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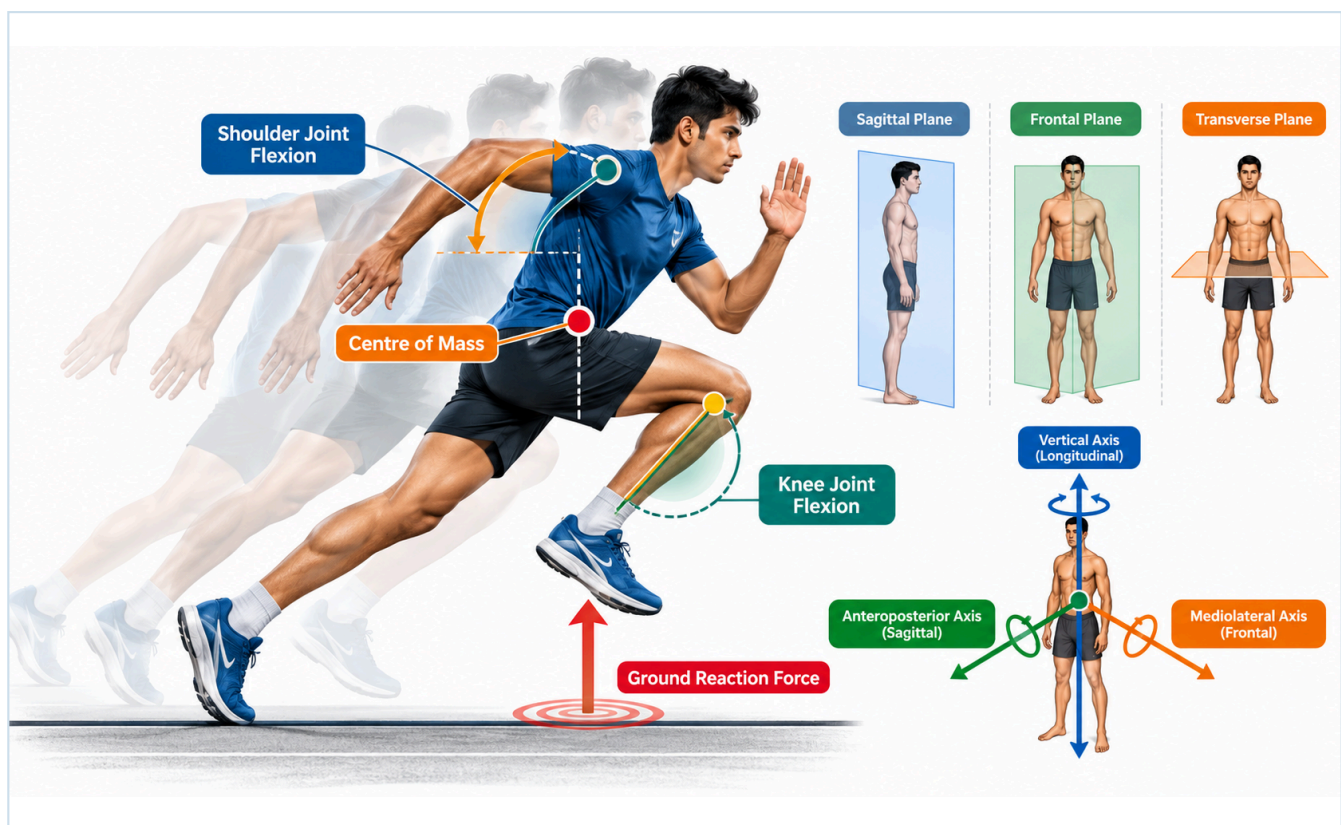
Knowledge in Motion

CLASS XI • PHYSICAL EDUCATION (048)

UNIT 8

FUNDAMENTALS OF KINESIOLOGY AND BIOMECHANICS IN SPORTS

CBSE 2026-27 | ILLUSTRATED STUDY EDITION



Current CBSE Alignment & Unit Overview

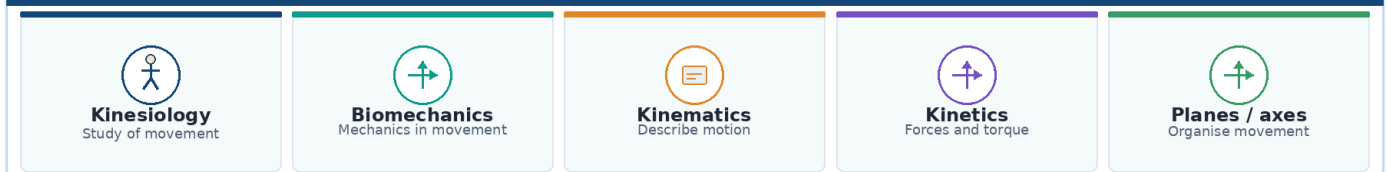
Unit 8 is part of the CBSE Class XI Physical Education (048) curriculum for the 2026–27 academic session. The unit carries 04 + 04b* marks in the current syllabus. The scope below follows the current CBSE topic list; supporting explanations and examples are added to make the prescribed concepts teachable and exam-ready.

CBSE Prescribed Area	Coverage in this Master
Definition and Importance of Kinesiology and Biomechanics in Sports	Detailed explanation + sports application + visual support + exam practice
Principles of Biomechanics	Detailed explanation + sports application + visual support + exam practice
Kinetics and Kinematics in Sports	Detailed explanation + sports application + visual support + exam practice
Types of Body Movements - Flexion, Extension, Abduction, Adduction, Rotation, Circumduction, Supination and Pronation	Detailed explanation + sports application + visual support + exam practice
Axis and Planes - Concept and its application in body movements	Detailed explanation + sports application + visual support + exam practice

Learning Objectives

- Define kinesiology and biomechanics and explain their significance in physical education and sports.
- Explain basic biomechanical principles and relate them to movement quality and performance.
- Differentiate kinetics and kinematics using sport-based examples.
- Identify and explain the prescribed body movements with appropriate joint examples.
- Explain the anatomical planes and axes and match them to common movements.
- Apply movement analysis to simple sport skills without reducing complex technique to a single mechanical rule.
- Interpret diagrams and case-based movement situations, including concept-based questions.

Unit Map • Kinesiology & Biomechanics



1. Kinesiology and Biomechanics in Sports

1.1 Kinesiology

Kinesiology is the study of human movement. In physical education and sports, it helps learners describe and understand how body parts move, how joints and muscles contribute to actions, and how movement can be observed systematically.

1.2 Biomechanics

Biomechanics applies principles of mechanics and physics to biological systems, especially human movement. Sports biomechanics examines how forces, motion, body position and equipment interact during skills and physical activities.

1.3 Importance in Sports

- Helps describe movement accurately.
- Supports technical analysis and skill improvement.
- Helps explain the effects of forces and body positions on performance.
- Provides a scientific framework for comparing movement patterns and testing technique changes.
- Supports safer practice by identifying unnecessary or poorly controlled mechanical demands.

Kinesiology vs Biomechanics

 Kinesiology How the body moves	 Biomechanics Forces and motion	 Use Observe and improve skills
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2. Principles of Biomechanics

Biomechanical principles help explain why objects and bodies start, stop, accelerate, rotate or remain balanced. At Class XI level, students should understand the following broad principles and connect them to simple sports situations.

Principle / idea	Meaning	Example in sport
Inertia	A body tends to maintain its state of motion unless acted on by an external force.	A stationary ball needs a force to begin moving.
Force and acceleration	A net force can change motion; the effect depends on force and mass.	A stronger push can produce greater acceleration when other conditions are comparable.
Action and reaction	Forces occur in interacting pairs.	A runner pushes against the ground and the ground provides a reaction force.
Balance and stability	Stability depends on factors such as base of support and the position of the centre of mass.	A wider base can support stability in a controlled defensive stance.
Leverage / torque concept	A force acting at a distance from a joint can create rotational effect.	Joint position and resistance placement can change the torque demand in a strength exercise.

Principles of Biomechanics

 Inertia Resists change in motion	 Force Changes motion	 Action-reaction Forces occur in pairs	 Stability Base and centre of mass
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Application note

Biomechanical rules are tools for analysis, not one-size-fits-all instructions. Skill technique must also consider the athlete, task, environment, equipment and performance goal.

3. Kinetics and Kinematics

3.1 Kinematics

Kinematics describes motion without focusing on the forces that cause it. Common kinematic ideas include position, displacement, distance, speed, velocity, direction, time and acceleration.

3.2 Kinetics

Kinetics studies the forces and torques associated with movement. Examples include muscle force, ground-reaction force, friction and the turning effect (torque) of a force around a joint.

Feature	Kinematics	Kinetics
Main question	How is the body/object moving?	Why is it moving or changing motion?
Typical variables	Position, displacement, speed, velocity, acceleration	Force, torque, mass, reaction force
Simple sports example	Measure the velocity of a sprinter	Analyse the force applied to the ground



4. Types of Body Movements

Movement	Meaning	Common example
Flexion	Decreasing the angle at a joint (in many typical anatomical descriptions).	Bending the elbow or knee.
Extension	Increasing the angle at a joint or returning from flexion.	Straightening the elbow or knee.
Abduction	Moving a body part away from the body midline.	Raising the arm sideways.
Adduction	Moving a body part toward the body midline.	Returning a raised arm toward the side.
Rotation	Turning around a longitudinal axis.	Turning the head or rotating the trunk/limb.
Circumduction	Circular/conical movement combining flexion, extension, abduction and adduction.	Large circular arm movement at the shoulder.
Supination	Rotation of the forearm that turns the palm upward in the standard reference position.	Turning the palm up to receive a ball.
Pronation	Rotation of the forearm that turns the palm downward in the standard reference position.	Turning the palm downward in a controlled task.

Flexion & Extension



Flexion
Joint angle decreases



Extension
Joint angle increases



Example
Elbow / knee action

Abduction & Adduction



Abduction
Away from midline



Adduction
Toward midline



Example
Arm / leg movement

Rotation & Circumduction



Rotation
Turns around an axis



Circumduction
Circular sequence of movement



Example
Shoulder / hip action

Supination & Pronation



Supination
Palm turns upward



Pronation
Palm turns downward



Joint region
Forearm rotation

5. Axis and Planes

Anatomical planes are imaginary flat surfaces that divide the body for describing movement. Axes are imaginary lines about which movement can occur. Matching a movement to its plane and axis helps describe motion precisely.

Plane	Divides body into	Commonly related axis	Representative movement
Sagittal plane	Left and right portions	Mediolateral / frontal axis	Flexion and extension
Frontal (coronal) plane	Front and back portions	Anteroposterior / sagittal axis	Abduction and adduction
Transverse (horizontal) plane	Upper and lower portions	Vertical / longitudinal axis	Rotation

Planes & Axes of Movement



Sagittal plane
Flexion / extension



Frontal plane
Abduction / adduction



Transverse plane
Rotation



Axes
Perpendicular to plane

5.1 Using Planes and Axes in Sports

- A jump squat includes substantial flexion and extension in the lower-limb joints, mainly described in the sagittal plane.
- A lateral raise moves the arm away from the midline and is described mainly in the frontal plane.
- A trunk twist is primarily rotational and is described around a vertical axis in the transverse plane.
- Real sport skills often combine movements across more than one plane and axis.

Movement Analysis



Setup
Starting position



Action
Joint and body motion



Force
Push / ground reaction



Follow-through
Complete the skill

Exam focus

Plane = the surface/framework in which a movement is described. Axis = the imaginary line around which the movement occurs. Learn the common plane–axis pairings and then apply them to sport examples.

Assessment Practice

MCQs

1. Kinesiology is mainly concerned with the study of:

- A. Blood groups
- B. Human movement
- C. Diet alone
- D. Team selection

2. Biomechanics applies principles of:

- A. Nutrition only
- B. Psychology only
- C. Mechanics to human movement
- D. Anatomical naming only

3. Which belongs mainly to kinematics?

- A. Reaction force
- B. Force
- C. Torque
- D. Velocity

4. Which belongs mainly to kinetics?

- A. Force
- B. Velocity
- C. Displacement
- D. Position

5. Bending the elbow so the joint angle decreases is generally:

- A. Extension
- B. Flexion
- C. Abduction
- D. Supination

6. Moving a limb away from the body midline is:

- A. Flexion
- B. Abduction
- C. Adduction
- D. Pronation

7. Turning the forearm so the palm faces upward is:

- A. Circumduction
- B. Supination
- C. Extension
- D. Pronation

8. A circular movement combining flexion, extension, abduction and adduction is:

- A. Rotation
- B. Adduction
- C. Circumduction
- D. Translation

9. The sagittal plane divides the body into:

- A. Front and back portions
- B. Left and right portions
- C. Upper and lower portions
- D. Equal diagonal portions

10. The frontal plane divides the body into:

- A. Upper and lower
- B. Front and back
- C. Left and right
- D. Inside and outside

11. The transverse plane divides the body into:

- A. Diagonal portions
- B. Left and right only
- C. Front and back only
- D. Upper and lower portions

12. A force that resists a change in motion is related to the idea of:

- A. Inertia
- B. Attention
- C. Circumduction
- D. Recovery

13. Kinetics focuses on causes of motion, especially:

- A. Only position
- B. Forces and torques

- C. Only time
- D. Only body shape

14. Movement around the vertical axis is commonly associated with:

- A. Abduction in the frontal plane
- B. Flexion in the sagittal plane
- C. Rotation in the transverse plane
- D. Extension only

15. Understanding biomechanics can help a coach:

- A. Ignore individual differences
- B. Diagnose every injury
- C. Replace all training
- D. Analyse movement and technique

Assertion–Reason

1. Assertion: Kinesiology studies human movement.

Reason: It examines movement patterns and the roles of body structures in producing movement.

Answer: Both true and Reason explains Assertion.

2. Assertion: Inertia is relevant to sports movement.

Reason: A body tends to maintain its state of motion unless acted on by an external net force.

Answer: Both true and Reason explains Assertion.

3. Assertion: Kinematics and kinetics are identical.

Reason: Kinematics describes motion while kinetics focuses on forces and torques associated with motion.

Answer: Assertion false; Reason true.

4. Assertion: Flexion generally decreases the angle at a joint.

Reason: The bones move closer together around the relevant joint.

Answer: Both true and Reason explains Assertion.

5. Assertion: Planes and axes provide a reference framework for analysing movement.

Reason: A plane describes the surface in which movement is observed and an axis is the imaginary line around which movement occurs.

Answer: Both true and Reason explains Assertion.

6. Assertion: Biomechanical analysis can support technique improvement.

Reason: It can help a learner observe movement and force patterns and test appropriate changes in context.

Answer: Both true and Reason explains Assertion.

Match the Following

Column A	Column B
1. Flexion	A. Forces and torques
2. Abduction	B. Decreases joint angle
3. Kinematics	C. Away from midline
4. Kinetics	D. Describes motion
5. Transverse plane	E. Upper and lower portions

Fill in the Blanks

1. The study of human movement is called _____.
2. Biomechanics applies principles of _____ to human movement.
3. Kinematics describes motion; kinetics focuses on the _____ causing motion.
4. Moving a limb away from the midline is called _____.

5. Turning the palm upward is called _____.
6. The sagittal plane divides the body into _____ and right portions.
7. The transverse plane divides the body into _____ and lower portions.
8. Rotation commonly occurs around a _____ axis.

2-Mark Questions

1. Define kinesiology.
2. Define biomechanics.
3. Differentiate kinetics and kinematics.
4. Name any two body movements.
5. Name the three anatomical planes.
6. What is inertia?
7. What is meant by action and reaction?
8. Define abduction.
9. Define supination.
10. What is an axis of movement?

3-Mark Questions

1. Explain flexion, extension and one sport example.
2. Explain abduction and adduction.
3. Describe kinetics and kinematics with examples.
4. Explain one principle of biomechanics.
5. Explain rotation and circumduction.
6. Explain supination and pronation.
7. Describe the three anatomical planes.
8. Explain the relationship between a plane and an axis.

4-Mark Questions

1. Explain planes and axes with examples.
2. Discuss basic biomechanical principles in sport.
3. Differentiate kinematics and kinetics using a sport action.
4. Explain the eight prescribed body movements with brief examples.
5. Explain why biomechanics is important for sport skill analysis.
6. Describe the role of stability and base of support in movement.
7. Explain force and acceleration using a sports example.
8. Analyse a movement using both kinematic and kinetic ideas.

5-Mark Questions

1. Analyse a simple sport movement using movement type, plane, axis and force considerations.
2. Explain why biomechanical analysis should be individualised rather than based on one universal technique.
3. Discuss how kinematics and kinetics complement each other in sports analysis.
4. Explain the major principles of biomechanics with suitable sports examples.
5. Describe how planes, axes and body movements can be used to analyse a skill.
6. Discuss the importance of balance, stability and force control in sports performance.
7. Explain how biomechanical knowledge can support safer and more efficient movement.

Case-Based / Competency Questions

Case 1

A volleyball player raises the arm sideways to prepare for a serve. Identify the movement and plane most closely involved.

Answer guidance: Expected: abduction of the arm, primarily in the frontal plane, around a sagittal/anterior-posterior axis.

Case 2

A thrower increases the force applied to an implement. Explain the kinetic aspect of this action.

Answer guidance: Expected: force/torque influence the motion; identify force as a kinetic variable and link it to acceleration.

Case 3

A coach records the displacement and velocity of a runner but not the forces acting on the runner. Is the analysis mainly kinematic or kinetic?

Answer guidance: Expected: mainly kinematic.

Case 4

A student confuses pronation with rotation of the entire shoulder. Clarify the movement using the forearm as the reference.

Answer guidance: Expected: pronation is rotation of the forearm so the palm turns downward/backward from anatomical position; it is distinct from shoulder rotation.

Case 5

A gymnast loses balance while landing. Using biomechanics, explain two broad factors that can affect stability.

Answer guidance: Expected: centre of mass position relative to base of support, line of gravity, base of support, and control of forces.

Case 6

A cricket skill is analysed in setup, force application and follow-through. Explain how biomechanical analysis can improve the movement without treating one rule as universal.

Answer guidance: Expected: observe motion/forces, identify inefficient positions, trial changes, individualise and re-evaluate.

Visual / Concept-Based Practice

Visual Question 1 • Name the Movement



A
Joint angle reduces



B
Limb moves outward



C
Palm turns down



D
Circular joint path

Visual Question 2 • Match Planes & Axes**Visual Question 3 • Analyse the Force****Quick Revision**

Concept	Quick recall
Kinesiology	Study of human movement.
Biomechanics	Application of mechanics to biological/human movement.
Kinematics	Describes motion.
Kinetics	Studies forces and torques causing/changing motion.
Movements	Flexion, extension, abduction, adduction, rotation, circumduction, supination, pronation.
Planes	Sagittal, frontal, transverse.
Axes	Mediolateral, anteroposterior, vertical.

Answer Key

MCQs: 1-B, 2-C, 3-D, 4-A, 5-B, 6-B, 7-B, 8-C, 9-B, 10-B, 11-D, 12-A, 13-B, 14-C, 15-D

Assertion–Reason: 1 Both true and Reason explains Assertion.; 2 Both true and Reason explains Assertion.; 3 Assertion false; Reason true.; 4 Both true and Reason explains Assertion.; 5 Both true and Reason explains Assertion.; 6 Both true and Reason explains Assertion..

Matching: 1-B, 2-C, 3-D, 4-A, 5-E.

Fill in the blanks: Use the key terms defined in the relevant section of the unit. Teachers may accept equivalent scientifically correct terms where appropriate.

References, Source Note & Academic Integrity

Primary syllabus source: Central Board of Secondary Education (CBSE), Physical Education (Subject Code 048), Class XI, Curriculum 2026–27. Unit scope and prescribed topics in this master follow the current 2026–27 syllabus. Secondary syllabus summaries were used only to cross-check wording and learning outcomes.

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