight, body composition, skeletal mass, and sexual maturation. The biological changes during adolescence that occur due to the onset of puberty, mark the transition of the child into an adult. The growth spurt associated with puberty, which results in physical and hormonal changes is also marked by remarkable changes in energy levels, thus developing in the individual a strong recognition of personal identity,

moral and ethical value sets, and a feeling of self-esteem. The hormonal changes are linked to the cognitive and psycho-social changes, wherein adolescents develop stronger reasoning skills, logical and moral thinking, and become more capable of abstract thinking and making rational judgements. This stage of adolescence surely creates opportunities for significant developments because of wide chronological age range, but it also creates space for dissatisfactions too, thus creating turbulence in the adolescent which can be reflected in behavioural as well as emotional aspects. They are exposed to a variety of substance abuse like tobacco, drugs etc. They face greater risk of violence and can experience different types of emotional drainage leading to depression and suicide tendencies.

**Do you know?**

**Adolescent health**

**Coming of age: adolescent health**

24 September 2018 – The world now has more young people than ever before – of the 7.2 billion people worldwide, over 3 billion are younger than 25 years, making up 42% of the world population. Around 1.2 billion of these young people are adolescents aged between 10 and 19 years. Adolescence is a critical time of life. It is a time when people become independent individuals, forge new relationships, develop social skills and learn behaviours that will last the rest of their lives. It can also be one of the most challenging periods. "Coming of age" examines these issues facing adolescents.

Read "Coming of age"

**Extension Activity**

Answer the following questions:

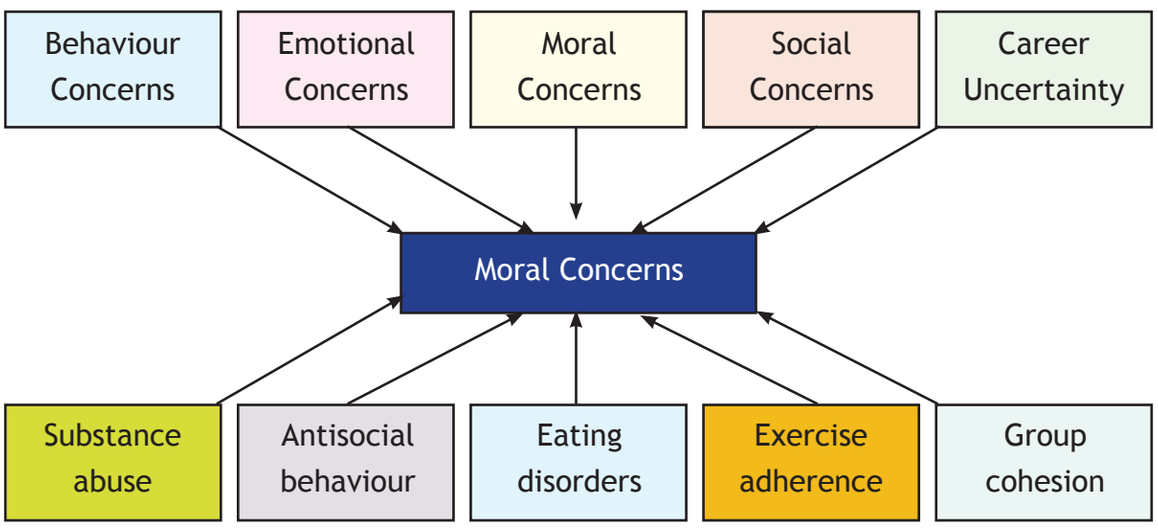
- How important is it for you to be accepted by your peers?
- What are some situations in which you have, or someone you know has, experienced peer pressure?
- Why do you think it's so difficult to withstand peer pressure?
- What would you do if one of your friends began pressuring you todo something you didn't want to do, or didn't approve?
- If someone were consistently trying to pressure you to dosomething you were uncomfortable with, would you consider that person a friend? Why or why not?
- Why do you think peer pressure is so often associated withnegative behaviour?
- What are some ways to avoid negative peer pressure?
- Is there positive peer pressure?
- What are the ways in which friends could have a positive influence? Share your views with the class.

**Early Adolescence** (10-14 yrs) is the initial stage wherein a child like Raman starts adjusting to the rapid body changes and adapts to sexual changes. This stage is very suitable for cognitive development, the child develops concrete thinking, and an ability to understand the perspective other than their own. They also fall short of problem-solving skills related to behaviour modifications. They develop early moral concepts about there being just no one right view, instead there can be different opinions regarding similar concerns. At this stage, a strong peer influence is also reflected through development of relationships among peer group/ friends and admiring celebrities.

**Middle adolescence** (14-17 yrs) is the stage wherein puberty has passed, thus creating a consciousness in the adolescents about their physical appearance and sexual attractiveness. This stage is very critical, as it establishes emotional separation from the parents and a desire for being independent and need for space. This period is also marked by development of abstract thinking, ability to use verbal communication effectively, and development of conventional morality. With the development of conventional morals, importance of peer pressure and peer acceptance and approval increases. They start focusing on maintaining social order but will surely like to match their behaviour with their beliefs by trying the things which they consider as "undesirable". Due to this, individuals in this age group are prone to engage in social problems including addiction to smoking, drug abuse and other health-risk behaviours.

**Late adolescence** (17-19 yrs) is the stage where the adolescent develops a personal sense of identity as the biological development concludes for most. Thus, he/she is now better able to cope with situations of peer group pressure, body imaging and behaviour impulses. They move on from concrete thinking to abstract thinking which prompts them to set their own moral guidelines without any need for social acceptance. This stage is also marked by increased behaviour control, consistency and stability leading to creating space for themselves within the society.

**Adolescence Problems**



**Adolescence problems:** When various problems like behaviour issues, emotional problems, moral dilemmas, social concerns along with career uncertainty combine together, they create behaviour deviations among the adolescents and raise concerns and problems among the society members at home, at school, in the sports teams etc. These behaviour deviations lead to problems such as substance abuse which have negative effects on health, developing of eating disorders leading to anorexia nervosa or bulimia nervosa, indulging in anti-social behaviour due to aggression and anxiety, non-adherence to outdoor activity, sports and exercise. The various types of concerns associated with adolescence at different stages are to be understood and supported by family, friends, teachers, coaches, relatives in accordance to the needs and demands of the individual. Any deviation in any of the mentioned aspects of the adolescent leads to different types of problems which need appropriate understanding and management.

The problems associated with adolescence due to behaviour deviations can be many, but a few major issues along with their management are discussed below.

1. **Substance abuse** is one of the major concerns among the adolescence. It is behaviour that is neither ethical nor socially acceptable. Drugs have addictive properties, and have lethal effects on health. Alcoholism, smoking, drugs etc attract the adolescence age group due to peer pressure and various other factors.

   **Management:** The issues related to intervention include a combination of cognitive and behaviour techniques.

   - The cognitive techniques include expression of concern for individuals by coaches and parents, setting limits on unacceptable behaviour and developing behaviour policies for class, team or group.
   - The behaviour techniques include involvement of peer for transfer of accepted behaviours, engagement of individuals during free time through participation in sports, exercise, recreation or any outdoor or indoor activities for constructive modification.

2. **Eating Disorders** are the result of various psychological aspects like anxiety, depression etc. due to which the adolescent develops eating disorders like

   (a) Anorexia nervosa which is reflected in bizarre eating patterns and habits like unusual starvation due to social or physique anxiety for weight loss.

   (b) Bulimia Nervosa which is presented by binge eating patterns due to depression and other psychological fluctuations.

   Eating disorders can be found among addicted exercisers when they stop exercising, start dieting and develop anorexia or bulimia due to depression, especially in females, who develop consciousness towards physical appearance.

**Management:** These issues concerned with eating disorders can be managed through two essential processes

- **Diet Awareness** is essential towards management of eating disorders. It can be done through promotion of awareness about dietary habits among the adolescents at various levels including at school, home, residential organizations and at community events involving adolescents.
- **Promotion of Fitness:** Physique and physical appearance have no substitute other than exercise and physical activity along with a healthy diet pattern. Promotion of fitness activities and participation in sports or outdoor activities need to be facilitated at all levels of community interaction opportunities.

3. **Anti-Social Behaviour** is a prominent pattern reflected among the adolescents due to the psychological turbulence happening along with sudden spurts of physical changes during adolescence when not adequately supported by the community and associated members. Issues of aggression have a larger impact on the adolescent due to change in cognitive abilities.

**Management:**

**Catharsis:** Aggression can be regulated through fulfilment or discharge of negative feelings, or catharsis. Individuals should be given an opportunity to speak and express their emotions, as suppressing of emotions and provision of opportunities for adolescents to share their thoughts along with their peer group.

**Circular Effect:** Aggression has a circular effect, as one act of aggression leads to another. Therefore, there is a need to break the circle so that it is not repeated again. Ideal recommended style to break the circle is through positive reinforcement.

**Management:**

- Break the violence cycle as soon as frustration is reflected i.e., aggressive behaviour of seniors is reflected on juniors or of one player on another.
- Provide space for players to speak and express their opinion and the manager/coach must listen to it positively.

4. **Exercise Adherence:** With the growth in physical aspects and development in social, mental, cognitive aspects in adolescence, energy channelization is essential for cohesive development. Participation in outdoor and indoor activity along with participation in sports and exercise is essential for lifelong learning towards wellness. Dropout rate from participation of sports and exercise is a

common reflection among the adolescence. The general reasons identified for the dropouts are:

**(a) Intrapersonal Constraints:**

i. Lack of fun and enjoyment or getting bored;

ii. Low perceptions of physical competence;

iii. Low intrinsic motivation and high stress level;

iv. Negative feelings towards team or coach;

v. Anxiety and nervousness due to excessive criticism.

**(b) Interpersonal Constraints:**

i. Family or peer pressure;

ii. Social priorities;

iii. Excessive alternate opportunities;

**(c) Structural Constraints:**

i. Time available for training;

ii. Sports related injuries;

iii. Financial feasibility;

iv. Insufficient facilities and infrastructure;

v. Overuse/Burnout;

**Adherence Management:** Support of family, teachers, coaches, trainers is essential towards helping adolescence towards exercise adherence as an essential component towards life.

| Adoption | Maintenance |
|---|---|
| • Access to facility and time<br>• Self-motivation<br>• Social influence<br>• Self-efficacy<br>• Behaviour coping skills | • Knowledge about importance of healthy life style, exercise and sports<br>• Positive attitude towards exercise and sports<br>• Confidence to succeed in vigorous exercise Programme/sport |

I. **Tick the correct option.**

1. Rajita regularly binges on large meals. She then makes herself vomit and follows up with two hours of exercise. Rajita is most likely suffering from which eating disorder?

   i. Toxaemia

   ii. Obesity

   iii. Bulimia nervosa

   iv. Anorexia nervosa

2. Which of the following is the age group for Early Adolescence?

   i. 6-9 yrs

   ii. 10-14 yrs

   iii. 14-17 yrs

   iv. 17-19 yrs

3. Which one of the following is NOT a problem related to adolescence

   i. Eating Disorder

   ii. Substance Abuse

   iii. Anti Social Behaviour

   iv. Lack of Language development

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

1. Define Adolescence as per WHO?

2. Explain the different stages of adolescence?

3. List some of the problems of adolescence.

III. **Answer the following questions briefly.**

1. Describe various adolescence problems? How can they be managed?

## 9.4 Team Cohesion and Sports

As a social psychological topic, team cohesion ranks as a very important factor for enhancing team performance and feelings of satisfaction among members. Let's try to understand about the terms Group and Team along with the term 'cohesion'.

Group can be defined as 'two or more persons who interact with one another such that each person influences and is influenced by each other person'. A team is more than just a group. The term 'team' can be defined as 'a small number of people

with complementary skills who are committed to a common purpose, common performance goals, and an approach for which they hold themselves mutually accountable'.

When we refer to a 'team' in sport psychology we are also referring to a group of people who play together and have a powerful influence on each other. For this reason, the terms group and team are sometimes used interchangeably. Group cohesion can be defined as "a dynamic process which is reflected in the tendency for a team to stick together and remain united in the pursuit of goals and objectives". Because a sports team is a group, definition of group cohesion can be applied equally well as a definition for team cohesion. Fundamental to the study of team cohesion is the understanding of group dynamics. Members of a team or group begin to interact with each other the moment the group is first formed. Once a group is formed, it ceases to interact with outside forces in the same manner that a collection of individuals would. The team becomes an entity in and of itself.

The word cohesion literally means sticking together. Thus, team cohesion is the sum of the forces that influence members to remain part of a group or team. A highly cohesive team is likely to be more united and committed to success than a team low in cohesion. It is often said that a team is more than just the sum of the individual players. This is because the cohesiveness of a team can be just as important as the talent of individual team members. If you are a follower of football or cricket, you might have noticed that, in certain seasons, teams composed of brilliant individual performers collectively underperform. This is probably due to the fact that the team members have somehow failed to 'gel' together. This is an example of lack of team cohesion.

Team Cohesion in sports: Team cohesion is a multidimensional construct that includes both Task Cohesion and Social Cohesion. In sports when team cohesion is to be developed, coaches need to differentiate between task cohesion and social cohesion. Task and Social cohesion are two independent components of team cohesion and failure to differentiate between the two can lead to failure in developing team cohesion among the teams. Task cohesion refers to the level of team members working together to attain and achieve common and identifiable team goals in a cohesive environment. Social Cohesion refers to the level of liking among the team members and amount of personal satisfaction of being together in as team members. Group orientation of each team may differ in their task and social cohesiveness, therefore its essential to understand the team cohesion in a more comprehensive way to help sports teams to remain united in the pursuit of goals and objectives.

**Group Cohesion:** Belonging to a peer group is a key need for an adolescent, which

can be dynamic in both structure as well as process. Group cohesiveness and its norms help to facilitate the group to achieve more than individuals would be able to on their own. The purpose of a group is towards bringing a change along with providing support and insight into either the individual, the group as a whole, or the environment. Working in groups may well encounter internal problems and conflict at certain stages, but with effecting group functioning strategies, they provide a positive and supportive environment to develop and learn new interpersonal skills. Teams are special kinds of groups, members of teams often have complementary skills and are committed to a common goal or purpose and they are mutually accountable for their activities. In teams, there is a positive synergy attained through the coordinated efforts of the members.

*Group Management:*

**a. Goal Setting**

i. Set teams goals and take pride in their accomplishment.

ii. Each player must be aware of their roles and make them believe it is important

iii. Take time to learn something personal about an individual

**b. Avoid formation of cliques**

i. Promote regular meetings and interactions

ii. Positive encouragement on loosing and avoiding public punishment

iii. Avoid personal prejudice or scape goats usage

iv. Provide equal opportunity

v. Focus on maximum transparency

vi. Develop team drills and activities to promote team cooperation

vii. Highlight areas of success even during failure.

**Determinants of Team Cohesion**

There are various factors which decisively affects the team cohesion among sports teams. While developing team cohesion in sports among the team members, several elements have been identified that determine conditions for setting high level of team cohesion. Below are list of few determinants of team cohesion in sports, which can be classified into personal factors, teams factors, leadership factors and environmental factors.

1. Personal factors

- Satisfaction
- Similarity of experience

2. Team factors
   - Prior success
   - Communication
   - Having team goals
   - Importance of achieving goals
3. Leadership factors
   - Effort to develop cohesion
4. Environmental factors
   - Size of group

**Benefits of Team cohesion**

The consequences or benefits of high level of team cohesion in sports can be observed for team as a group outcome as well as for individual athletes. Improved team cohesion do help individual athletes to give their optimal performance and it also helps team as a group to stay unified in a cohesive environment while attaining team goals and objectives. Let's discuss the benefits of team cohesion from the perspective of group outcome as well as individual outcomes.

1. Group outcomes
   - Team stability : Research reveal that when athletes reflect high level of social cohesion in sports teams, there is high possibility of their continuation in sports in future season. Therefore, social cohesion is a strong predictor of athletes intension to continue with sports team involved and improve team stability.
   - Team Efficacy: Group cohesion helps teams to believe in their abilities and develop self-confidence among team members, leading to improved level of group or team efficacy. Team efficacy helps teams, and its members to believe that that can be successful.
2. Individual outcomes
   - Improved Athletic Performance: Team Cohesion in sports has a strong association with improved athlete performance. When athletes as associated with common and identifiable team goals (task cohesion), their individual performance of athletes within the team is enhanced.

- Perceived Psychological Momentum: Sports team having high level of team cohesion and have increased task cohesion are more likely to enjoy the benefits of psychological momentum. Team cohesion helps athletes during competition and contests to develop a perception about momentum of competition to be in their favor.
- Enhanced mood, emotion, and satisfaction: Improved team cohesion reflect increases positive emotions and greater self-satisfaction among athletes. Athletes part of highly cohesive sports team enjoy positive mood compared to athletes associated with less cohesive teams.

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I. **Tick the correct option.**

1. Which of the following is considered as characteristic of team cohesion?
   i. Members seeing themselves as one rather than collection of individuals.
   ii. Members of group having their own objectives
   iii. Members hold hidden agenda
2. The main objective of Team Cohesion is to ?
   i. Work independently
   ii. Cooperate and work together to accomplish common goals
   iii. Criticize other group.
3. Which of the term describes the level to which group members work together towards a common and identifiable objectives of a team?
   i. Group Respect
   ii. Task Cohesion
   iii. Social Cohesion
   iv. Group Respect

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

1. Define Group and its characteristics ?
2. Describe the benefits of Team Cohesion?
3. Explain the determinants of Team Cohesion?

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

1. How important is for a sports team to develop Team Cohesion.

2. Discuss a plan to develop team cohesion among team members?

## 9.5 Introduction to Psychological Attributes

### 9.5.1 Attention

The term attention and various concepts related to attention are very common in the arena of sports and athletes do consider it important for performance. Attention is about taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or train of thoughts. It implies withdrawal from some things in order to deal effectively with others. In sport, nothing can be more important than paying attention to the object at hand. On the surface, the idea of paying attention seems simple enough, but psychologist have long recognized that the attention process can be very complex. Attention in sports describes the focusing of his or her own role in relation to other teammates, set of situations, particular stimulus on the play field and its often accompanied by an increase in readiness to receive and respond to the situation involved. Inability to do so may lead to effect performance even by the athletes with highest skill sets and abilities. For athletes, state of attention may be produced initially in many ways, including as a conscious, intentional decision, as a normal function of social interaction, or as a reaction to an unexpected event. Attention can more broadly defined as the concentration of mental effort on sensory or mental events, thus attention focus on addressing to relevant environmental cues and elimination of irrelevant cues.

In sports, the theory of all-or-none phenomenon which means either you concentrate or you don't is not relevant anymore. It interesting to understand that there are various types of attention focus and each type have specific utility for specific sports, this is referred as attention styles. The attention styles can be classified of four types which is divided as per two independent dimensions ie. 'direction' and 'width'. Attention style as per width can be narrow attention or broad attention focus, whereas attention style as per direction refers to external and internal attention focus.

**A.** **Width:** refers to athletes' tendency to take in multiple or wide range of information as opposed to focusing very narrowly on one source of information or cue while churning out other cues and information.

(a) **Broad Attention** Focus allows athletes to perceive several occurrences simultaneously. Athletes with broad attention focus would be aware of rapidly changing situation and environment around them. For example, a batsman focusing on the pace of the ball as well as the seam and swing

of the ball, or a football player dribbling the ball focusing on ball as well being aware of the space where he is moving.

(b) **Narrow Attention Focus** is the ability of the athlete to focus on a particular or important task when surrounded by multiple cues. For example, athlete listening only to his team-mates' instructions or focusing on to their specific task rather than getting distracted by other cues or information.

**B.** **Direction** refers to where we tend to focus our attention, and varies from internal state of own mental or physical state to external state of what is happening around the athletes.

(a) **External Attention Focus** directs an athlete to focus outward or attend to other objects or cues other than their own self. A hockey player focusing on their own position on the field as well as attending focus to opponents and their own team mates around them is an example of external attention.

(b) **Internal Attention Focus** directs inward thoughts without attending to the external cues or objects. A Basket baller just sticking to his/her own position on the court rather than making changes to get away from opponents or an shooter focusing only on to their shooting target without getting distracted by other influencing factors.

## 9.5.2 Mental Toughness

Mental toughness is a multifaceted construct made up of multiple key components including values, attitudes, cognitions, emotions, and behaviors that refer to an individual's ability to thrive through both positively and negatively construed challenges, pressures, and adversities. Mental toughness is having the natural or developed psychological edge that enables you to (a) generally, cope better than your opponents with the many demands (competition, training, lifestyle) that sport places on a performer, and (b) specifically, be more consistent and better than your opponents in remaining determined, focused, confident, and in control under pressure.

Mental toughness is not considered just as personnel disposition anymore, according to latest research mental toughness consists of 'natural and developed' psychological characteristics. Mental toughness is important to sports psychology because it represents a culmination of what it takes to be an elite athlete at any level of competition. There are several important factors required for mental toughness:

i. Ability to thrive through challenge,

ii. Sport awareness,

iii. Tough attitude,

iv. Desire for success.

**Attributes of Mental Toughness**

Mental toughness can be developed among athletes and play an important role in competitive sports. There are several characteristics of an individual which can be considered as attributes of mental toughness.

- Self-confident and self- assured
- Able to focus and concentrate
- Intrinsically motivated
- Strong work ethic
- Committed to excellence
- Persistent and determined
- Positive attitude, no negativism
- Resilient in the face of failure or injury
- Thrive on pressure and challenge
- Consistent personal values
- Emotional intelligence
- Physically tough
- Gracious in face of success

## 9.5.3 Resilience and Sports

The challenge to solve mystery of life is lifelong. The ability to cope and recover with these said or unsaid encounters in life is known as Resilience. The one who has the ability to adapt to life's challenges by integrating a wide range of traits, habits, and skills is a resilient person.

Resilience refers to one's ability to bounce back emotionally in the face of adversity

Resilience is the ability to bounce back from adversity, trauma, tragedy, danger or other sources of stress in life.

Resilience is the force within the individual that drives a person to confront and overcome adversity. Resilience drives a person to confront and overcome adversity

and has been described as an innate righting mechanism. This force may be described as an innate mechanism and as the human capacity to confront and overcome adversity.

When stress is prevalent, one can learn to deal with it and bounce back quickly. Becoming more resilient in the face of inevitable stress can enhance one's outlook and health significantly. In other words, it can be said that one of the ways in psychology, to deal with trauma, threats, adversity, or substantial stressors such as problems in sportsperson's personal or professional life, health challenges, and performance-related stress is to develop a strategy known as Resilience.

Sports is no different story, everyday existence in sports entails a certain amount of stress. It's always there, no matter if it is learning of the new skill, injury, fear of training load, challenge of winning in competition, etc. In the face of hardship situations in sports, it is easy to lose one's composure. Despite the best efforts to cope with pressure, results might be unfortunate like, high chances of failure, dropouts, loss of interest, lack of confidence, harm to self, aggression, inability to perform learnt skills, etc

**Types of Resilience:**

1. **Natural Resilience:** It is a natural ability that is bestowed upon a person at conception. It is characterized by openness to new experiences, an eagerness to learn, and a want to have fun.

2. **Adaptive Resilience:** Adaptive resilience is when, as a result of adverse circumstances, one has to learn, adjust and adapt.

3. **Restored Resilience:** Restorative or ''learned' 'resilience is the type of resilience, restored by learning skills that aid in coping with life's challenges. This can also aid in dealing with the past, present, and future traumas in a more effective manner.

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I. **Tick the correct option.**

1. Which of the following is not a psychological attribute ?

   i. Heart rate

   ii. Attention

   iii. Resilience

   iv. Mental Toughness

2. Attention focus allowing athletes to perceive several occurrences simultaneously is referred as:

i. Narrow Attention Focus

ii. Broad Attention Focus

iii. External Attention Focus

iv. Internal Attention Focus

3. An individual's ability to bounce back emotionally in the face of adversity is referred as :

i. Aggression

ii. Anxiety

iii. Resilience

iv. Motivation

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

1. Describe Attention along with its types?

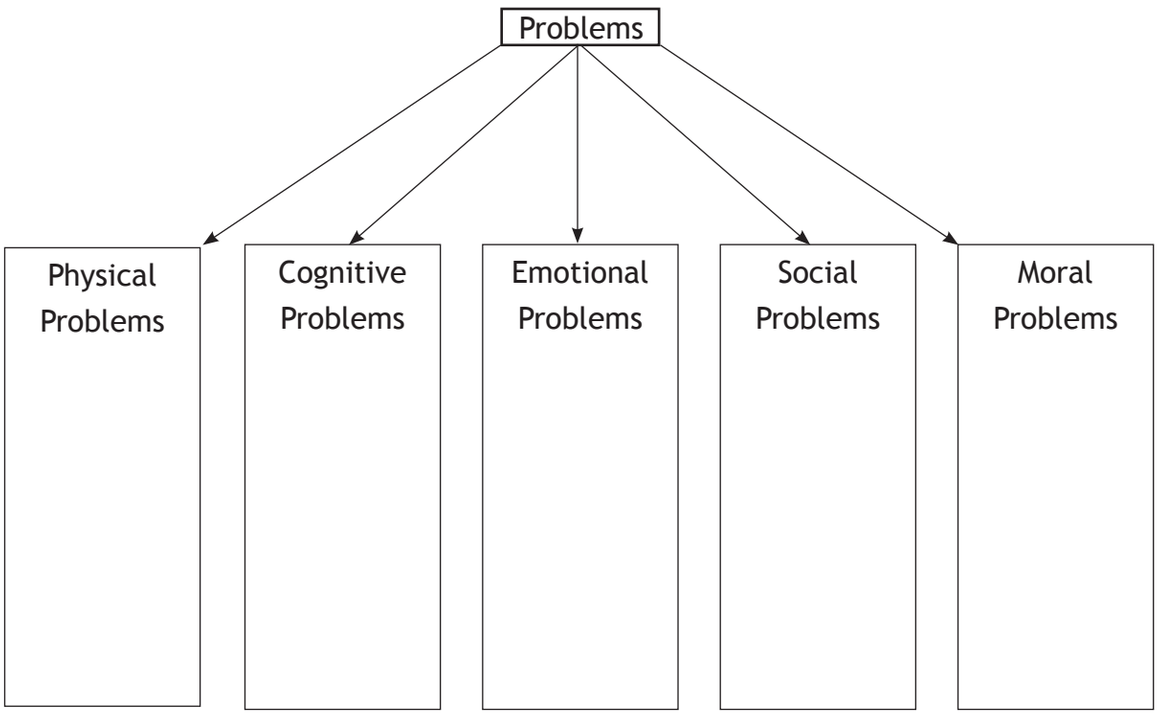
2. Explain Resilience and its importance in sports?

3. Describe role of Mental Toughness sports performance?

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

1. Explain the role of various psychological attributes influencing sports performance ?

IV. **What are the common problems faced by Adolescents?**




V. **Case Study**

Zaneet , a school sports champion and grade A student, has not been performing well in the past few months due to which his coach scheduled a counselling session with him to understand his problems. After a heart to heart talk the coach understood that his problems are basically related to his age and are commonly faced by Adolescents. Therefore he explained to Zaneet how to deal with these issues.

a) List down any four Adolescent problems.

b) List down any four ways how to manage Adolescent Problems.

c) What is the range of Adolescence?

## VI. Sports Integration

| Sports Integration – WRITING A STORY |
| --- |
| Choose an Indian athlete who has won a medal in the International arena – Olympics, Paralympics or Special Olympics. Research and write the story of the athlete highlighting the factors that made her/him succeed. |

## Suggested Reading


- Baron. R.A. (2008). "Psychology" Pearson Education South Asia, New Delhi.
- Cox. R.H. (2012). "Sport Psychology: Concepts and Applications" Mc Graw Hill, New York, USA.
- Jarvis. M.(2006). "Sport Psychology" Routledge, New York, USA.
- Weinberg. R.S; Gould.D. (2003). Foundations of Sport and Exercise Psychology" Human Kinetics, Champaign. USA.


UNIT 10

# TRAINING AND DOPING IN SPORTS

## Content

# Learning Outcomes

You will

- understand the concept and principles of sports training.
- summarise training load and its concept.
- understand the concept of warming up & limbering down in sports training and their types, method & importance.
- acquire the ability to differentiate between the skill, technique, tactics & strategies in sports training.
- interpret concept of doping.

| Discussion | | | | | |
|---|---|---|---|---|---|
| Do you follow a fitness routine? Complete the given training and share your information within your group. After discussion, is there anything you would like to change? If so, why/why not? | | | | | |
| **Personal Details** | | | | | |
| Name | | Age | | Gender | |
| **Physical Fitness Goals** | | | | | |
| What are your short-term physical fitness goals? (3 months) | | What are your medium-term physical fitness goals? (6 months) | | What are your long-term physical fitness goals? (a year) | |
| **Your Current Lifestyle/state** | | | | | |
| How would you describe your current level of fitness? | Unfit | Below Average | Average | Good | Very Good |
| How important is an exercise to you? | Not all important | Slightly important | Moderately important | Very important | Extremely important |
| How often do you exercise? | 1-2 times a week | 2-3 times a week | 3-4 times a week | 4-5 times a week | Everyday |
| What barriers, if any, prevent you from exercising more regularly? | I don't have enough time | I can't stay motivated | I have an injury | I don't enjoy exercising | I exercise regularly with no barriers |
| Would you say you eat a healthy balanced diet? | Not really | Sometimes | Fairly often | Often | Always |

## 10.1.1 Introduction

Sports performance training is the training of the body and mind to prepare the athlete for the rigors of a specific sport. It differs from personal training in that the athlete is conditioned and appropriately prepared to compete in her/his sport of choice, rather than broader general fitness. Individual characteristics such as age, gender, and fitness levels are combined with scientifically proven training methods

and exercises to create a customized, sports-specific workout plan that results in a more confident, motivated athlete. The focus is to enhance the athlete's performance in competition by using the latest advancements in sports science and kinesiology to develop a sport-specific strength and conditioning programme that improves the athlete's overall athleticism – strength, agility, speed, power, coordination, and balance as it relates to the sport in which they compete. For example, a volleyball player involved in sports performance training will perform exercises that mimic the movement patterns required on the volleyball court. She will focus on reaction, balance, vertical leap, agility, and high-intensity interval training. By modelling her training around the demands of her sport, she will develop the specific abilities needed to excel in competition.

**Do you know?**

The preparations of an ancient Olympic athlete started many months, even years, before the opening of the festival, in the gymnasium. The Ancient Greek gymnasium was a public location used for training, education, exercise, and socializing – something like the modern community centre. In Ancient Greek society, achieving a harmonious balance between body and mind was an essential aspect of an individual's personal development. Therefore, the gymnasium hosted wrestling matches and provided weight lifting training as well as music rehearsals and philosophy lectures.

## 10.1.2 Meaning and Concept of Sports Training

Training for achieving something in a competition is not a new idea. With the passage of time, more time and effort is being devoted to training and preparation for competitions. For example: Invention of new techniques in the field of athletics and weight training methods has shown very encouraging results. Training for any game or event has become very technical, and a scientific approach is needed to get the desired results.

Sports training is based on specific individual care, improved fitness, scientific ways, psychological feedback, technical help, sound machines and apparatus, climate, diet, safety precautions, etc. Training methods are based upon scientific principles in a systematic order. Thus, the training helps develop fundamental skills, advanced skills, techniques, tactics, strategies, emotional stability during the competition, motivational forces, etc. It gives the trainee practical and theoretical knowledge regarding performance, and it also guides her/him on how to improve further in different ways. We can say that these are methods to improve general and specific performance in games and sports. The following definitions may be helpful in understanding the meaning of sports training.

**Definition**

"Sports training is the basic form of preparation of sportsmen."

'Mathew'

"Sports training is a pedagogical (educational) process, based on scientific principles to prepare sportsmen for higher performances in sports competition."

'Hardyal Singh'

"Sports training is based on scientific knowledge and a pedagogical process of sports perfection which through systematic effect on psycho-physical performance ability and performance readiness aims at leading a sportsman to top level of performance."

"Harre"

"Sports training is the basic form of an athlete's training. It is the preparation systematically organized with the help of exercises, which in fact is a pedagogically organized process of controlling an athlete's development."

"Matveyev"

"Sports training is a planned and controlled process in which, for achieving a goal, changes in complex sports and motor performance ability to act and behaviour are made through measures of content methods and organisation."

"Martin"

"Sports training is a scientific-based and pedagogically organized process through which planned and systematic effect on performance ability and performance readiness aim at sports perfection and performance improvement as well as at the contest in sports competition."

"G. Thiess and G. Schnabel"

"Sports training is a targeted approach to training focused on your sport of choice."

"Todd Townes"

"Sports training is training designed specifically to increase performance and minimize injury of general sports performance as well as specialized sports performance.

"P. Garrison"

**Extension Activity**

Sports training is the process of preparing athletes for a specific competition. This preparation needs long-term planning, which includes:

- Conditioning training (strength training, endurance training, flexibility training)
- Training of technique (Technical preparation)
- Training of tactics (Tactical preparation)
- Psychological training (Mental preparation)

Working in groups, interview five sportspersons from different school teams participating in CBSE's Zonal Competitions (or any equivalent Competition). Find out details of their training under the heads given above.

## 10.1.3 Principles of Sports Training

For formulation, implementation, and development of players and guidelines for coaches, certain principles of sports training are followed, which are given below:

a) **Principle of Continuity:** Training should be a continuous process. There should not be any breaks. It should be a regular phenomenon. If there are long intervals between training sessions, an individual's fitness decreases, and the human body adapts to reduced load.

b) **Principle of progression load and overloading:** The principle of overload states that there should be greater than the average load on the body as required for training adaptation. It means that the training load should be increased to improve the performance of sportspersons. The load should be given carefully. If more load is given to the trainee constantly, performance may decline.

c) **Principle of Specificity of Training:** General and specific training are equally important to improve performance. Initially, general training should be given to developing all components of fitness and later on the proportion of specific training should be increased gradually. For example, speed improved through running will also benefit football. All athletes need general fitness development, but throwers need more strength training.

d) Principle of uniformity: Firstly, training is uniform to all players. But training should have an individualistic approach with time. A coach should take into consideration the following points:

   i. Sex

   ii. Age

iii. Psychological difference

iv. Training level

e) **Principle of periodization:** It prepares the sportsperson to give their best performance in a particular competition. It has three phases:

- Macro-cycle,
- Meso-cycle and
- Micro-cycle.

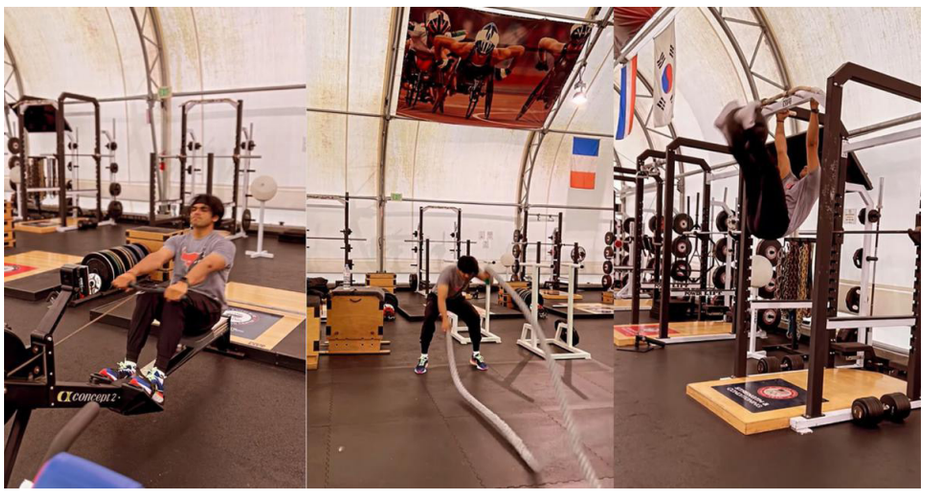
**Macro Cycle:** Duration of three months to one year. The last macrocycle should be aimed at recovery and relaxation.

**Meso Cycle:** Duration of three to six weeks. Here also, the last cycle should be aimed at recovery.

**Micro Cycle:** Duration of three to ten days. The last training session should aim at recovery and relaxation.

f) **Principle of Warming up and Limbering Down:** Warming up is a must before any training session as it prevents muscle soreness and injury. After the training session, gradual cooling down or limbering is also essential for returning to the normal level.

g) **Principle of Active Participation:** Active participation means the player should follow the principle of the law of readiness, which is very significant for getting good results in various levels of competition. The player and teacher should participate actively.




h) **Principle of Variety:** Training is a long-term process, and load and recovery can become boring for both the athlete and the coach. So, a successful coach should plan variety in the training programme to maintain the interest and

motivation of the athlete. Sometimes, change and variety may be achieved by changing the nature of the exercise, time of the day of the session, training group, and the environment.

i) **Principle of Ensuring Result:** The apex aim of sports training is to attain good results. It can be said that sports training aims to enable the sportsperson to put up a better performance in the competition. This principle cannot be achieved without the implementation of other principles. So, stress should be laid on the implementation of the other principles by the coach.

j) **Principle of Rest and Recovery:** The training programs should be designed in a way that there is proper rest and interest in the training activities because the body regenerates during rest and becomes better and stronger than before.

I. **Tick the correct options**

1. In order to develop the best performance of an athlete in competition, sports training has become
   a. scientific and systematic
   b. disorganized and irrational
   c. complex and painstaking
   d. easy and approximate
2. The main benefit of systematic and scientific sports training is an increase in
   a. performance
   b. injuries
   c. physical labour
   d. supervision
3. 'Micro-cycle' involves training of
   a. One week
   b. 1-2 weeks
   c. 6-8 weeks
   d. 8-10 weeks
4. According to the Principle of Continuity, a training program should be
   a. regular
   b. irregular

c. once a week

d. once a month

5. The systematic planning of athletic or physical training is called

a. periodization

b. specificity.

c. frequency.

d. variance.

6. Which of the following is not a principle of sports training?

a. Principle of specificity

b. Principle of overload

c. Principle of continuity

d. Principle of rest

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

1. What do you understand by the term sports training?

2. What is the need for sports training?

3. What do you understand by the Principle of Meso-cyclicity?

4. List the phases of the principle of periodization.

5. What do you mean by the progression of load?

6. Differentiate between general and specific preparation.

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

1. In what ways does sports training become an essential part of a trainee's life in sports?

2. Why is systematic sports training required for an athlete?

3. Apart from training, list the factors, that contribute to a successful plan?

4. "Scenario of sports training is changing day by day." Justify the statement.

5. All players diligently follow the principles of training. Specify the factors that should be kept in mind while preparing a training plan.

**Extension Activity**

For a month, every day in the morning you/all will do 30 minutes of physical activity, in which you will follow the schedule designed by your sports teacher. At the end of every week mark, the principle of sports training is applied in the training program:

List the Principles of training that you applied to improve your performance

1.

2.

3.

4.

5.

6.

7.

8.

## 10.2.1 Training Load: Over Load, Adaptation, and Recovery

The sports training process involves activities and movements, leading to fatigue. Fatigue is the direct product of load caused by physical activity or exercise. Fatigue is essential for improving the performance capacity of a sportsperson. Training load, therefore, is of central importance in sports training. Load, overload, and recovery are critical issues for team physicians treating and caring for athletes.

## 10.2.2 Training Load

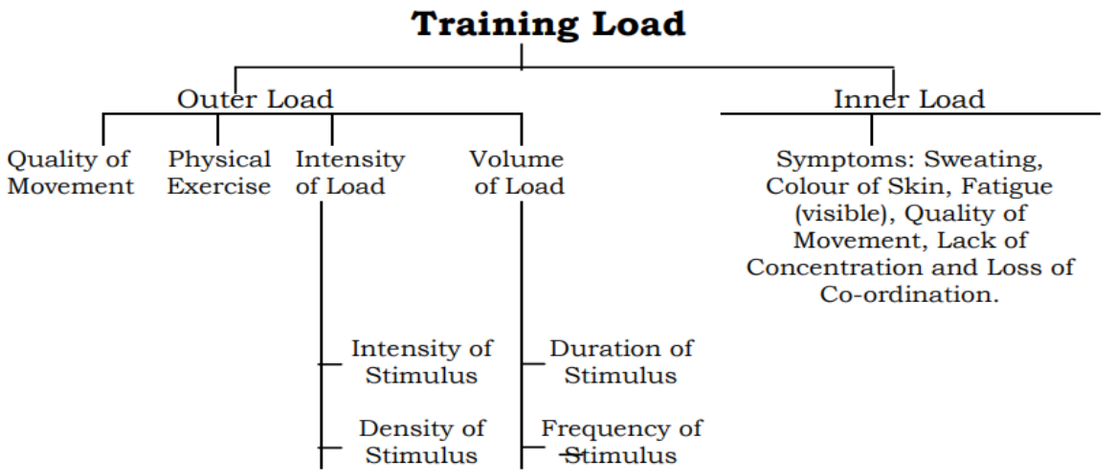
Physiological and psychological demands are placed on the individual through motor stimulus (movement), resulting in improvement and maintenance of performance capacity. Training load is of two types, namely

- Outer load and
- Inner load

Load is an inevitable result of athletic conditioning, training, and competition. Load inactivity may be a stimulus experienced and responded to by an individual before, during, or after participation. Load creates a demand or stress (both physiological

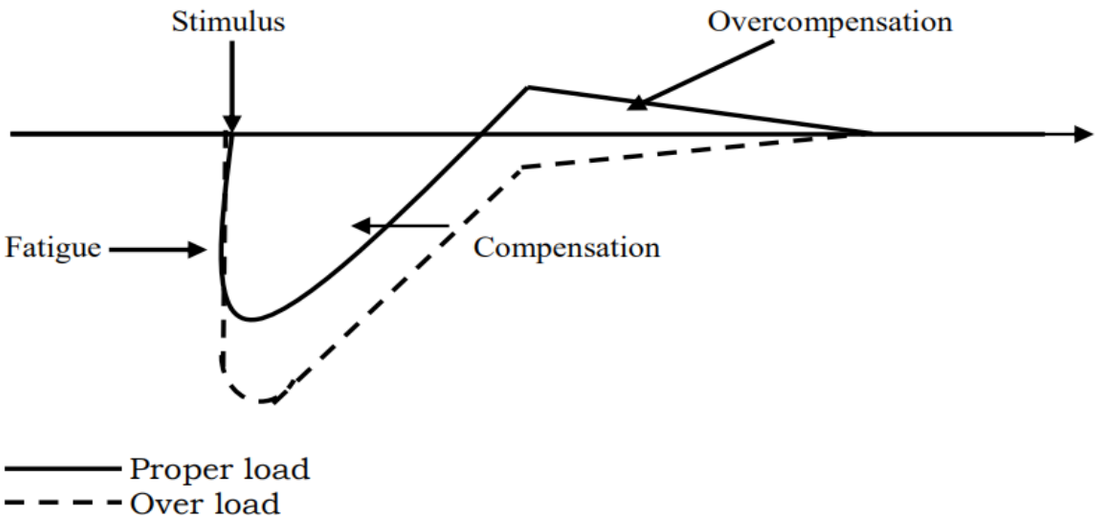
and psychological) and has internal and external components. Load that is safely managed may improve athletic capacity and performance and reduce risk of injury and illness.

The following figure will provide a complete concept of various features of training load.




## 10.2.3 Overload

The normal development of the training state of a sportsperson is disturbed when the physical and psychic daily load of life exceeds the loading capacity of the individual. Overloads, administered over a more extended period, lead to decreased performance capacity. Modern sports scientists consider the overloading phenomenon a disturbance in regular nervous activity. Performance in sports is not only a matter of muscular metabolic efficiency but it also, to a large extent, depends upon the efficiency of the nervous system. When the nervous system is disturbed, optimum energy and metabolic process utilization also gets disturbed. The other body systems can also not perform to the best of their efficiency. An excessive training load causes incomplete adaptation, and the sportsperson will have problems recovering from the training stimulus. These problems with recovery can also be cumulative. They occur when the loading is repeatedly too tremendous or too closely spaced. The decline in performance caused by incomplete adaptation is one of the most apparent symptoms of overtraining. In this situation, the coach must allow time for proper recovery and should evaluate and reduce the training loads used.




Thus, we can say that overload is a load that is excessive or a load that is not well managed. It will result in anatomical, physiological, and psychosocial conditions that manifest in altered performance, injury, and illness. Identifying and modifying load and minimizing overload have been advocated as central parts of optimal performance and injury and illness and prevention strategies.

The definition of overload chosen by the coach depends upon the particular physical characteristics that need to be developed.

- **Strength:** overload is increasing the resistance in terms of kilogram, etc.
- **Strength endurance:** overload is increasing repetitions of activity with a resistance ranging from the athlete's own bodyweight to adding weighted belts, etc. to the athlete, to light and sub-maximal loads. The lactic anaerobic energy pathway has high involvement.
- **Aerobic/heart endurance:** overload is increasing the amount of time that the person can continue a low strength demand in a steady state of work of low-intensity repetitions. The aerobic energy pathway is involved exclusively.
- **Speed endurance:** overload is increasing the number of high-quality repetitions of an exercise per unit of time; or increasing the quality of repetition while keeping the number at or above a fixed threshold; although this may take place in a climate of the cumulative lactic anaerobic pathway by-products, the alactic energy pathway has critical high involvement.
- **Speed:** overload is performing (and or selecting) a given task faster.

- **Elastic strength/power:** overload is increasing the resistance without loss of speed, or increasing the speed of moving a fixed sub-max ▫ max resistance.
- **Mobility:** overload is taking effective joint action beyond its present limit.

**Overloading is of two types.**

a) **Dominance of excitation process:** This state occurs when the training load suddenly increases without adequate preparation.

b) **Dominance of relaxation process:** This state results when an overdose of training load is administered continuously over an extended period.

**Causes of Overloading**

The main cause which leads to overloading can be discussed under the following four categories:

**1. Faulty Training Method**

(a) The recovery process may be neglected.

(b) There may be a rapid increase in the training load thus adaptation does not take place.

(c) There is a high volume of load with maximum or sub-maximum intensity.

(d) There is forced technical training involving complicated movements without adequate rest.

(e) There may be excess of competition with high demands.

(f) The training may be one-sided.

**2. Life Factors**

(a) The player may have had an insufficient night's rest.

(b) The player's daily routine is irregular.

(c) The player may have a luxurious daily routine.

(d) There may be an indulgence in alcohol and nicotine on part of the player.

(e) Bad living conditions of the player may be responsible.

(f) The player's leisure time activity is faulty.

(g) There is a quarrel in the family or the community.

**3. Social Factors**

(a) There could be excess of engagements.

(b) Friction in the family could also be a reason for overload.

(c) If the sportsperson is unsatisfied in her/his profession or studies, it may lead to overload.

(d) A misunderstanding with colleagues could also be a reason.

(e) Overloading in professional work, studies etc. could also be a reason.

(f) The family could have an unfriendly attitude towards sports.

(g) Excess of entertainment programmes could be a reason.

**4. Health Factors**

The sportsperson could be suffering from any/either of the following.

(a) Fever

(b) Bad stomach

(c) Infectious disease

(d) Injuries

**Symptoms of Overload**

The symptoms of overload are grouped as follows and they also appear in the same order:

**1. Psychological symptoms**

(a) Increased excitability.

(b) Tendency toward hysteria.

(c) Becoming quarrelsome.

(d) Less contact with the coach.

(e) Increased sensitivity towards criticism.

(f) Depression.

(g) Indifference.

(h) Loss of confidence.

(i) Loss of motivation.

2. **Performance Symptoms**

(a) Increased error in technique.

(b) Decreased concentration.

(c) Decreased differentiation ability.

(d) Decrease in strength, speed, and endurance abilities.

(e) Slow recovery.

(f) Decreased competition readiness.

(g) Increased tendency to surrender to competition.

(h) Uncontrolled behaviour in competition.

3. **Somatic-Functional Symptoms**

(a) Loss of sleep.

(b) Loss of appetite.

(c) Loss of weight.

(d) Disturbance in digestion.

(e) Frequent giddiness.

(f) Susceptibility to injuries.

**Do you know?**

Training monitoring is about keeping track of what athletes accomplish in training, for the purpose of improving the interaction between coach and athlete. Over history, there have been several basic schemes of training monitoring. However, the difficulty in standardizing the conditions of training made this process unreliable. With time, the measurement of heart rate (HR) evolved from interval training toward index workouts, where the main monitored parameter was the average time required to complete index workouts. These measures of training load focused on the external training load, and what the athlete could actually do. With the advancement in the scientific community, HR, lactate, VO2, and power output, were used to monitor training loads in athletes of differing abilities. These methods often require laboratory testing for calibration and tend to produce too much information, in too slow a time frame, to be optimally useful to coaches. The TRIMP concept which was mathematically complex was also introduced. Nowadays wearable sensors are used which provide high-resolution data of the external training load. These methods are promising, but problems relative to information overload and turnaround time for coaches remain to be solved.

**Extension Activity**

Join team practice sessions and start preparing for an Annual Zonal Competition for this year Scale your level of exertion experienced by you in the Rating of Perceived Exertion below every day after the session for 15 days

| Scale | Experience (Exertion) | ✓ |
|---|---|---|
| 0 | Nothing at all | |
| 0.5 | Very, very slight just noticeable | |
| 1 | Very slight | |
| 2 | Slight | |
| 3 | Moderate | |
| 4 | Somewhat severe | |
| 5 | Severe | |
| 6-7 | Very severe very severe | |
| 8-9 | Very, very severe | |
| 10 | Maximum | |

I. **Tick the correct options**

1. Outer load in training depends on
   a. sweating
   b. colour of skin
   c. the intensity of load.
   d. fatigue
2. Intensity of load, Volume of load, Physical Exercise are features of
   a. outer load.
   b. intensity.
   c. inner load.
   d. recovery
3. Cause of Overload in training is associated with.
   a. intensity
   b. frequency
   c. duration
   d. faulty training method

4. Overload in sports training relates to when

   a. oxygen is adequate to meet the needs of the body.

   b. the oxygen-supplying mechanisms are not able to increase.

   c. the intake of oxygen is insufficient to meet the demand.

   d. the supply of oxygen is more than required.

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

1. What do you mean by training load?

2. List the causes of training overload?

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

Explain overload in training and draw a flow chart of symptoms of overload?

## 10.2.4 Adaptation

In a literal sense, the word adaptation means to get adjusted. The human organism can get modified (adapted) to the environment, and as the environmental conditions change, the human organism also changes in due course. This adaptation process is also applicable to sports training—the human organism can modify to a new state of performance efficiency due to the administration of external load. Thus, load and adaptation go side by side. This adaptation process is biochemical and applies to improving conditional abilities (strength, speed endurance) only. As the sportsperson is exposed to the training and competition demands, this results in a disturbance of the homeostasis (internal body balance). The sportsperson makes an effort to restore the state of homeostasis by causing the different systems and bodily functions to adjust to the state of disturbance. In case the bodily homeostasis is disturbed again and again for a certain period, the human body responds by causing structural and metabolic changes, enabling the body to withstand the load more efficiently. This is called adaptation.

The following three conditions are to be fulfilled for adaptation to the training load.

1. Training load has to be as per the loading capacity of the sportsperson.
2. Recovery period should be in proportion to the training load.
3. Loading and recovery process must be repeated for a certain period (10 to 20 days).

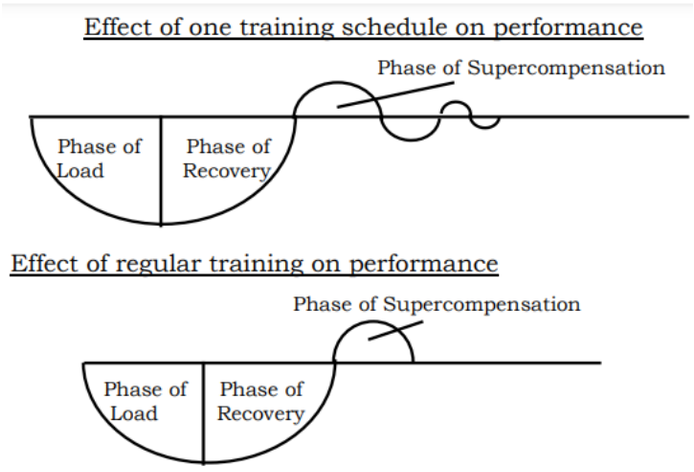



Fig. 3. Adaptation to training loads


Fig.4. Procedure of increasing training load

**Conditions of Adaptation**

To ensure the effectiveness of the training load in each training unit, the following conditions of adaptation are to be strictly adhered to:

a) Adaptation is maximum when the training load is given on an individual performance basis. To enable a sportsperson to have optimal benefit from training, the limitations shall be administered keeping in mind the specific character of an individual.

b) There should be a correct proportion between intensity and volume of training load. The intensity of stimulus has an inverse relationship with the volume of stimulus.

c) The adaptation process results from the correct proportion between phases of load and recovery.

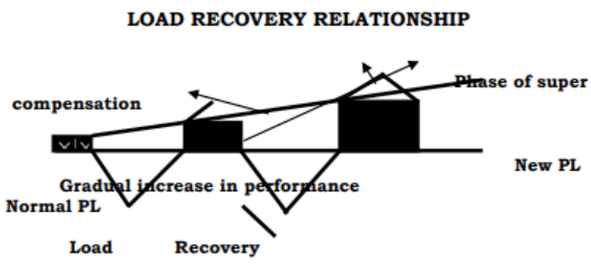
**Recovery**

Both training and competition loads enhance sports performance. In the long-term training process, the quantum of load is gradually increased, leading to improved performance. A beginner adapts to training load faster, whereas, with the increase in training age, higher loads are administered, resulting in slower growth in performance. Sportspersons cannot effectively undertake very high loads of training unless proper

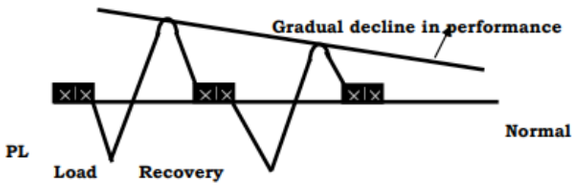
means are adopted to accelerate the process of recovery. Administering appropriate means can ensure quicker recovery and enable a sportsperson to undertake more frequent loads.

Recovery is the period and process during which the body responds to load. Adequate recovery may result in positive adaptations for athletic capacity, performance, and injury and illness risk. In contrast, inadequate recovery may maladapt for athletic ability, performance, injury, and illness.

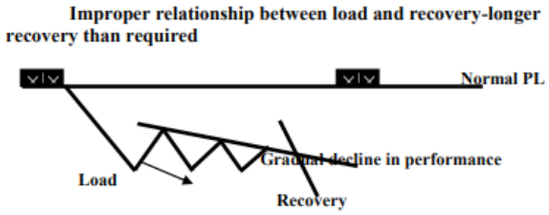
Recovery from training and competition loads requires a considerable amount of time. Recovery can be divided into the following three stages:




**Proper relationship between phases of load and recovery**




**Improper relationship between load and recovery-longer recovery than required**




**Improper relationship between load and recovery-very high load and short recovery**

**Stage I:**

In this phase, fatigue and recovery co-occur as the training or competition progresses. This process occurs because of the resynthesis of adenosine triphosphate (ATP), Creatine phosphate (CP), and glycogen and the neutralization of lactic acid. For activities, which continue for a long duration and for sports played for a considerable period, the pace of recovery in this phase plays an important role. Recovery during this phase largely depends upon the functional capacity and efficiency of different systems and organs.

**Stage II**

This phase commences with the completion of the training schedule (cessation of physical activity) and ends with the restoration of homeostasis of the body. This phase lasts from a few minutes to 2 to 3 hours. The following active recovery means can be adapted to make the recovery process faster.

1. Deep breathing exercises

2. Intake of drinks containing carbohydrates, vitamins, salts, and minerals.

**Stage III**

This phase of recovery can last from many hours to several days. In this phase, the anabolic process facilitates recovery. Substances such as enzymes and proteins, which get depleted in the process of undertaking the load, get resynthesized.

The pace of recovery is affected by the following factors:

Stimulus intensity and stimulus volume (factors of load).

a) Types of training load

b) Health and fitness status

c) Rest and sleep

d) Good diet

e) Daily routine

f) Total load of the day

**Do you know?**

There are two different categories of recovery:

- **Immediate or short-term recovery** - This is the most common form of recovery and occurs within hours after an exercise session or event. Short-term recovery includes low-intensity exercise after working out and during the cool-down phase.
- **Long-term recovery** - This refers to recovery periods that are built into a seasonal training schedule and may include days or weeks incorporated into an annual athletic programme.

**Extension Activity**

As a group, survey whether your school team preparing for zonal competitions for this year is recovering and adapting properly. Scale their level of physiological experience in the form below:

| S.no | Experience | ✓ |
|---|---|---|
| 1 | Fatigue | |
| 2 | Loss of motivation | |
| 3 | Irritability | |
| 4 | Restlessness | |
| 5 | Weight loss | |
| 6 | Lack of mental concentration | |
| 7 | Sore muscles | |
| 8 | Anxiety | |
| 9 | Unrefreshed on awakening | |

I. **Tick the correct options**

1. Which are the conditions that need to be fulfilled for adaptation to the training load?
   a. Recovery period should be in proportion to the training load.
   b. Rest should be given more focus than training
   c. Loading process must be repeated for a long period
   d. Training load should not be compromised even during injury
2. Factors for the slow pace of recovery include
   a. optimal health and fitness
   b. adequate rest and sleep
   c. good diet
   d. fatigue and lactic acid accumulation
3. Overload in training can be avoided by increasing
   a. intensity
   b. frequency
   c. duration
   d. recovery

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

1. What do you mean by adaptation?
2. Explain the importance of the recovery process in training?

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

1. Explain the conditions of Adaptation that ensure the effectiveness of the training load

## 10.3.1 Warming up and Limbering Down

Warming up is a process by which the human machine is brought to a condition at which it safely responds to the nerve impulses of the person for quick and efficient action. Warming up is heating the body's muscles and preparing them to start work. It helps the athletes prepare physically, mentally, and physiologically for any training or competition. If warming up is effective, muscles become ready to respond efficiently. In this process, muscles are warmed-up by running, jogging, and performing freehand exercises before the training or competition. This preparation before training or competition is called warming up. The following definitions may help to know more about warming up.

- "Warming-up raises the body temperature by running and performing exercises before the activity or competition."
- "Warming up is a practice in itself."
- "Warming up is a process by which human-machine is brought to a condition at which it safely responds to the nerve impulses of the persons for quick and efficient action."
- "Warming up is done to tone up the body to meet the ensuring activity."
- "Warming up consists of a series of preparatory exercises either before a training session or competition."

Picture Source: https://www.dreamstime.com/warm-up-exercise-set-workout-stretch-muscles-warm-up-exercise-set-workout-stretch-muscles-physical-training-image153271559

**Types of Warming-Up**

There are the following types of warming up.

1. **Passive Warming-up:** In this, the player warms up his body through external sources and not with actual participation in physical activity. It can be done by sunbathing, using a heavy uniform, drinking hot water, massage, drinking hot beverages (tea, coffee), etc. Performing Passive Warming-up by these means is beneficial because there is no energy expenditure in warming up.

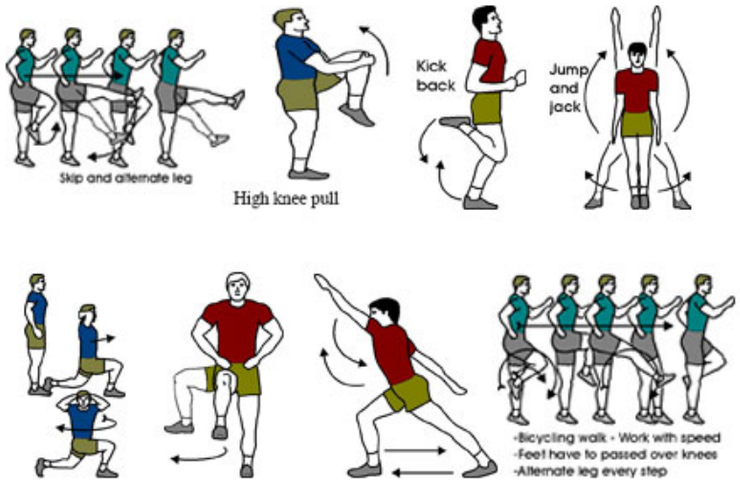
2. **Active Warming-up:** In active warming-up, the individual warms his body through actual participation in physical activities. These activities improve his efficiency and tone up the muscles for the training for competition. Its duration is 10 to 30 minutes. Warming up is done slowly without spending much energy just before the workout. In active warming up the body's temperature increases up to the required level. Jogging and stretching exercises are included in such type of warming-up. There are two types of active warming up:-

   (a) General Warming-up

   (b) Specific Warming-up

   (c) **General Warming-up:** General warming-up is usually performed in all types of activities. This warming-up type includes jogging, jumping-running, stretching, striding, wind sprints, calisthenics, and other general exercises. It increases the mobility of all the joints and improves the coordination of the body and mind. It also enhances muscle tone. It prepares the body physically and mentally. The duration of general warming up depends upon the nature of the work.

   (d) **Specific Warming-up:** These particular exercises are performed after the activities of general warming-up. The are of a particular type that vary from game to game. This type of warming up increases the mobility of all joints and improves the coordination of the body and mind. For example, a sprinter may take a few starts and run for a short distance before the actual competition. A basketball player may practice for lay-up shots or free throws before the match. The primary stress is practicing various skills in the game, in the specific warming-up.




Picture Source: https://exerciseinjuryprevention.weebly.com/

**Do you know?**

Warming up is a preliminary exercise of physical and mental preparation for strenuous exertion.

*Specific Warming-Up for Some Games*

- **Basket Ball:** Dribbling, shooting, shuttle run, lay-up shots, dodging, free throws and take practice, etc.
- **Cricket:** Dummy bowling and batting, catching, fielding, etc.
- **Badminton:** Tossing, high clear, low clear, smashing, making with jumps, dropping practice and court crafting, etc.
- **Tennis:** Knocking, wall practice, volley, clear service practice, clear slice, lob, return, etc.
- **Shot Put:** Shifting the shot from left hand to right hand and vice versa, standing throws, putting the shot with both hands, gliding practice with or without the shot, etc.
- **Kho-Kho:** Dodging, Zig-Zag running, pole to pole running.
- **Volleyball:** Blocking, passing, smashing, etc.

**Methods of Warming Up**

There are various methods through which an athlete can warm up his/her body.

1. **Physical Activities:** These activities involve some set of exercises for the body parts through which the body gets prepared to perform any task at an optimum level. These exercises must be done at a slow pace and low intensity to prevent fatigue or overload before the competition or sports event. Some of the best physical warming-up activities include:

(a) **Jogging** - This is generally done at a slow pace for 5 to 10 minutes to increase the body temperature.

(b) **Bending and Stretching Exercises** - These include limb and trunk exercises like stretching of shoulder muscles, arm muscles, clavicle muscles, back muscles, hip muscles, and leg muscles and include movements like flexion, extension, abduction and adduction, circumduction, and rotation.

(c) **Striding** - Striding is best before events requiring explosive effort. The athlete may run around 30 to 40 meters at sub-maximum intensity at least 3-4 times with proper rest in between.

(d) **Wind Sprints** - Wind sprints are sprinting exercises performed for short distance with spikes. The athlete moves from a walk or slow run to a faster run and repeatedly reverses.

2. **Massage:** This method increases and regulates blood flow in the body, thereby increasing the athlete's body temperature for producing efficient movement. Different techniques of massage include effleurage, petrissage, kneading, friction, vibration, and percussion.

3. **Drinking Hot Beverages:** This method including warm water, tea, coffee, etc stimulates the body's functions. However, care must be taken to consume these in limited quantities to avoid any discomfort.

4. **Bath:** Hot bath therapy is usually very common in sports in cold countries. It can be performed before and after the task. A hot bath before the event may improve the blood flow, and increase body temperature and muscle activation of the athlete. After the task, it may help an athlete to cure muscle tension and reveal relaxation to the body.

**Importance of Warming Up**

**Warming up plays a vital role in sports training or competitions.**

1. **Psychological preparedness:** Performing a set of routine or specific activities/ exercises before the training and competition helps an athlete plan and build himself /herself to competing readiness, thereby eliciting optimum output.
2. **Reduces anxiety and tension:** Warming up reduces anxiety and tension and increases the motivational levels of a sports person.
3. **Facilitate optimum performance:** Performance can be optimised by increasing the speed of nerve impulses and metabolic rate improving the reaction time of a sports person.
4. **Prevents sports injuries:** Adequate warming up before the training period or competition prevents loosening and tearing of muscles and reduces muscle cramping.

5. **Assists flexibility:** Warming up assists flexibility and increases the range of motion helping a sportsman to exert force up to maximum reach.

6. **Enhances mechanical:** Suppleness of muscles is increased through warming up.

7. **Facilitates motor fitness components:** Motor fitness components like strength, endurance, flexibility, coordinative abilities, and speed are enhanced.

8. **Increases muscle temperature:** As a result of warming up, which muscles both contract more forcefully and relax more quickly, the risk of over-stretching a muscle and causing injury is reduced. It also improves muscle elasticity; this can enhance speed and strength.

9. **Increases blood temperature:** Due to warming up, there is an increase of blood temperature and build up of lactic acid, which leads to weakening of the binding of oxygen to haemoglobin. As a result, oxygen is more readily available to working muscles, which may improve endurance.

10. **Blood vessels dilate:** Warming up dilates blood vessels that increases blood flow and reduces stress on the heart.

11. **Increases range of motion:** The increased range of motion allows large joints such as shoulders and knees to reach their maximum movement potential.

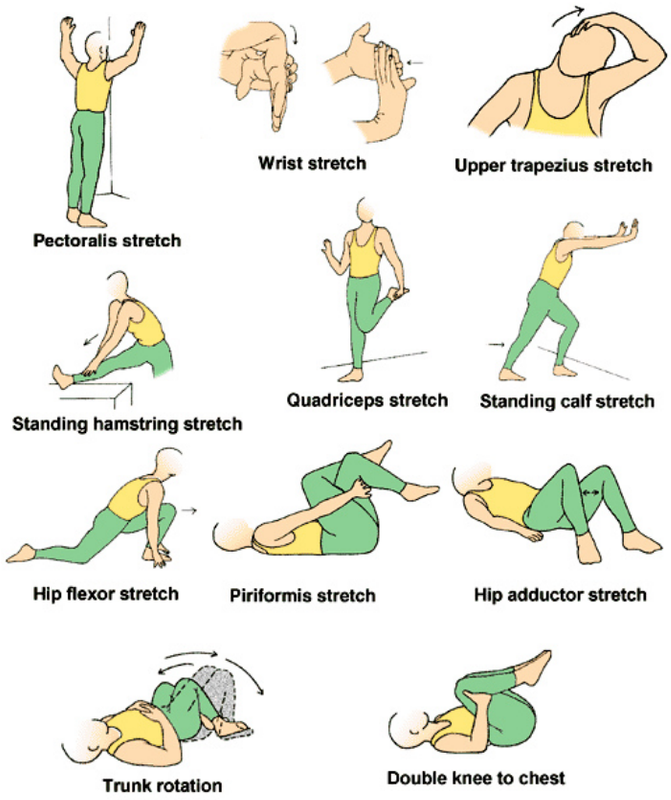
## 10.3.2 Meaning of Limbering Down

Limbering down or cooling down is also called warming down. This is an easy exercise that will allow the body to gradually shift from an exertional state to a resting or near resting state. It is a necessary activity after training or competition. Depending on the intensity of the exercise, cooling down can involve a slow jog or walk, or stretching can be used with lower intensities. Players take a cooling bath, ice bath, or cryotherapy for relaxing their muscles.

Some major static stretching exercises which are very important for cooling down are described here.

- **Ham Strings:** Lying on your back, raise one leg straight directly, above hips. Holding the calf or thigh, press the heel towards the ceiling as you pull the leg back towards the chest. Repeat the same for the other leg.
- **Chest:** Standing straight, interlace fingers behind your back. As you straighten out your arms, lift your chin towards the ceiling.
- **Glutes:** Lying on your back, cross your right leg over the bent left knee. Then bring the left knee to the chest, holding onto the back of your thigh, gently pressing the right knee wide.

- **Quadriceps:** Lying on your right side, pull left leg into the left glute, feeling the stretch in front of the thigh.
- **Triceps/Shoulders:** Take one arm overhead, bend at the elbow joint, and extend your palm down the centre of your back, gently pulling the elbow with the opposite hand. Take the same arm across the chest, gently pulling at the elbow joint to extend through the shoulder.




Picture Source: http://jump3.adsguest.com/html01_w301.php?hh=www.infracomposites.com&s=2.157.6282865.4.28.33.types%20of%20dynamic%20exercises

**Do you know?**

Stretching keeps the muscles flexible, strong, and healthy, and we need that flexibility to maintain a range of motion in the joints. Without it, the muscles shorten and become tight. Then, when you call on the muscles for activity, they are weak and unable to extend all the way. That puts you at risk for joint pain, strains, and muscle damage.

**Benefits of Limbering Down**

a) **Regulating your heart rate.** Exercising in general causes your heart rate to increase and after exercising, your heart beats faster than normal. You need to bring it to its normal rate, but stopping suddenly and quickly, without slowing down gradually, can cause dizziness and light-headedness. So, for instance, if you are running, the best way to slow your heart rate down is by walking.

b) **Control body temperate:** Exercising causes your body temperature to increase. After exercising, body temperature needs to be normalized. A proper cooling down or limbering down helps in reducing the body temperature to normal.

c) **Preventing injuries:** Like warming up, cooling down after exercises helps prevent injuries such as muscle tears. Skipping cooling down and stretching after a workout not only slows down muscle recovery but also reduces the benefits gained from a workout.

d) **Stress relief and relaxation.** Exercising is as good for the mind as it is for the body. As your body begins to slow down, you begin to get into a relaxed mood and the brain begins to release dopamine and serotonin, the two hormones that are responsible to make us feel good and less stressed.

e) **Body restoration.** Our bodies undergo several changes during working out, such as increased secretion of adrenaline, increased temperature, and accelerated breathing. Cooling down after a workout helps restore the body to its normal condition.

f) **Reducing the build-up of lactic acid.** After intense workouts, lactic acid builds up in our bodies which can lead to muscle cramping and stiffness. Cooling down helps speed up the process of releasing the lactic acids in our body and accordingly, the body recovers more quickly.

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I. **Tick the correct option**

1. Warming up is performed to
   a. learn new skills
   b. enhance mechanical efficiency
   c. relax
   d. reduce heart rate
2. Cooling down activity is performed for
   a. dilating blood vessels
   b. increasing muscle temperature
   c. increasing blood temperature
   d. reducing the build-up of lactic acid

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

1. What do you understand by active and passive warm-up?
2. What do you understand by the term specific warmup?

3. List the names of any four muscles that relax during cooling down.

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

**1.** "Warm up is important for optimum performance". Justify the statement.

2. Define Cooling Down. Enlist the benefits of cooling down.

3. How is general warming up is different from specific warming up?

## 10.4.1 Concept of Skill, Technique, Tactics & Strategies.

Skill, Technique, and Style are essential attributes for an athlete to perform at an optimum level on the sports field. Some people are born with a natural ability for a particular game or sport such as speed, agility, coordination, flexibility, balance, and reaction time. But they still need to develop and perfect their skills with frequent practice to bring about the result they wish to achieve. In simple words, skill is a learned and practiced ability that helps an athlete or sportsperson achieve the desired result with maximum certainty and efficiency. Technique is the way of performing that fundamental skill/activity in a sport involving a well-timed and coordinated sequence of muscle actions so that the movements involved produce the best performance and are least likely to cause injury. Style, on the other hand, is the individual's way of adapting skill and technique to develop his/her performance in a smart way.

**Skill**

Skill can be defined as the capacity of the sportsman to realize the technique in actual motor action. Skill is defined as the automatization of motor action. Skill is sport-specific. It exists within all sports, but each sport needs different skills. A skill is seen as a coordinated action involving a group of movements executed consistently and smoothly. There are many interpretations of what constitutes a skilful movement because views vary from novice to expert. Several different experts have defined the skill. The following are some definitions: -

"An organized, coordinated activity in relation to an object or situation, which involves a whole chain of sensory, central and motor mechanisms."

"Galligan"

"Excellence of performance - the successful integration of a hierarchy of abilities appropriate to a task under given conditions."

"Prof. G.P. Meredith"

Picture Source: https://www.gq.com/story/watch-lionel-messis-record-breaking-free-kick

**Do you know?**

Anders Ericsson, a psychologist, writes that it takes 10,000 hours of practice to become an expert. In other words, an athlete training for 5 hours a day, for 7 days a week over 365 days a year would take about 5.5 years to acquire expertise in her/his chosen sport or game.

**Technique**

Technique is the mechanical model of doing any task through which an athlete minimizes his energy expenditure and produces remarkable output. It involves a well-timed and coordinated sequence of muscle actions that have been developed through the experience of players, coaches, and the analysis provided by sports science. These techniques have evolved and been refined so that the movements involved produce the best performance and are least likely to cause injury. Using good technique in sports is beneficial because it promotes high performance and reduces the risk of injury.


Picture

Thus, technique means the way of doing a particular task scientifically. This way

of doing a thing should be based on scientific principles and effectively achieve an aim. It is an essential movement of any sport or event. We can say that a technique is a way of performing the skill. It is the basic movement of any sport or event. For example, rolling the thumb over the cricket ball by the bowler in cricket is a technique to get the extra spin. Several techniques are combined into a movement pattern in the triple jump (running and then hop step and jump phases.)

"Technique is the most rational and effective form to perform exercises." A technique involves scientific and economic methods adopted to achieve top performance in sports competitions.

"Ozolin N.

**Tactics**

We can say tactics are the skills required in any game that allows a player or team to effectively use their skills and talent to the best possible advantage, consisting of tactical actions as well as other measures which are adopted before or during the competition for successful participation.

Tactics have been defined as the following.

- Tactics are actions and strategies planned to achieve an overall objective and, in the sport, that objective is predominantly to win.
- Tactics- It means the intelligent or creative application of skills during the competition.
- Tactics are methods by which performers try to outwit (get the better of, beat) an opponent.

Tactical preparation relates to measuring especially organized physical exercises, trials, mental drills, modelling, etc. Its aim is to inspire and encourage cognitive and competitive tactics. Tactical preparation enables athletes to make the most effective utilization of their motor and technical abilities in competitions. Strategy and tactics should not be used interchangeably. Strategy is the overall plan for successful participation in the competition whereas tactics is the actual realization of strategy in practice.

**Factors affecting Tactics**

a) Opposition – including their strengths and weaknesses.

b) Players available for selection.

c) The importance of the game/match.

d) Possibly even the weather.

**Do you know?**

The spatial component is foundational to tactical awareness. Once students appreciate the need to manipulate how they use 'space', then 'time' and 'force' components become a natural progression to their growing tactical sophistication. The advanced components add to the relationship aspect of tactical play. Opponents who can use space, force, and time to affect their play create an unpredictability that keeps the outcome of play uncertain as they probe the ability of their opponents. This relationship focus is fundamental to making gameplay.

**Elements that develop Tactical understanding**

| Game and focus | Principle of Play depth | *Tactical Awareness Components for breadth* | | | | |
|---|---|---|---|---|---|---|
| | | *Initial* | | | *Advanced* | |
| | | SPACE *Where* | FORCE *How* | TIME *When* | SELF *In relation to...* | OTHER *In relation to...* |
| *Toss onto target*<br>Bounce, catch then send. Co-operative then compete | Consistency ↓ Placement & Positioning | Where is the biggest target area? | How hard send ball to be able to get ball to hit target? | When playing a shot can you get to next shot? | In relation to the ball move self to bounce of the ball | |
| | | Where is your partner's target area? | How will you apply the force to keep the ball in? | When use height to recover? | What is the area to get into to be ready for next shot? | How can you anticipate the placement of partner's shot? |
| *Castle game*<br>Bounce to hit target. Co-operative then compete | Consistency ↓ Placement & Positioning ↓ Spin & Power | Where will the ball land? | How can you use force to control ball accuracy? | When do you hit the ball high for time to get to bounce? | In relation to target where is best place to stand? | In relation to opponent's hit where should you stand? |
| | | Where do you go after striking the ball? | How hard hit ball and in which direction to be ready for next shot? | When will partner hit ball to target? | How can you position yourself to use your favoured side? | Can you send the ball where your opponent does not expect it to go? |
| | | Where will the ball bounce if you use spin? | How will force be applied to the ball to make it spin? | When should you spin the ball and when use power? | How well can you spin the ball and control placement? | How can you use spin to get your opponent out of position? |

## Strategies

Strategy is basically laying down the goals and making a plan to get there. In short, this is something like, having the goal to win the season or win the match as well as making a plan to achieve this, such as developing an athlete's power, working on comradery, and selecting the right players.

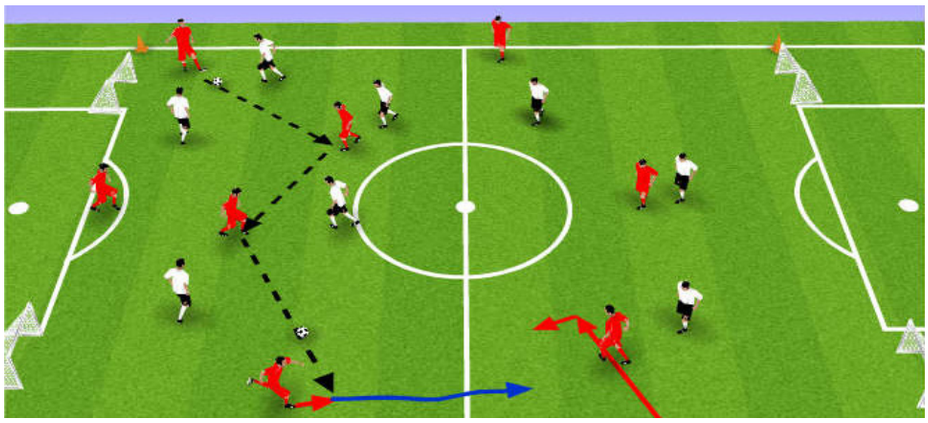
*It can be defined as "a plan of action designed to achieve a long-term or overall aim."*

Strategy often requires a SWOT (strengths, weaknesses, opportunities, and threats) analysis. The coach might analyse the team and plan to utilise strengths and develop weaknesses. She may also analyse the opposition to identify the best approach to be

used in the game to win. For example, the team has a weak tackler to target.

Strategizing is a great way to improve the team's synchronicity. The process involves aligning each member to the same end goal. Each of the players' motivations are combined and the team's morale consequently improves. Having the same focus and end goal will have them work as a unit in the game.

If the team has a strategy, improvements in players' individual performances becomes apparent. Each player will be more aware of their individual aims and their place in the team as a whole. Formulating strategies will involve open conversations and lots of set planning of techniques and tactics. As a result, players will be more confident about what is expected of them on the field. Every player will have a better understanding of their input in the team's performance and will be more motivated. For example: Football is a game of complex strategies and tactics. The basic strategy that each football team devises for a game is called a game plan. Each team has up to hundreds of diagrammed plays and strategies that are worked out ahead of time for pre-determined situations. During the game and at half time these strategies are worked on and altered to adjust for the other team's strategies. Often how well these adjustments are made will determine the outcome of the game (offensive or defensive strategy).



Picture Source: https://pesmic.weebly.com/grade-8/offensive-strategy

I. **Tick the correct answer.**

1. SWOT in strategy is required as

   a. strategy, working, output, and thought.

   b. strengths, weaknesses, opportunities, and threats.

   c. strengths, working, opportunities, and threats.

   d. success, weaknesses, outcome, and target.

2. In football, shooting is required to score goals. Shooting is a

   a. technique

   b. style

   c. skill

   d. strategy

3. The way of performing an action scientifically is

   a. style

   b. technique

   c. skill

   d. strategy

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

1. Define Technique.

2. What do you mean by strategy in sports?

3. Elucidate Tactics in brief.

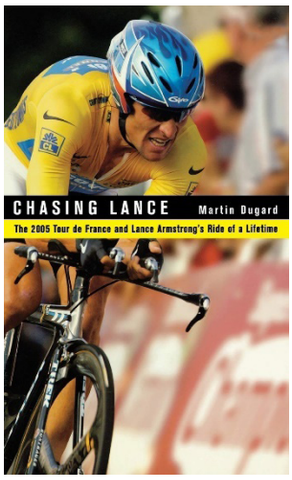
III. **Answer the following questions in 150-200 words.**

1. Explain the Technique with a suitable example.

**LANCE ARMSTRONG CYCLE OF LIES**

Lance Armstrong, (born September 18, 1971, Plano, Texas, U.S.), was an American cyclist, who was the only rider to win seven Tour de France titles (1999–2005) and was later stripped of all his titles. Why?

Armstrong entered sports at a young age, excelling in both swimming and cycling, and by the time he was a teenager he was competing in triathlons and swimming competitions. Before his high-school graduation, the junior national team of the U.S. Cycling Federation had recruited him. Armstrong competed in Moscow at the Junior World Championships and in 1990 won the U.S. Amateur Championships. In 1992 he turned professional when he joined the Motorola team, and one year later he became the second-youngest man to win in world road racing. Armstrong won stages of the Tour de France in both 1993 and 1995 but withdrew from three of four Tours he attempted from 1993 to 1996.




Picture Source: Chasing-Lance-Armstrongs-Lifetime-included/dp/0316166235

After the 1996 Tour de France Armstrong fell ill, and in October his physicians diagnosed testicular cancer, which had by that time also spread to his lungs and brain. He underwent chemotherapy and surgery, which were considered his best chances for survival. Months of treatments followed before he could attempt his comeback in a sport so demanding that some doctors questioned whether he could bear the strains of a three-week race like the Tour de France. In June 1998 he won his first important race since his cancer was diagnosed, the Tour of Luxembourg. Previously Armstrong had been a specialist in one-day races, but late in 1998, after a fourth-place finish in the three-week Vuelta an España (Tour of Spain), he was persuaded to change his training regime and compete in the next Tour de France.

On July 25, 1999, Armstrong became the second American to win the Tour de France, the sport's most prestigious race, and the first to win for an American team (three-time winner Greg LeMond had raced with European teams). Riding with the U.S. Postal Service (USPS) team, Armstrong won the 3,630-km (2,256-mile), 22-day race in 7 minutes 37 seconds. During the Tour, he fought allegations of doping, because traces of a banned substance—corticosteroid, from a prescription skin cream he used for saddle sores—were found in his urine. The International Cycling Union (Union Cyclist Internationale; UCI) cleared him, but he continued to endure accusations of doping, especially from the French press. Thus, Armstrong felt his July 23, 2000, win in the Tour de France to be a vindication of his 1999 win and an answer to his critics.

He won the Tour again in 2001 and 2002, relying on his strength in the mountain climbs. In 2003 he overcame crashes and illness to claim his fifth consecutive Tour de France, tying a record set by Miguel Indurain. He surpassed Indurain in 2004 when he won his sixth consecutive race. After winning his seventh Tour in 2005, Armstrong retired from the sport, but in September 2008 he announced that he was returning to competitive racing. He was placed third in the 2009 Tour de France and stepped away from competitive racing permanently in 2011.

In April 2010 Floyd Landis sent an e-mail to a USA Cycling official, admitting that he and other former teammates, most notably Armstrong, were guilty of doping. The following month a U.S. federal grand jury investigation into doping allegations against Armstrong was initiated. That year Armstrong finished 23rd in what he had announced, prior to the race's start, to be his final Tour de France. He retired for a second time in February 2011 and thereafter began competing in triathlons. The 2010 grand jury investigation was closed in February 2012 with no criminal charges filed against Armstrong.

In June of that year, the U.S. Anti-Doping Agency (USADA) alleged that Armstrong and five of his associates—three doctors, a manager, and a trainer—had been part of a decade-long doping conspiracy beginning in the late 1990s. According to USADA, Armstrong used performance-enhancing drugs—including erythropoietin (EPO) and human growth hormone—and distributed drugs to other cyclists. USADA also accused Armstrong of having undergone blood transfusions and testosterone injections. The allegations resulted in his immediate ban from triathlon competitions. In August 2012 he declined to enter USADA's arbitration process, which led the agency to announce that it would strip him of all his prizes and awards from August 1998 forward—including his seven Tour de France titles—and enact a lifetime ban from cycling and any other sport that follows the World Anti-Doping Code. Armstrong stated that his decision to no longer contest them was not an admission of guilt but was instead a result of his weariness with the process. Despite Armstrong's continued protestations of his innocence, the evidence of his doping was so overwhelming that in October 2012 he was officially stripped of his titles and banned from the sport when the UCI accepted USADA's findings. In January 2013, during a televised interview with Oprah Winfrey, Armstrong finally admitted to taking performance-enhancing drugs from the mid-1990s through 2005.

Apart from his racing career, Armstrong dedicated himself to campaigning for cancer awareness and established a foundation to further that goal. His Lance Armstrong Foundation became one of the largest organizations funding cancer research in the U.S., and the foundation's iconic yellow rubber "Livestrong" bracelet was a trendy fashion accessory for a time in the early years of the 2000s. However, in the wake of his doping scandal, he stepped down as the foundation's chairman and as a member of its board of directors, and the charity officially changed its name to the Livestrong Foundation. He published the memoirs It's Not About the Bike: My Journey Back to Life (2000) and Every Second Counts (2003), both co-authored by Sally Jenkins

## 10.5.1 Concept & Classification of Doping

Doping refers to an athlete's use of prohibited drugs or methods to improve training and sporting results. Steroids are the drugs that often come to mind when we talk

about doping. In addition, doping also includes an athlete's use of other forbidden drugs (such as stimulants, hormones, diuretics, narcotics, and marijuana), use of prohibited methods (such as blood transfusions or gene doping), and even the refusal to take a drug test or an attempt to tamper with doping controls. The IOC defines doping as the use of any method or substance that might harm the athlete in a quest to gain an unfair advantage over their fellow competitors.

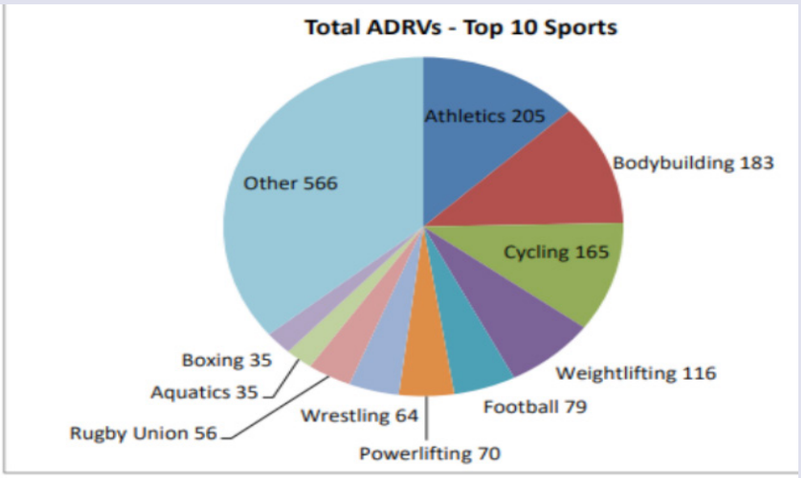
Hence, training at altitude to increase the blood's ability to carry oxygen is allowed, but using drugs such as EPO to achieve the same result isn't. The controversy in 'Le Tour de France', and the Atlanta games of 1996, have shown the use of doping to be widespread. However, doping isn't a new trend bought on by the advent of modern pharmaceutical agents. History shows that athletes in the ancient Olympic games were willing to take plant extracts to better their competitors.

**Do you know?**

Doping was punished even in ancient times. If athletes were caught cheating, they were banned from the games and their names were often engraved into stone and placed in a pathway that led to the stadium. To this day, those stone pedestals line the entranceway to the Olympic stadium in Olympia, Greece, the site of the ancient Olympics (776 BC-394 AD). Inscribed on each pedestal is the name of the offending athlete, his wrongdoing, and the names of family members.

Sports with the highest number of Anti-Doping Rule Violations (ADRVs)

1. Athletics (205)
2. Bodybuilding (183)
3. Cycling (165)
4. Weightlifting (116)
5. Football (79)
6. Powerlifting (70)
7. Wrestling (64)
8. Rugby Union (56)
9. Aquatics (35)
9. Boxing (35)




International Olympic Committee defines doping as "the use of any method or substance that might harm the athlete, in a quest to gain an unfair advantage, over his/her fellow competitors." In other words, it can be said that doping is the use of such substances or methods that are custom-made to increase the abilities of an athlete, both physical and mental, and/or to cover the use of such substances while in training.

According to World Anti-Doping Agency (WADA, "Doping is defined as the occurrence of one or more of the anti-doping rule violations set forth in Article 2.1 through Article 2.8 of the anti-doping code (WADA code effective from 1 Jan 2021). These are as follows:

I. Presence of a prohibited substance or method.

II. Use or attempt to use a prohibited substance or method.

III. Refusing to submit sample collection after being notified.

IV. Failure to file athlete's whereabouts after being notified.

V. Tampering with any part of the doping control process.

VI. Possession of a prohibited substance or method.

VII. Trafficking a prohibited substance or method.

VIII. Administering or attempting to administer a prohibited substance or method to an athlete.

Thus, according to the anti-doping code, doping is not only about using a prohibited substance or method to improve performance but also about breaking any of the rules listed by WADA.

Following are some of the substances and methods used for doping in sports:

"The use of any support or practice that improves athletic performance or physical work capacity. It can be achieved through physical, pharmacological, psychological, nutritional or mechanical means" (Katch et al. 2007).

**Do you know?**

The World Anti-Doping Code (Code) is the core document that harmonizes anti-doping policies, rules, and regulations within sports organizations and among public authorities around the world. It works in conjunction with eight International Standards which aim to foster consistency among anti-doping organizations in various areas. Every year WADA publishes an updated code every year. The following 2022 list is as follows:

**SUBSTANCES & METHODS PROHIBITED AT ALL TIMES**

- S0: Non-approved substances
- S1: Anabolic agents
- S2: Peptide hormones
- S3: Beta-2 agonists
- S4: Hormone and metabolic modulators

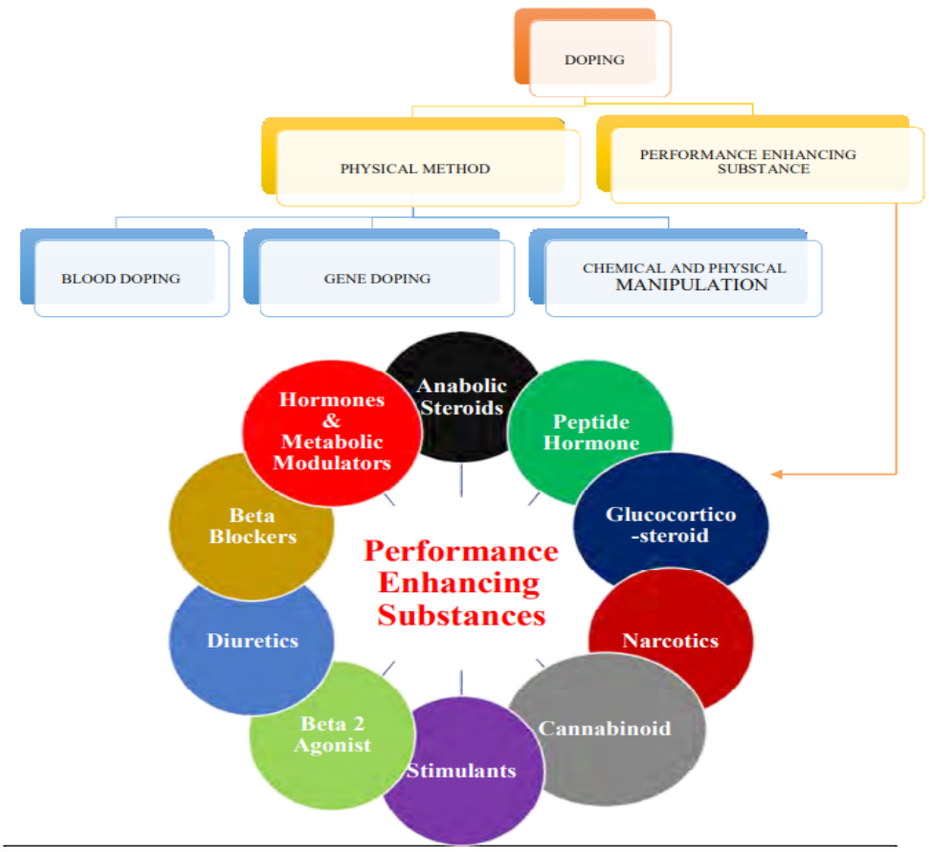
- S5: Diuretics and masking agents
- M1: Manipulation of Blood and Blood Components
- M2: Chemical and Physical Manipulation
- M3: Gene and Cell Doping

**SUBSTANCES & METHODS PROHIBITED IN-COMPETITION**

- S6: Stimulants.
- S7: Narcotics.
- S8: Cannabinoids
- S9: Glucocorticoids.

**SUBSTANCES PROHIBITED IN PARTICULAR SPORTS**

- P1: Beta-blockers




**Extension Activity**

Survey of Doping in Sports

Talk to at least 15 sportspersons or athletes from your school, or a nearby school. You could also talk to people who regularly go to a gym for a workout. Fill up the following questionnaire.

| | No | Don't know | Maybe | Probably | Yes |
|---|---|---|---|---|---|
| Do you think doping is necessary to achieve the best results? | | | | | |
| Does anyone you know use performance-enhancing drugs? | | | | | |
| Are you aware of the substances you cannot use in competitions? | | | | | |
| Do you think your performance would improve by banned substances? | | | | | |
| Have you ever tried any banned substances to improve performance? | | | | | |
| Are you aware of the side effects of doping? | | | | | |
| Is the NADA doping test available for the tournaments/ competitions you participate in? | | | | | |
| According to you who recommends performance enhancing drugs toplayers? | | | | | |
| Have you felt a pressure to use banned substances? | | | | | |
| Based on the survey above, and your own ideas, make a PPT on Doping and Sports. | | | | | |

I. **Tick the correct options**

1. Doping refers to an athlete's use of
   a. prohibited drugs and methods
   b. methods to improve training

c. methods to improve performance.

d. Altitude training for oxygen capacity

2. WADA stands for

a. World Anti-Doping Association

b. World Anti-Doping Alliance

c. World Anti-Doping Agency

d. World Anti-Doping Alumina

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

1. Is doping only about using a prohibited substance or is it a method to improve performance? Comment.

2. Enlist any three (WADA) Anti-Doping Codes which are mentioned in Articles 2.1 to 2.8. Classify the methods of doping in brief.

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

1. List the rules laid down by WADA in the anti-doping code.

**Anabolic Steroids:**

Anabolic steroids, also known more properly as anabolic-androgenic steroids, are steroidal androgens that include natural androgens like testosterone and synthetic androgens that are structurally related and have similar effects to testosterone.

Anabolic steroids include testosterone, the male sex hormone, and structurally similar compounds. In addition to increases in muscle mass and bone maturation, these compounds promote the production of creatine phosphate, which allows the athlete to train harder. Other desired effects of anabolic steroids include increased fat-free mass, strength, aggression, and ability to sustain and recover from high-intensity workouts.


Picture Source: https://teens.drugabuse.gov/drug-facts/steroids-anabolic

**The side-effect of Anabolic steroids**

a) High blood pressure,

b) Acne,

c) Abnormalities in liver function,

d) Alterations in the menstrual cycle,

e) Decline in sperm production and

f) Impotence in men,

g) Kidney failure and heart disease, and

h) Heightened aggression.

**Do you know?**

Testosterone was first synthesized in Germany in 1935 and was used medically to treat depression. Professional athletes began misusing anabolic steroids during the 1954 Olympics when Russian weightlifters were given testosterone. In the 1980s, anabolic steroid use began to extend into the general population, and young men began using these substances, sometimes to enhance athletic performance but in most cases to improve personal appearance.

**Human Growth Hormone**

Human growth hormone (hGH)- also called somatotrophin or somatotrophic hormone is naturally produced in the body. It is synthesized and secreted by cells in the anterior pituitary gland located at the base of the brain.

The primary role of hGH in body growth is to stimulate the liver and other tissues to secrete insulin-like growth factor IGF-1. IGF-1 stimulates the production of cartilage cells, resulting in bone growth, and plays a crucial role in muscle and organ growth. All of these can boost sporting performance.


Picture Source: https://www.shutterstock.com/video/search/human-growth-hormone

**Side effects Human Growth Hormone**

a) Diabetes in individuals prone to it

b) Worsening of heart disease and muscle, joint, and bone pain

c) Hypertension

d) Cardiac deficiency

e) Abnormal growth of organs

f) Accelerated osteoarthritis and

g) Enlargement of the extremities, such as hands and feet.

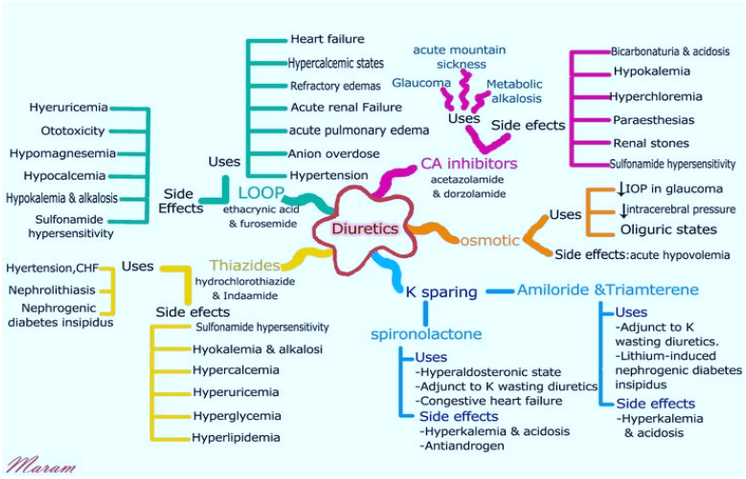
**Did you know?**

The first human to receive GH therapy was in 1956; it was of bovine origin and was given for 3 weeks for metabolic balance. Studies revealed no effects. Growth hormone (GH) first was isolated from the human pituitary gland in 1956, by both Li and Papkoff, in California, and Raben, in Massachusetts, but its biochemical structure was not elucidated until 1972. In 1958, Raben reported the results of the first trial to show the effects of human GH on growth. By 1960 it was clear that GH-deficient children would benefit from pituitary GH. In 1960, National Pituitary Agency (NPA) was formed to further the goals of coordinating pituitary collection and extraction to support both basic and clinical research.

**Diuretics**

Diuretics, sometimes called water pills, help rid your body of salt (sodium), and water and inhibit the re-absorption of water in the kidney. Most of these medicines help kidneys release more sodium into the urine. The sodium helps remove water from blood, decreasing the amount of fluid flowing through veins and arteries. This reduces blood pressure. Diuretics can be used in a sport as a masking agent to prevent the detection of another banned substance.

As well as masking other drugs, diuretics can also help athletes lose weight, which they could use to their advantage in sports where they need to qualify in a particular weight category.




Picture Source: https://www.pinterest.com/pin/727120302308304512/

**Side Effects include:**

a) Headaches

b) Muscle cramps

c) Dizziness

d) High blood sugar levels

e) Abnormal heart rhythm

f) Fatigue

**Do you know?**

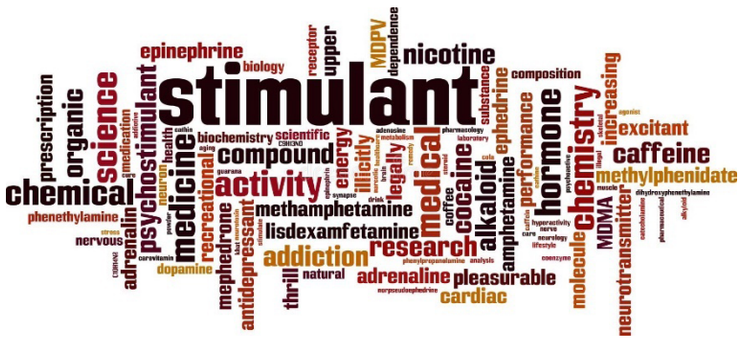
The modern history of diuretics began in 1919 when a medical student at the University of Vienna found that mercurial injections effectively excreted water in syphilitic patients. For decades, these drugs were considered the main weapon to treat oedema, despite their toxicity. Only by the end of the Second World War specialized and advanced studies were conducted, and it was then proved that sulphonamide derivatives had diuretic properties.

**Stimulants**

Stimulants are a group of drugs that result in increased activity in the body. Sometimes referred to as "uppers," these drugs are frequently abused due to their performance-enhancing and euphoric effects. This type of drug speed up messages traveling between the brain and body.

Stimulants speed up mental and physical processes, which can produce desirable

effects in the short term by increasing dopamine levels in the brain. While users may feel great due to the short-term effects of stimulants, long-term abuse of these drugs can have significant consequences. Generally, those who abuse stimulants experience heightened energy levels and enhanced focus. They can make a person feel more awake, alert, confident, or energetic. Stimulants are usually snorted, swallowed, smoked, or injected. Prescribed stimulants are typically taken orally, and the duration of their effects differs depending on the type.




Picture Source: https://image.shutterstock.com/image-photo/narcotic-word-cloud-hand-marker-600w-1191150307.jpg

**Side effects of stimulants include**

a) Anxiety

b) Tension

c) Increased body temperature

d) Nausea

e) Tremor

f) Seizures

g) Coma

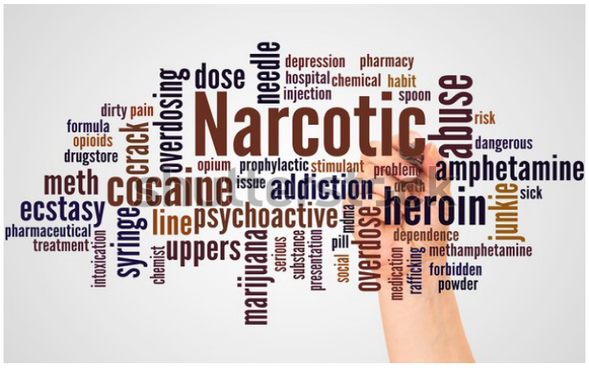
h) Death.

**Do you know?**

Stimulants, including cocaine and amphetamines, are among the most widely used and abused illegal substances. The first of the synthetic stimulants, amphetamine (isolated in 1887), was first popularized in the 1930s with an OTC nasal decongestant (Bezedrine inhaler) containing the amphetamine phenylisopropylamine and later for fatigue, narcolepsy and depression.

## Narcotics

Narcotics are drugs that can change a person's psychic and physical status through a wide range of symptoms, from sleep to euphoria and excitation. Narcotics are a type of drug injected into a human's bloodstream, muscles, or under the skin and can also be swallowed. The main effect of narcotics is to reduce, eliminate, and hide the pain.




Picture Source: https://image.shutterstock.com/image-photo/narcotic-word-cloud-hand-marker-600w-1191150307.jpg

**Side effects of narcotics are**

a) Nausea

b) Vomiting

c) Constipation

d) Sweating

e) Mental confusion and drowsiness

f) Affect Cardiovascular, respiratory, and central nervous systems.

**Do you know?**

Narcotics occurring naturally in the form of opium derived from poppy have been used since ancient Greek times, both for relieving pain and for producing euphoria. Extracts of opium were smoked, eaten, or drunk (as laudanum, a crude mixture of alcohol and opium). The pharmacologically active components of opium were isolated during the first half of the 19th century. The first was morphine, isolated by a young German pharmacist, F.W.A. Sertürner, in about 1804. A much milder narcotic, codeine, was in turn isolated from morphine.

**Blood Doping**

Blood doping or "blood manipulation" is a prohibited method of improving an athlete's performance by artificially boosting the blood's ability to bring more oxygen to muscles.

The three widely used types of blood doping are:

a) Blood transfusions

b) Injections of erythropoietin (EPO)

c) Injections of synthetic oxygen carriers

**Do you know?**

Blood doping started in the late 1960s, but was not outlawed until 1986. While it was still legal, it was commonly used by middle and long-distance runners. The first known case of blood doping occurred at the 1980 Summer Olympics in Moscow as Kaarlo Maaninka was transfused with two pints of blood before winning medals in the 5 and 10 kilometre track races, though this was not against the rules at the time.

**Blood transfusions**

The most basic method of increasing the amount of haemoglobin of an athlete is through blood transfusion. There are two forms of blood doping: autologous and homologous.

Autologous blood doping is the transfusion of one's blood, stored, refrigerated, or frozen until needed.

Homologous blood doping is the transfusion of blood that has been taken from another person with the same blood type.

Although blood transfusions for blood doping date back several decades, experts say its recent resurgence is probably due to the introduction of efficient EPO detection methods.

**Do you know?**

The history of blood transfusion originated with William Harvey's discovery of blood circulation in 1628. The earliest known blood transfusions occurred in 1665, and the first human blood transfusion was performed by Dr. Philip Syng Physick in 1795. The first transfusion of human blood for the treatment of haemorrhage was performed by Dr. James Blundell in London in 1818. The first blood bank was established in Leningrad in 1932, and the first blood bank in the United States opened at Chicago's Cook County Hospital in 1937.

### Injections of Erythropoietin (EPO)

Erythropoietin EPO is a peptide hormone produced naturally by the human body. EPO is released from the kidneys and acts on the bone marrow to stimulate red blood cell production, and this hormone regulates the number of red blood cells in the body.

Athletes inject EPO to increase the concentration of red blood cells and their aerobic capacity.

**Do you know?**

Human EPO was first isolated from the urine of anaemic patients in 1977, and its gene was later isolated in 1983. One year later, 2 groups succeeded in cloning the EPO gene and expressing it in Chinese hamster ovary (CHO) cells, enabling development of recombinant human EPO (rHuEPO) as a drug.

### Injections of Synthetic oxygen carriers

These are chemicals that can carry oxygen. Athletes use synthetic oxygen carriers to achieve the same performance-enhancing effects of other types of blood doping: increased oxygen in the blood that helps fuel muscles. Synthetic oxygen carriers include perfluorocarbons and haemoglobin-based oxygen carriers. These agents effectively transport and deliver oxygen to tissues and have been explored as oxygen carriers in blood-substitute products for purposes such as emergency blood transfusion.

### Side effects of blood doping include

a) Quick increases in blood pressure

b) Convulsions

c) Influenza-like symptoms

d) Increased cancer risk

e) Liver damage

f) Increased viscosity of blood

g) Thickening the blood,

h) HIV

i) hepatitis B

j) hepatitis C

k) Heart disease, stroke, and cerebral or pulmonary embolism.

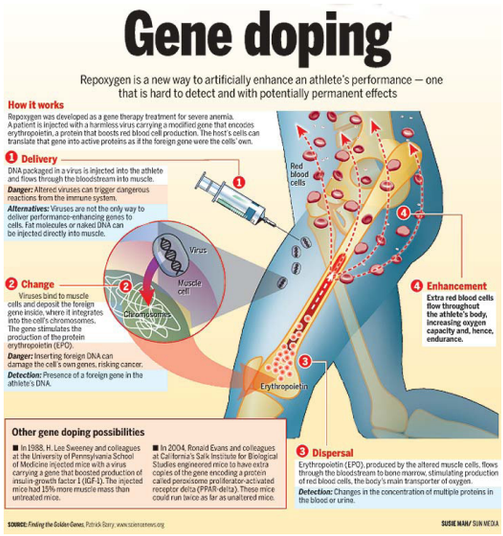
**Do you Know?**

Artificial oxygen carriers were initially developed as "blood substitutes" in the 1980s and 1990s. Artificial oxygen carriers can be grouped into haemoglobin-based oxygen carriers (HBOCs) and perfluorocarbon-based oxygen carriers (PFCs).

## Gene Doping

Gene doping is a form of drug abuse in sport in which genetic material is injected into the muscle to improve someone's performance or make their muscles grow stronger. According to World Anti-Doping Agency (WADA). Gene doping is the transfer of nucleic acids or nucleic acid sequences and the use of standard or genetically modified cells.

Advancements in gene therapy for medical reasons mean potential cheats might seek to undergo procedures to modify their genes to enhance their physical capabilities. Genetic enhancement includes manipulating genes or gene transfer by healthy athletes to improve their performance physically. Genetic enhancement includes gene doping and has the potential for abuse among athletes. It is said that gene doping could be used to increase muscle growth, blood production, endurance, oxygen dispersal, and pain perception.




Picture Source: https://genedopingkondapi.weebly.com/what-is-gene-doping.html

## Side effects of Gene Doping include

a) Cancer

b) Autoimmunization

c) Heart attack.

d) Increased blood viscosity

e) Difficult laminar blood flow through the vessels

f) Severe immune response

g) Abnormal vision

h) Headache

i) Nausea

j) Vomiting

**Do you know?**

The concepts of gene therapy arose initially during the 1960s and early 1970s. The history of concern about the potential for gene doping follows the history of gene therapy, and the medical use of genes to treat diseases, which was first clinically tested in the 1990s. In 1999, the field of gene therapy was set back when Jesse Gelsinger died in a gene therapy clinical trial, suffering a massive inflammatory reaction to the drug.

I. **Tick the correct options**

1. The performance enhancement drug generally used by boxers and judo players to reduce their weight is

   a. Diuretic

   b. Peptide hormone

   c. Anabolic steroid

   d. Beta-2 agonist

2. Stimulants benefit performance by

   a. increasing heart and respiratory rates and suppressing the symptoms of fatigue

   b. having a painkilling and sedating effect

   c. releasing hormones promoting growth, healing and body repair

   d. preventing the release of adrenaline

3. Some of the side effects of using narcotics include

   a. suppressed appetite, increased blood pressure, and body temperature

   b. addiction, suppressed appetite, toxicity

   c. impotency, infertility, arteriosclerosis, heart disease, liver and kidney cancer

   d. a damaging effect on endurance, heart disease

4. The full form of NIDA is

   a. National Institute of Drug Abuse

   b. National Institute of Dramatic Art

   c. National Institute of Developmental Administration

   d. National Institute of Drug Anabolic

5. The term psychoactive refers to

   a. a drug that alters mood, cognition and/or behaviour.

   b. a drug that lowers the threshold of pain.

   c. a particularly active psychopath.

   d. a drug-induced hallucination.

6. When you are dealing with the people of Substance abuse, what will be your initial step?

   a. Detoxification

   b. Supportive Environment

   c. Rehabilitation

   d. Medication

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

1. Players using peptide hormones to enhance performance suffer from serious side effects. What are these side effects?

2. List the names of prohibited substances according to WADA (latest).

3. While it is easy to reduce weight through a diuretic substance, it may have serious consequences. Explain the side effects associated with diuretics abuse?

4. What is a prohibited substance? How does it affect the sports person's performance?

5. Define substance abuse.

6. How can you identify the sports person who is suffering from substance abuse?

7. What do you understand by the term Rehabilitation?

8. List the signs and symptoms of substance abuse.

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

1. Adopting illegal ways to enhance performance by taking Performance Enhancing Drugs may lead to severe side effects. List the major side effects of Doping.

2. Explain any two doping steroids. Mention five side effects of each.

3. What do you understand by substance abuse. List the health issues arising out of use of psychoactive drugs.

4. Discuss your views on Doping.

5. With training in sports, how we can achieve the target to produce better results in 2024 Olympic Games. Share your views

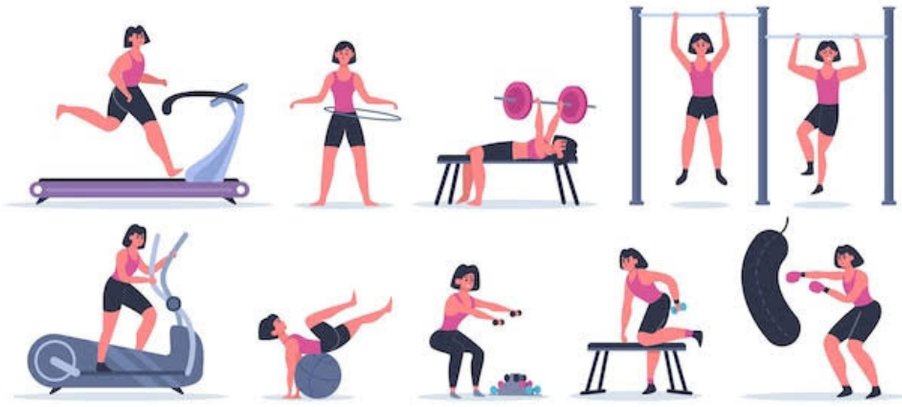
IV. **Complete the table regarding Doping in Sports.**

| Substance | How it is taken | Reasons for taking it | Harmful effects |
|---|---|---|---|
| Anabolic Steroids | | | |
| Peptide Hormone | | | |
| Glucocorticosteroid | | | |
| Narcotics | | | |
| Cannabinoid | | | |
| Stimulants | | | |
| Beta 2 Agonists | | | |
| Diuretics | | | |

| | | | |
|---|---|---|---|
| Beta Blockers | | | |
| Hormones and Metabolic Modulators | | | |

## V. CASE STUDY

Training and Doping in Sports



Solis was identified by his basketball coach as a talented player. He was thus asked to come daily in the morning for coaching with the school team members. He was explained about training principles and use of techniques and skill development.

a) List down any four principles of sports Training.

b) What could be the causes of overload?

c) What are the factors affecting recovery?

d) A training plan is constructed by incorporating various training cycles. A micro cycle may last from _____ days.

e) Principle of _____ helps in incorporating the law of readiness.

## VI. ART INTEGRATION – MAKING POWERPOINT PRESENTATION

Staging A Play About Fair Play in Sports

Games and contests become opportunities to strive – with opponents – for excellence. Those who cheat or take performance-enhancing drugs do not play the game. Fair Play means more than just following the rules.

A sportsperson who plays fair:

- Respects the Rules
- Respects the officials and accept their decisions
- Respects opponents
- Gives everyone an equal chance to participate
- Maintains self-control at all times

Choose a situation where an athlete

- Broke rules
- Cheated/took drugs
- Or, helped an opponent.

Write a play about her/him.

Perform the play during the Special Assembly of your school.

**Suggested Reading**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