A Textbook of Physical Education Class 11

Chapter 8

FUNDAMENTALS OF KINESIOLOGY AND BIOMECHANICS IN SPORTS

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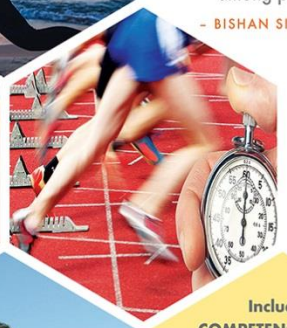
"My single achievement is that, with my sincere and honest approach, I inculcated the spirit of oneness and togetherness among players."

– BISHAN SINGH BEDI



Includes COMPETENCY-BASED QUESTIONS (CBQs)

Assertion-Reason Type Questions

Data-Based/Picture-Based/ Case-Based Questions

MCQs

Revised and Updated

A Textbook of

Physical Education

Based on the latest CBSE syllabus

XI

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DEFINITION AND IMPORTANCE OF KINESIOLOGY AND BIOMECHANICS IN SPORTS

Meaning of Kinesiology

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

Figure 8.1 Kinesiology is the study of body movements.

"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*

"Kinesiology encompasses holistic health disciplines which use the gentle art of muscle monitoring to access information about a person's well-being. Originating in the 1970's, it combines Western techniques and Eastern wisdom to promote physical, emotional, mental and spiritual health. Kinesiology identifies the elements which inhibit the body's natural internal energies and accesses the life enhancing potential within the individual."

– *Australian Kinesiology Association*

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.

Meaning of Biomechanics

"Biomechanics is the study of the structure and function of biological systems by means of the methods of mechanics."

– H Hatze

"The study and analysis of human movement patterns in sports is called biomechanics."

– Watson

"(Biomechanics is) the science and action of forces, internal or external, on the living body."

– Stedman's Medical Dictionary

Importance of Biomechanics in Sports and Physical Education

The importance of biomechanics in sports can be outlined as follows:

1. Improvement of the Sports Technique:
2. Improvement of Equipment and Facilities:
3. Minimisation of Injury:
4. Improvement of Training:
5. Understanding of the Human Body:

Figure 8.3 Biomechanics helps to describe, explain and predict the mechanical aspects of human exercise, sport and play.

PRINCIPLES OF BIOMECHANICS

There are nine main principles of biomechanics. They are as follows:

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

Types of Body Movements (flexion, extension, abduction, adduction, rotation, circumduction, supination and pronation)

Movement is a change of place or location. We observe a variety of movements in our body. They are as follows:

Flexion

Flexion is a movement that decreases the angle between two body parts. For example, when the elbow flexes, the angle between the ulna and the humerus decreases. Similarly, the angle between the femur and the tibia decreases when the knee flexes.

Extension

Unlike flexion, extension increases the angle between two body parts. When the elbow extends, the angle between the ulna and the humerus increases until an angle of 180° is reached and the arm becomes straight.

Figure 8.4 Flexion and extension

Abduction

Abduction is a movement in the frontal plane that takes the body part away from the midline or towards an imaginary centre line.

Adduction

Adduction is a movement in the frontal plane that returns the body part to the midline or takes it away from the imaginary centre line. Adducting the fingers brings them together.

Figure 8.5 Abduction and adduction

Though for biomechanics, it is simpler to explain gross movements in terms of single planes, in reality the motion is tri-planar or three-dimensional. For instance, walking is biomechanically described to occur in a sagittal plane.

Rotation

Rotation of body parts may be internal or external. Body parts can be rotated towards or away from the centre of the body.

Circumduction

Circumduction is a conical movement of a body part, such as a ball and socket joint or the eye. This body movement is a combination of flexion, extension, adduction and abduction.

Pronation and Supination

When a person is laying face-down on a surface, it is pronation. When a person is laying face-up on a surface, it is supination.

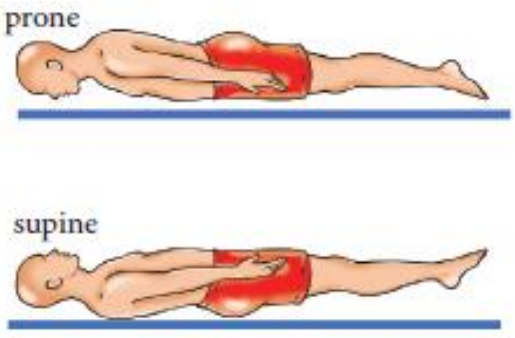

Figure 8.8 Pronation and supination

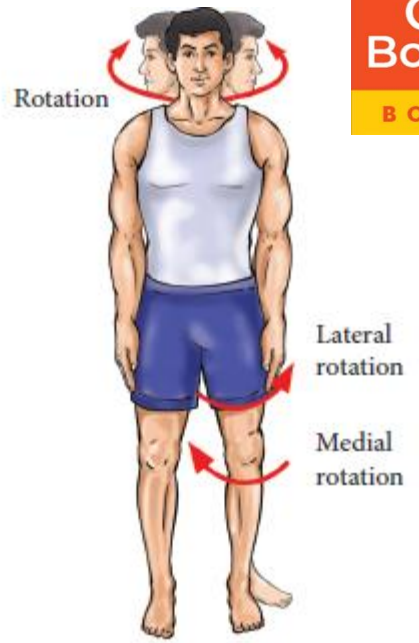

Figure 8.6 Rotation of the head, neck and lower limb

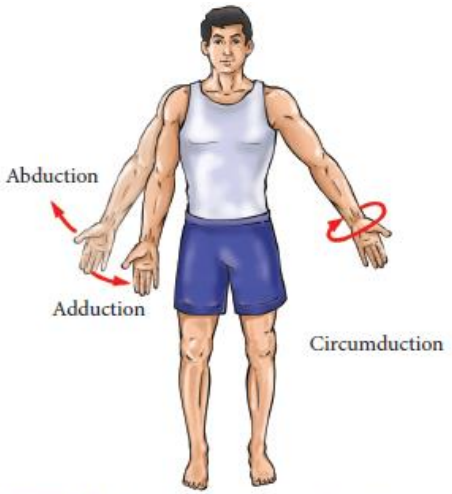

Figure 8.7 Angular movements: abduction, adduction and circumduction of the upper limb at the shoulder

AXIS AND PLANE – CONCEPT AND ITS APPLICATION IN BODY MOVEMENTS

Axis

An axis is an imaginary straight line about which a body rotates. Movement at the joint takes place in a plane about an axis. There are three kinds of axis:

1. Sagittal or Anteroposterior Axis:

2. Frontal or Medio-lateral Axis:

3. Vertical or Longitudinal Axis:

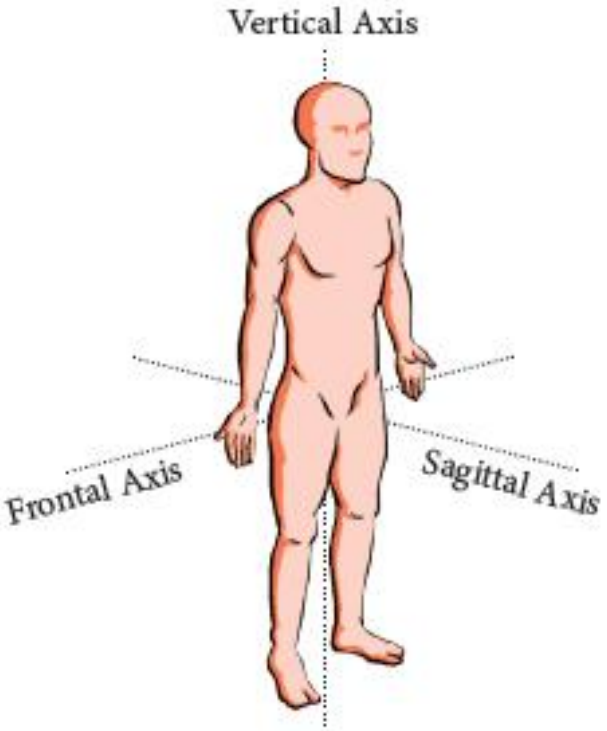

Figure 8.10 Various axes of human body

AXIS AND PLANE – CONCEPT AND ITS APPLICATION IN BODY MOVEMENTS

Plane

It shows the human body in its erect form, the hands slightly spread to the sides, palms facing forward (when the visual is frontal), legs together with the knees straight and feet resting on the ground with the toes pointed straight. There are three planes that pass through the human body.

1. Sagittal Plane:

2. Coronal/Frontal Plane:

3. Transverse or Horizontal Plane:

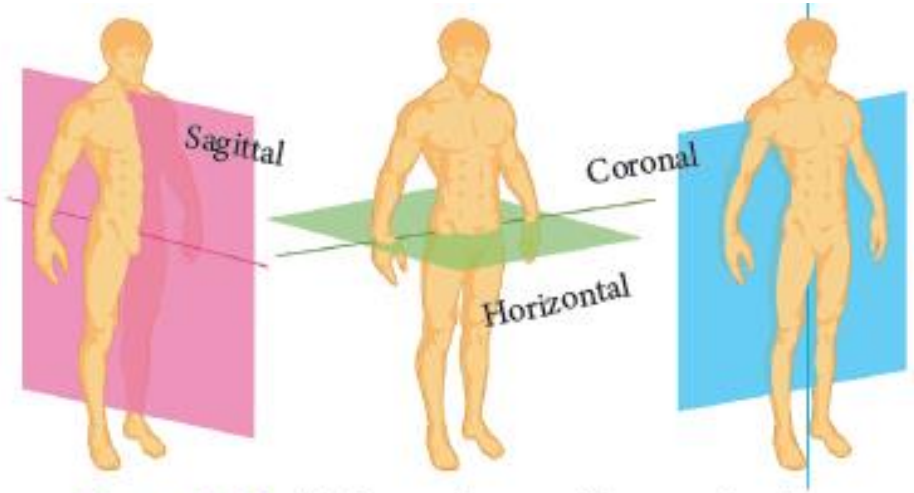

Figure 8.11 Various planes of human body

SUMMARY

1. The word Kinesiology is a combination of Greek word for 'movement' (*Kinesis*) and 'study' (*logos*). It is the study of movements, whether of the human body or of non-human animals.

2. According to Canadian Kinesiology Alliance (CKA), there are three main scopes for practice of Kinesiology: Adaptation through exercise, Neuroplasticity and Motor redundancy.

3. The word 'biomechanics' is an amalgamation of two Greek words: '*bio*' for life or 'living things' and '*mechane*' for 'machine'. Biomechanics looks at the study of forces acting on bodies.

4. In sports, biomechanics has a crucial role both in injury prevention and enhancement of performance.

5. There are seven main principles of biomechanics: Stability, Maximum effect, Maximum velocity, Impulse, Reaction, Torque and Angular momentum.

6. Flexion is a movement that decreases the angle between two body parts.

7. Unlike flexion, extension increases the angle between two body parts.

SUMMARY

8. Abduction is a movement in the frontal plane that takes the body part away from the midline or towards an imaginary line.

9. Adduction is a movement in the frontal plane that returns the body part to the midline or takes it away from the imaginary centre line.

10. Rotation of body parts may be internal or external. Body parts can be rotated towards or away from the centres of the body.

11. Circumduction is a conical movement of a body part, such as a ball and socket joint or the eye.

12. When a person is laying face-down on a surface, it is pronation. When a person is laying face-up on a surface, it is supination.

13. An axis is an imaginary straight line about which a body rotates.

14. Plane shows the human body in its erect form, the hands slightly spread to the sides, palms facing forward, legs together with the knees straight and feet resting on the ground with the toes pointed straight.