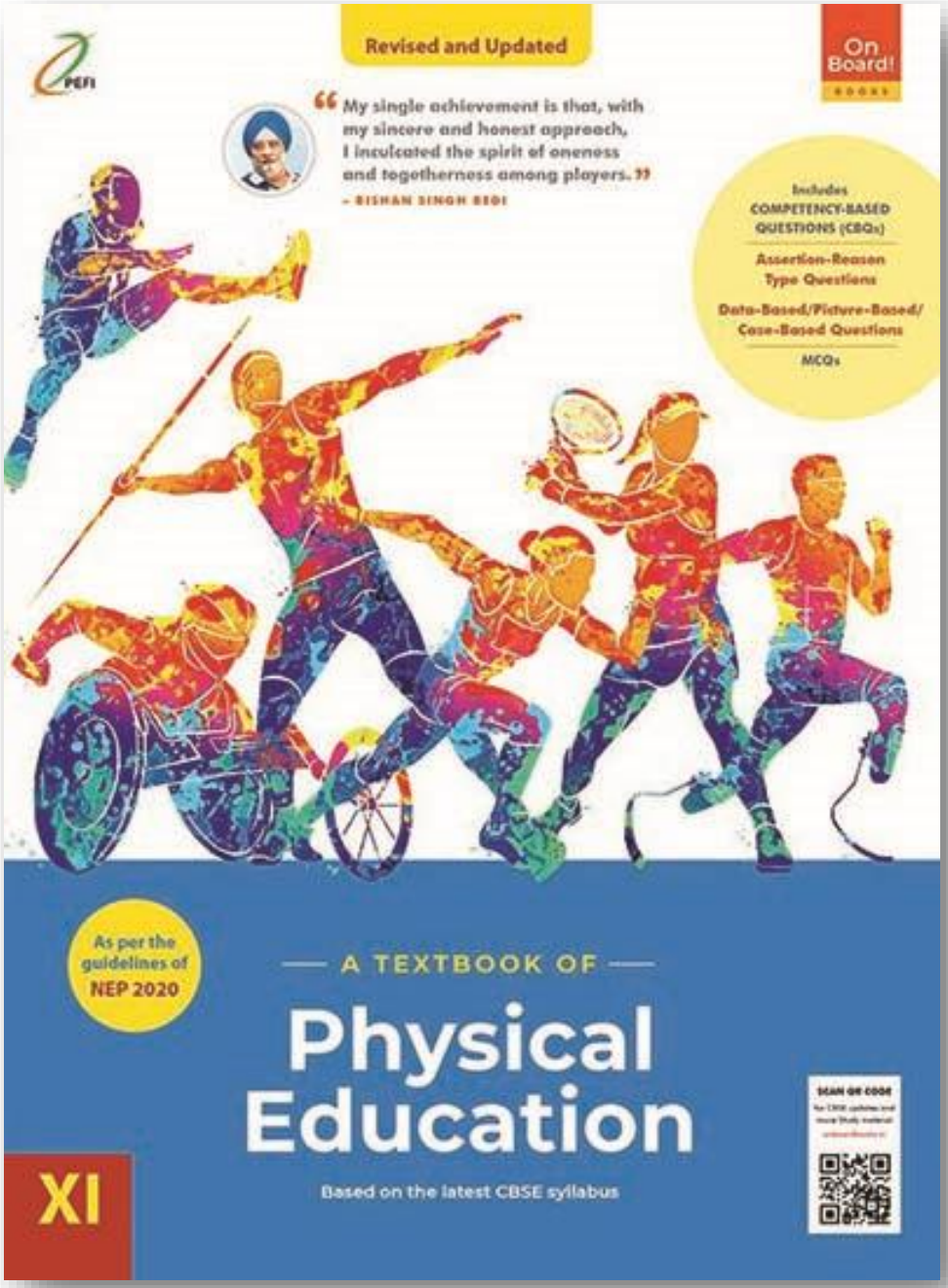

A Textbook of Physical Education Class 11

Chapter 8

FUNDAMENTALS OF ANATOMY, PHYSIOLOGY AND KINESIOLOGY IN SPORTS

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DEFINITION AND IMPORTANCE OF ANATOMY, PHYSIOLOGY AND KINESIOLOGY

Anatomy

Anatomy is the study of the structure of living organisms.

Physiology

Physiology, on the other hand, is the study of how living systems function.

Kinesiology

Kinesiology is the study of movements, whether of the human body or that of non-human animals.

"Kinesiology is the academic discipline which involves the study of physical activity and its impact on health, society, and quality of life."

– *American Kinesiology Association*

Figure 8.1 Kinesiology is the study of body movements.

Importance of Anatomy and Physiology

- Knowledge of Our Body:
- Selection of Sports:
- Prevention of Sports Injuries:
- Augmenting Rehabilitation and First Aid:
- Preparation of Training Programme:
- Understanding the Difference between Male and Female Anatomy:
- Correct Sports Massage Therapy:
- Proper Physical Fitness Development:
- Cultivating a Culture of Knowledge:

Importance of Kinesiology in Sports and Physical Education

1. Kinesiology that covers personal, public and environmental health.
2. Kinesiology involves application of biomechanics, anatomy, physiology and psychology to examine how the human body responds to physical activity.
3. It focuses on the acquisition and development of motor skills.
4. Kinesiology improves the area of rehabilitation from sport-related injuries as well as therapeutic application of physical exercises.
5. Exercise methods can be evaluated and altered for better performance and safety, etc.

FUNCTION OF SKELETAL SYSTEM, CLASSIFICATION OF BONES AND TYPES OF JOINTS

The Skeletal System

The skeletal system is a combination of all the bones in the body together with the structures that support them. The adult human body has 206 bones of various shapes and sizes.

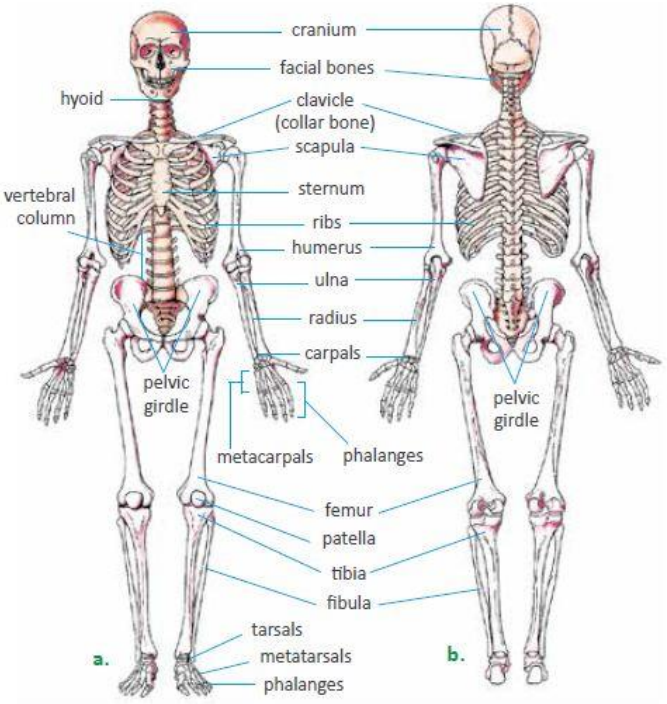

Figure 8.3 The human skeleton
a. anterior view **b.** posterior view

Functions of the Skeletal System

The functions of the skeletal system are:

1. Locomotion:
2. Support:
3. Protection:
4. Calcium Storage:
5. Acting as Levers:
6. Endocrine Regulation:

Classification of Bones

Bones can be classified as follows on the basis of their shape and formation:

1. Long Bones:
2. Short Bones:
3. Flat Bones:
4. Sesamoid Bones:
5. Irregular Bones:

JOINTS AND TYPES OF JOINTS

Joints are the points where bones intersect. They hold the skeleton together and help it to carry out movements. According to their range of motion, joints can be classified into three groups:

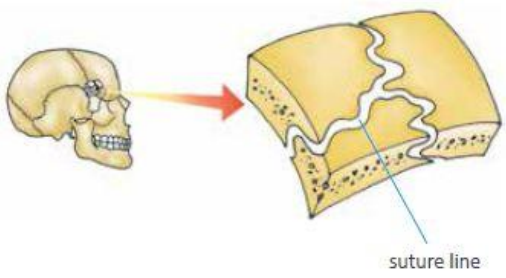

Figure 8.4 Fibrous joint (suture)

A. Immovable Joints (also known as synarthrosis)

B. Slightly Movable Joints (also known as amphiarthrosis):

They are further divided into two categories:

1. Symphysis: 2. Synchrondrosis:

C. Freely Movable Joints (also known as diarthrosis):

Synovial joints are further classified as:

- Gliding Joints:
- Hinge Joints:
- Condyloid Joints:
- Saddle Joints:
- Ball and Socket Joints:
- Pivot Joints:

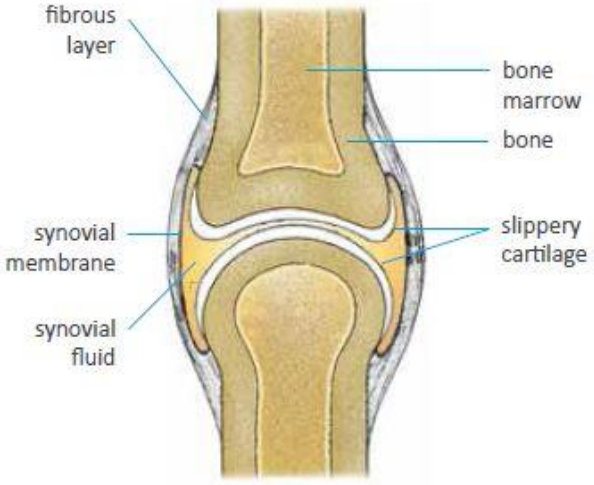

Figure 8.6 Synovial joint

PROPERTIES AND FUNCTIONS OF MUSCLES

Properties of Muscles

Muscles are soft tissues made of cells containing actin and myosin proteins.

Four properties of muscles help in the performance of all their functions:

1. Excitability:
2. Contractility:
3. Extensibility:
4. Elasticity:

Functions of Muscles

The functions of muscles are:

1. To Produce Physical Movements of Every Kind:
2. To Maintain Body Posture:
3. To Protect Organs of the Body:
4. To Circulate Blood:
5. To Execute Internal Organ Functions:
6. Regulating Body Temperature:

Figure 8.8
Muscular system

FUNCTION AND STRUCTURE OF RESPIRATORY SYSTEM AND CIRCULATORY SYSTEM

Respiration

Respiration is the chemical process of converting oxygen and glucose into CO2, water and energy and then eliminating the CO2 and excess water through exhalation.

Structure of Respiratory System

The Nose: Pharynx: Larynx:
Trachea: Bronchi: Diaphragm:
The Lungs:

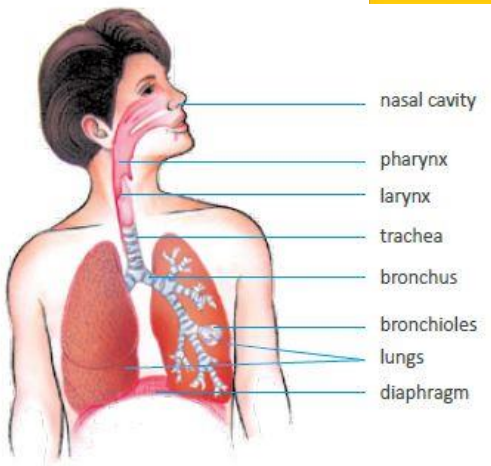

Figure 8.9 The respiratory system

Mechanism of Respiration

It can be divided into two stages:
1. Inspiration or Inhalation:
2. Expiration or Exhalation:

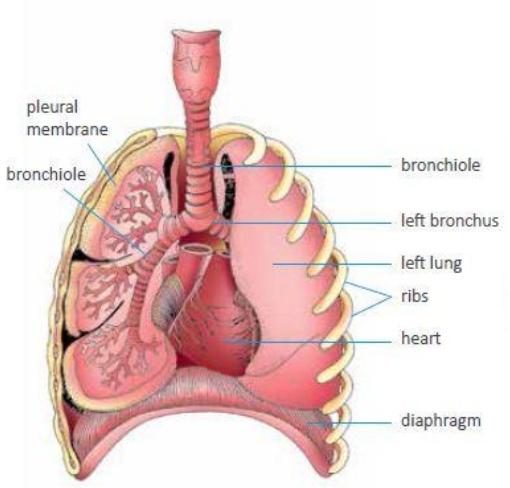

Figure 8.10 The lungs

Types of Respiration

The two types of respiration are:
1. External Respiration:
2. Internal Respiration:

Functions of Respiration

The main functions of respiration are:

- to implement inhalation and exhalation and thus obtain oxygen and eliminate carbon dioxide and excess water from the body
- to produce energy inside the body using oxygen
- to produce sound through the vibration of the vocal chords
- to enable olfaction, the detection of smell.

Meaning of Circulatory System

The circulatory system is a complex and vital network of organs and vessels that work together to transport blood, nutrients, hormones, oxygen, antibodies and lymph throughout the body. By continuously supplying these substances and removing waste products such as carbon dioxide, it maintains homeostasis (the stable state of normal body temperature and pH balance) and fights diseases

The circulatory system may be broken down into the following components:

- Heart
- The three vessels: arteries, veins and capillaries
- Lymphatic System

The Heart

The heart is a hollow four-chambered muscular organ responsible for the pumping of blood.

Shape, Size and Weight: Location: Structure: Function

The function of the heart is composed of three types of circulation:

1. Pulmonary Circulation:
2. Systemic Circulation:
3. Coronary Circulation:

Blood Vessels

Arteries

Arteries make-up one of the three vessels Through which blood is carried throughout the body. They transport oxygenated blood from the heart to the body. Each artery has three layers:

1. Tunica Intima:
2. Tunica Media:
3. Tunica Adventitia:

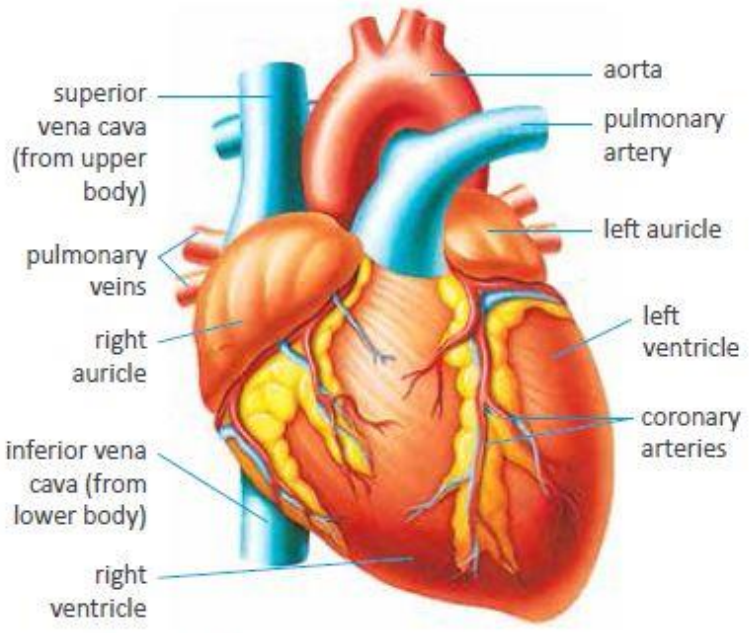

Figure 8.12 The external view of human heart

Arteries do not have a uniform size and structure. They may be divided into three categories:

1. Conducting Arteries: 2. Muscular Arteries: 3. Arterioles:

Veins

Veins are different from arteries in many ways. They perform the opposite function – with the exception of pulmonary veins. Veins transport deoxygenated blood to the heart from the rest of the body.

Capillaries

Capillaries are the smallest vessels with diameters ranging from 8 to 10 micron and are made of tunica intima only. Capillaries can be classified into three types based on the structure of their endothelial cells:

1. Continuous Capillaries: 2. Fenestrated Capillaries:
3. Sinusoidal Capillaries:

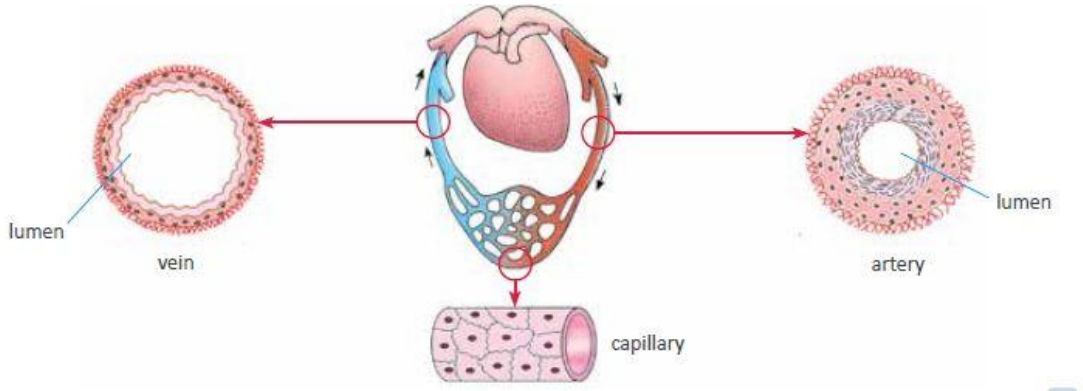

Figure 8.13 Diagrammatic relationship between arteries, veins and capillaries.

The Lymphatic System

It is an open subsystem, the function of which contributes to the efficient running of the cardiovascular part of circulation and to the strength of the immune system in general.

The lymphatic system primarily transports 'lymph', an interstitial fluid containing leftover WBCs and other materials.

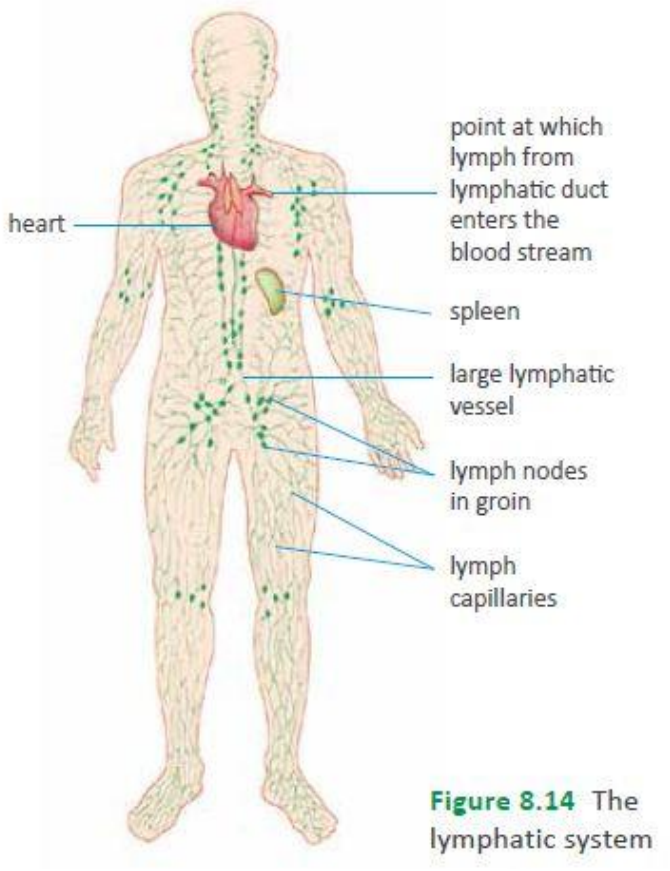

Figure 8.14 The lymphatic system

Functions of the Circulatory System

The circulatory system performs five important functions:

1. Transportation of Oxygen, Essential Nutrien and Hormones:
2. Stabilisaton of pH Balance:
3. Maintenance of Body Temperature:
4. Removal of Waste Products:
5. Boosting the Immune System:

EQUILIBRIUM – DYNAMIC AND STATIC AND CENTRE OF GRAVITY AND ITS APPLICATION IN SPORTS

Meaning of Equilibrium

A body is said to be in equilibrium when all the forces acting on it, are counterbalanced by equal and opposite forces and their sum becomes equal
to zero.

Centre of Gravity and Types of Equilibrium

A body's centre of gravity is the point at which its weight is evenly distributed and all sides of the body are in balance.
Equilibrium is divided into:

1. Static Equilibrium:
2. Dynamic Equilibrium:

Principles of Stability

The degree of stability is influenced by the following factors.

1. Area of Base of Support:
2. Vertical Distance of the COG from the Centre of the Base of Support:
3. Location of the COG:
4. Horizontal Distance of the COG from the Direction of Movement:
5. Weight of the Body:
6. Friction:

Equilibrium: It is a state when the resultant of all the forces acting on a body becomes zero. Based on the degree of stability, equilibrium is divided into three types:

1. Stable Equilibrium:
2. Unstable Equilibrium:
3. Neutral Equilibrium:

Application in Sports Biomechanics

Equilibrium, stability and COG form the bases of many scientific studies of sports mechanics and developments and upgrade of techniques. Understanding these concepts is advantageous for gymnasts, runners, footballers, weightlifters and a host of various other sportspersons, as they give an idea of how to hold positions and stay balanced while performing, how to increase their speed and minimise physical effort, etc.

Figure 8.16 We see high COG and very less stability in a few movements in gymnastics and other sports.

SUMMARY

1. Anatomy is the study of the structure of living organisms. It is derived from two Greek words: '*ana*' for 'up', and '*tomia*' for 'cutting'.

2. Kinesiology is the study of movements, whether of the human body or that of non-human animals. It is applied in strength training, sports conditioning, physical and occupational therapy and occupational health and safety.

3. In sports, it is crucial to learn how our circulatory system, respiratory system, nervous system, muscles, bones and metabolism work and what type of chemical changes occur inside our body during exercise. Training methods are planned accordingly to fully utilise the athletes' potential without ruining their health.

4. The skeletal system is a combination of all the bones in the body together with the structures that support them. The adult human body has 206 bones of various shapes and sizes.

5. Joints are the points where bones intersect. They hold the skeleton together and help it to carry out movements.

6. Muscles are soft tissues made of cells containing actin and myosin proteins.

SUMMARY…

7. Muscles are made of connected fibres whose length may vary from 3 mm to 4 cm and thickness from 0.01 mm to 0.1 mm.

8. Respiration is the chemical process of converting oxygen and glucose into CO_2, water and energy, and then eliminating the $CO_2$and excess water through exhalation.

9. More than 5 litres of blood travels through 96,560 kilometres of blood vessels per minute at rest. When the heart fails, the entire body of the organism is fatally affected.

10. Veins, with the exception of pulmonary veins, transport deoxygenated blood to the heart from the rest of the body.

11. Up to 60% of the body's total volume of blood is found in the veins at any point of time.

12. There are around 40 billion capillaries in our body, though they carry only 5% of the total volume of blood.

13. A body is said to be in equilibrium when all the forces acting on it are counterbalanced by equal and opposite forces and their sum becomes equal to zero.

14. Based on stability, equilibrium can be stable, unstable or neutral.