

OVERVIEW of Movement analysis, technology and biomechanics.

How can the coach develop my technique?

A. Overview of musculo-skeletal system

- The skeleton provides attachments for the muscular system for movement and offers protection for vital organs such as the cardio-respiratory and vascular system.
- The average human adult has 206 bones that are divided into the axial and appendicular skeletons.
- The human body consists of 5 types of bones: long, short, flat, irregular and sesamoid bones.
- Skeletal muscles are those that attach to bones and have the main function of contracting to create movement. They are also sometimes known as striated muscles due to their appearance or voluntary because we have direct control over them contracting.
- As one muscle contracts to cause the movement, another relaxes to allow the movement to take place. The muscle directly responsible for the movement is the agonist and the muscle that relaxes is the antagonist.
- The body is made up of a combination of slow and fast-twitch muscle fibres.
- Muscular contractions can be classified into either isotonic or isometric. Isotonic contractions can be sub-divided into concentric and eccentric contractions.

B. Overview of movement analysis

- To understand how to improve technically the athlete or coach must understand the component parts of the technical model and the movements that contribute to successful performance.
- The possible movements at each joint or articulation (where two or more bones meet) can help coaches understand skill development and performance improvement.
- Synovial Joints - is the most common joint in the human skeletal system, they have a joint cavity and ligaments hold the articulating bones together. These joints are freely moveable.
- There are 3 imaginary anatomical planes that intersect at the body's centre of gravity dividing the body into equal portions; Sagittal, Frontal and Transverse.
- There are 3 imaginary anatomical axes that intersect at the body's centre of gravity. These are; transverse, frontal and longitudinal.
- Levers allow us to create movement that is greater than the force applied.
- Most levers in the body are 3rd class levers.

C. Overview of Biomechanical principles

- Newton's three laws of motion:
 - Newton's 1st Law: A body continues in its state of rest or motion in a straight line unless acted upon by an external force.
 - Newton's 2nd Law: The rate of change of momentum of a body is directly proportional to the force causing it and the change takes place in the direction in which the force acts.
 - Newton's 3rd Law: To every action there is an equal and opposite reaction.
- Momentum allows us to understand how mass and velocity influences the movement of athletes.
- Impulse allows us to explain how force and time can cause the athlete to start moving or change direction.
- Force - time graphs are often used to demonstrate impulse.
- Balance and stability can be understood through knowledge of a person's centre of mass.
- Stability is increased by making the base larger and lowering the centre of mass.
- Linear motion allows us to understand how quickly the athlete or object is travelling and in which direction. $\text{SPEED} = \text{DISTANCE} / \text{TIME}$
- Angular motion relates to rotating movements at joints. A cyclist will produce angular movement at the legs, pushing the pedals to achieve linear motion.
- Moment of Inertia is the body's resistance to motion.
- A projectile is any object or body that is in flight. The flight path (trajectory) of the object is influenced by gravity and air resistance.

- There are three key factors that determine the path of the projectile: Angle, Height and Velocity of the projection.
- The Bernoulli principle refers to changes in fluid (water and air) speeds due to changes in pressure.
- Magnus Effect - this is the Bernoulli principle applied to spinning objects. The side of the object that is spinning in the direction of the air will result in a high velocity air flow and therefore low pressure.
- Fluid mechanics looks at the movement through air and liquid, applying the principles of increasing and decreasing, drag through streamlining and altering laminar flow.

D. Overview of Performance analysis and technology

- Performance analysis can provide information on Technical, Tactical, Physical and Behavioral aspects of sport.
- Physical analysis is mainly carried out through fitness testing and GPS data from training and matches.
- Notational analysis is the method for recording information from a match and can be either real time analysis or post-match analysis. Coach observation is only 30-45% accurate.
- There are also other problems associated with coach observation:
 - The vast amount of information in a game/performance is difficult to retain
 - The emotions during the game/performance can cloud judgement
 - Pre-conceived ideas and personal bias of players and opposition
- Technical and Tactical data is usually gained from video/computer/GPS analysis. It provides objective data from statistical information.
- Every aspect of a performance can be analysed from individual to unit and team performance.
- Biomechanics also provides technical data in terms of forces, joint angles, and aerodynamics to name a few.
- Psychological analysis and profiling can be gained via coach observation, questionnaires and interviews.

Acknowledgements

Page	Image description	Acknowledgements
COVER	Gareth Bale	Gonzalo Arroyo Moreno / Stringer / Getty Images