UNIT-8

Fundamentals of Anatomy, Physiology and Kinesiology in Sports

Anatomy:

Anatomy is a branch of biology that deals with the study of body structure of organism which includes then systems, organs and tissues.

Physiology:

Physiology is the branch of biology that deals with the functions and activities of living organisms and their parts, including all physical and chemical processes.

Kinesiology:

Kinesiology is the study of human or non-human movements, performance and functions by applying the science of biomechanics, anatomy, physiology, psychology and neuroscience.

Importance of study of Anatomy, Physiology and Kinesiology in Physical Education:

- ✓ Anatomy provides the Knowledge of Structure of various Organs
- ✓ Physiology provides the Knowledge of Function of various Organs
- ✓ Useful in the Prevention of Sports Injuries
- ✓ Serves in the process of Rehabilitation
- ✓ Useful in the Selection of Sports
- ✓ Facilitates Preparation of Training Programs
- ✓ Helps to Know about Chemical Changes during Exercise
- ✓ Serves to Understand the Anatomical and Physiological Differences among Males and Females
- ✓ Helpful in Providing First Aid to Sportspersons
- ✓ Useful in Developing Physical Fitness Administration
- ✓ Aid in Sports Massage
- ✓ Facilitates Understanding of the Environmental Effects on Sportspersons

Explanation Importance of study of Anatomy, Physiology and Kinesiology in Physical Education:

Study of anatomy and physiology plays very important role in the field of sports because of following reasons.

Helps in physical fitness: Strong and fit body is an inevitable asset in the field of sports. Study of anatomy and physiology helps a sport person to understand the structure and function of different parts of human body and to acquire a fit and healthy body.

Provides knowledge about body structure; on the basis of knowledge of body structure, a sports person knows about the strength and weakness of his body and accordingly they can develop forte in the field of game which is suitable for the sports person as per their body structure.

Helps in selection of games: on the basis of knowledge of body structure, the coach and player can choose an appropriate sport/ game which is suitable for a particular sport. Like tall students can be selected for basketball and volleyball. And short and stout students can be selected for weight lifting.

Protects from sports injuries: on the basis of anatomy, sports equipment's are designed that help in safe play.

Helps in the process of rehabilitation: knowledge of ligaments, tendons and muscles helps in rehabilitation from the injuries sustained during the game or sport.

Helps in maintaining healthy body: study of anatomy and physiology provides detailed knowledge about all body parts, their nature and functions. This helps the player to adopt good, safe and healthy use of body.

Helps to know about individual differences: there is a lot of difference between the body of male and female. The knowledge of anatomy and physiology helps in understanding these individual differences. On the basis of these differences, the size of the court, time of game and equipment are designed differently for male and female players.

Skeleton System:

This is the bony frame work of body consisting of numbers of bones. Total bones in human body are 206.

- Axial Skeleton
  - ✓ Skull – 28
  - ✓ Sternum – 1
  - ✓ Ribs – 24
  - ✓ Hyoid bone – 1
  - ✓ Vertebral column – 26 for adults and 33 for children
- Appendicular Skeleton
  - ✓ Upper limbs – 64
  - ✓ Lower limbs – 62

Function of Bones

- ✓ Provide Support
- ✓ Provide Protection
- ✓ Bony System Serves for the Attachment of Muscles
- ✓ Bony System Gives Shapes to the Body
- ✓ Act as Levers
- ✓ Passive Instruments of Locomotion

Functions of Skeletal System

- ✓ Shape and structure: The bony framework give human being its shape and structure like tall or small, thin or stout.
- ✓ Support: It gives support to the body. The bones provide support to our muscular system.
- ✓ Protection: Bones protect our vital organs. i.e. skull, protects brain, thoracic cage protects heart, lungs and pancreas.
- ✓ Lever: Bones act as a lever like a simple machine. For example, while lifting a weight, movable joints like elbow joint acts like fulcrum and length of arm bone acts like crow bar to reduce effort and helps to lift weight.
- ✓ Storehouse: The hollow space of bones acts like a storehouse of different minerals and salts like calcium, potassium, iron, etc.
- ✓ Production of RBCs: Red blood cells are produced in the bone marrow. It is the factory to produce RBCs.
- ✓ Junction: Bones provide junction or attachment to skeletal muscle that helps in visible movement.

- ✓ Self-repair: Whenever bones are damaged, they are capable of doing self-repair.

Classification of Bones

- ✓ Long Bones
- ✓ Short Bones
- ✓ Flat Bones
- ✓ Irregular Bones
- ✓ Sesamoid Bones

Classification of Bones

- ✓ Long bones: They are long and wide. They act as lever. They are found in legs and arms. Example: humours, femur, tibia and fibula.
- ✓ Short bones: They are short in size and cube shaped. They are found in wrist and phalanges. Example: metatarsal and carpal.
- ✓ Flat bones: These bones are flat and thin. They are composed of a central layer of sponge bone fixed between two outer layers of compact bone. Example: ribs and shoulder.
- ✓ Sesamoid bones: These bones are seed like shaped and developed in the tendons where there is more friction. Example: palms of hands, sole of feet and knee caps,
- ✓ Irregular bones: These bones have in complete shaped as compared to other types. The bones of spinal column and skull are examples of these bones.

Types of Joints

1. Immovable Joints:

These joints are fixed and do not move e.g... Skull Joint

Immovable or fibrous joints: They are fixed joints. They never move. Example: joints of skull.

2. Slightly Movable Joints:

The movement of such joints is very limited e.g... Inter-vertebrates. Slightly movable or cartilaginous joints: These joints provide very little movement. Example: backbone joints, pelvic joints.

- ✓ Symphysis
- ✓ Synchondrosis

3. Freely Movable Joints:

Such joints are freely movable.

- ✓ Gliding Joints
- ✓ Hinge Joints
- ✓ Condyloid Joints
- ✓ Saddle Joints
- ✓ Ball and Socket Joints
- ✓ Pivot Joint

Freely movable or synovial joints. These joints provide different movements. There are five main types of movable joints,

Hinge joint. These joints allow a forward and backward movement. Example; knee joints, elbow joints.

Pivot joint. These joints give a rotation movement. Such as the movement of neck.

Ball and socket joint. In these joints one bone has ball like shape and other has a socket like shape. They are fit together to make a free movable joint. Example shoulder joint and hip joint.

Saddle joint. It is a joint where one of the bones forming the joint is shaped like a saddle with the other bone resting on it like a rider on a horse. Example: wrist joint.

Gliding joint. It is a joint in which articulation of contiguous bones allows only gliding movements, as in the wrist and the ankle.

Muscular System: Properties of Muscles

Definition of Muscle:

Muscle is the tissue composed of fibers capable to effect bodily movement or muscle is the body tissue that can contract to produce movement.

4. Excitability—Excitability is the ability of a muscle to activate. If the excitability of the muscle is greater, its force, velocity and endurance will also be greater.
5. Contractibility—Contractibility is the ability of the muscle to shorten forcibly when it is simulated adequately. The muscle changes its shape when stimulated.
6. Extensibility—Extensibility is the ability of the muscle to be stretched or intended. The muscle fibers shorten while contracting. But they can be stretched, then beyond their resting length when relaxed. If muscle tissue could not stretch, you would not have the mobility you have.
7. Elasticity—Elasticity is the ability of the muscle tissue to return to its normal resting length to return to its normal resting length and shape after being stretched. If the muscle tissue does not have elasticity, it would remain as its stretched length.

Structure of Muscle:

Every muscle fiber made up of very large number of microscopic threads called myofibril. Each myofibril consists of protein molecules called Acting and myosin.

There are about 600 voluntary muscles in the body. Each muscle is made up of thousands of long and narrow muscle cells called muscle fibers. These muscle fibers are arranged in bundles and enclosed within a tough layer of connective tissue called epimysium (sarcolemma). Every muscle fiber is made up of very large number of microscopic threads called myofibril. Myofibril consists of protein molecules called actin and myosin.

Function of muscles:

Muscles are machine for converting chemical energy into mechanical work. The contractions and relaxations of muscles due to certain chemical changes in our body are:

1. To produce and control movements of the body

2. To maintain natural posture of the body acting on the bony structure
3. Helping in the economy of effort by working in association with long levers and pulleys.

Between Slow Twitch Fibre and Fast Twitch Fibre

Slow twitch fibre is also known as red fibres which contract slowly. These play significant role in aerobic activities as we may see in long distance and cross-country races. Fast twitch fibres: These fibres are also known as white fibres. These fibres contract quickly and provide strength and speed but they fatigue more quickly. Those individuals who need intense burst of energy for shorter duration as in boxing, jumping events or throws need more percentage of fast twitch fibres.

Structure and functions of Respiratory system and circulatory system:

The Respiratory system regulates the exchange of gases. Structure of the respiratory system involves the following organs in human beings.

- ✓ External Respiration
- ✓ Internal or Tissues Respiration

Inhalation and exhalation are the two processes of external respiration. This breathing process oxygenates to the blood. It gets purified as carbon dioxide is removed from the blood. External respiration takes place in the lungs. Internal respiration is the process of respiration that takes place in the tissues and cells. Blood full of oxygen reaches the tissue where oxygen is used up during energy production process and carbon dioxide is then taken by the blood to the lungs.

Functions of Respiratory no System

- ✓ To provide oxygen to blood
- ✓ Removal of waste products from the body e.g... CO_2
- ✓ Maintain body temperature
- ✓ It affects circulation of blood
- ✓ To exchange oxygen and carbon dioxide between the air and blood,
- ✓ To produce sound, it helps vocal cords to produce sound,
- ✓ To regulate blood PH level.
- ✓ To protect against some microorganism. Respiratory system blocks the entry of microorganism in the body at various levels, thus it provides protection against harmful microorganisms like virus, bacteria, etc.

Structure of Heart and introduction of circulatory system

Circulatory System:

Circulatory system serves the function of transporting materials in the body. It consists of heart and blood vessels (arteries, veins, capillaries)

Heart:

The human heart is a hollow cone-shaped muscular organ. It is a pumping system inside the body.

Structure of Heart:

The heart is divided into four chambers. A septum divides it into a left and right side. Each side is further divided into an upper and lower chamber. The upper two chambers called auricles and the bottom chambers are ventricles.

The human heart is a four chambered muscular organ shaped and sized roughly like a man's closed fist with two-thirds of the mass to the left of midline.

Chambers of the Heart

The internal cavity of the heart is divided into four chambers:

- ✓ Right atrium
- ✓ Right ventricle
- ✓ Left atrium
- ✓ Left ventricle

The two atria are thin - walled chambers that receive blood from the veins. The two ventricles are thick-walled chambers that forcefully pump blood out of the heart.

The right atrium receives deoxygenated blood from systemic veins; the left atrium receives oxygenated blood from the pulmonary veins.

Valves of the Heart

Pumps need a set of valves to keep the fluid flowing in one direction and the heart is no exception. The heart has two types of valves that keep the blood flowing in the correct direction. The valves between the atria and ventricles are called atrioventricular valves (also called cuspid valves), while those at the bases of the large vessels leaving the ventricles are called semilunar valves. When the ventricles contract, atrioventricular valves close to prevent blood from flowing back into the atria. When the ventricles relax, semilunar valves close to prevent blood from flowing back into the ventricles.

Function of Heart:

Systemic Circulation

Pulmonary Circulation

- ✓ It circulates the pure blood to all parts of the body. This is called systemic circulation.
- ✓ It carries the impure blood from all parts of the body to the lungs for purification. This is called pulmonary circulation.
- ✓ It regulates the blood pressure.
- ✓ It regulates the heart rate.
- ✓ Regular exercise improves the efficiency of the heart.

Arteries:

Arteries are blood vessels that take blood away from the heart, except for pulmonary artery, which carries deoxygenated blood from the heart to the lungs.

Veins: Veins are blood vessels that return blood to the heart.
Capillaries: Exchange of material take-place in capillaries.
Blood: Blood is a special mixture of fluid which acts as a medium of transporting nutrients and gases from one part of body to another.
The Functions of Blood:

- ✓ Transport of oxygen from the lungs to the tissues and carbon dioxide from the tissues to the lungs.
- ✓ It carries food material absorbed from the intestines to the tissue, cells for growth, energy and repair process.
- ✓ It carries the waste products of cellular activity and carries them to kidneys, lungs and intestines for excretion.
- ✓ It carries hormones, vitamin and other chemicals to the place of need.
- ✓ It helps to maintain water balance in the body.
- ✓ It regulates the body temperature.
- ✓ White blood cells of the blood acts as a defensive mechanism

Heart Rate: It is number of pumping of heart in one minute.
Stroke Volume: It is the volume of blood pumped by heart in one beat. It is approximately 80 ml per beat in normal adult, whereas trained players have 100 ml per beat as stroke.
Cardiac Output: Stroke volume x heart rate. It is 5 to 6 litters at basal level.
Blood Pressure: It is the force exerted by the blood on the walls of the blood vessels
Second Wind: The breathlessness caused due to prolonged exercise is removed automatically by our body. It is called as second wind.
Oxygen Debt: The amount of oxygen taken by an athlete during the recovery period after strenuous activity is called oxygen debt.
Equilibrium: dynamic and static and centre of gravity and its application in sports
Equilibrium: It is defined as a state of balance or a stable situation, where opposite forces cancel each other out and where no changes are occurring.
Types of Equilibrium

(i) Dynamic Equilibrium: It is the balance of the body during movement. Dynamic stability is balancing the body during movement. It frequently happens that the line of gravity of an athlete will fall outside the base of support for movement. For example, in a sprint start, the body weight is ahead of the supporting foot but before the body can fall forward the other foot moves ahead to provide support and the process repeats itself. A man carrying heavy bucket in his right-hand leans towards his left-hand side to maintain equilibrium. While climbing up a hill the climber bends forward so that he does not fall. The equilibrium is maintained by bringing the CG down.

(ii) Static Equilibrium: Dynamic stability is a balance of the body during its rest or stable position. Static equilibrium is when the center of gravity is in a stable position. A body is said to be in stable equilibrium if it comes back to its original position when it is slightly displaced. 'Static stability is very important in shooting, archery and hand stand in gymnastics, etc. Stable objects generally have wide bases and low CG. Bottom of the ship is made heavy to keep CG as low as possible. This makes the ship stable.

Guidance principles to determine the degree of stability

- ✓ Broader the base, greater the stability.
- ✓ Lower the center of gravity, higher the stability
- ✓ When the body is free in the air, if the head and feet move then hips help move up and vice-versa.
- ✓ Body weight is directly proportional to stability.
- ✓ Centre of gravity: Centre of gravity is that point in a body or system around which its mass or weight is evenly distributed or balanced and through which the force of gravity acts. The center of gravity is fixed, provided the size and shape of the body do not change.

Broad base of support: for greater stability increase the area of the base and lower the center of gravity as much as is consistent with the activity involved. Examples:

(a) a basketball player stops, spreads his feet wide as shoulder line and lowers his CG to dodge the opponent.

(b) Defense position of the player in volleyball.

(c) Wide stance of a golfer.

(d) Tackling position of a player in football.

Stability is directly proportional to the weight of the body the object or a person with heavy weight will have greater stability as compared to person with less weight. Example: it is difficult to move a heavier person as compared to less heavy person. On the basis of this principle, wrestling, boxing, judo, etc. are organized according to different age groups.

Direction of an acting force: to start quickly in one direction, keep the-CG as high as possible and as near as possible to the edge of the base nearest to the direction of intended motion.

Example: The crouched position in starting a race, the CG is kept high by not bending the knees extremely and by keeping the hips high, also the lean of the body is towards the hands so that the weight rests on the hands. From this position the movement hands are raised from the ground; motion starts by reason of the pull gravity. This pull is added to the force exerted against the starting block by the feet and thus aids in speed When the body is free in the air, if the head and feet move down, the hips move up and vice versa.

Example: This principle is applied in the high jump in western or valley roll technique at the take-off, the head and one foot is thrust up as high as possible. As the head and one leg clear the bar, they are dropped which raises the hips to clear the bar. As the hips are lowered, the opposite leg is raised to clear the bar.

This is also used in pole vault, hurdles and jacksnipe, dive in swimming.