COURSE GUIDE

KHE 336
KINESIOLOGY

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ICE BREAKER

Hello student, I am delighted to welcome you to KHE 335 - Kinesiology. In the course of your programme in Human Kinetics, you have participated in one or more sports. Mention the movements you performed in the sports. You have also done courses that may have introduced you to the systems of the human body and their structures, like anatomy and physiology. Mention any three body parts you have used in sports and mention the movement they helped you perform.

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INTRODUCTION

In Kinesiology, you have the opportunity to study important principles you can use for a successful career and effective ministry in physical education, sports and pre-physical therapy emphasis in exercise science. The focus of introduction to Kinesiology is to mold your knowledge in activity skills and scientific factors in body movement related to sports, dance, exercise, active recreation and adapted movement activities.

WHAT YOU WILL LEARN IN THIS COURSE

Kinesiology has become a popular science in the field of sports sciences and other movement related disciplines. Sports and human movement related organisations need competent individuals who will be able to explain and apply the scientific basis of human movement in the development, promotion and maintenance of health and performance in sports and work environment. Introduction to kinesiology as a course will prepare you to identify and acquire the competence required in developing basic movement activities for development of fitness. You will also be able to identify good postures and their benefits.

COURSE AIM

The aim of this course is to enhance your opportunities of employability through the acquisition of knowledge of the science of human movement, which is Kinesiology.

COURSE OBJECTIVES

By the end of this course, you will be able to:

- describe the term kinesiology;
- discuss the importance of kinesiology to human kinetics;
- identify fundamental movements;
  - make an application of the lever system to human body;
- demonstrate appropriate body postures;
- analyse different effects of force of the body;
- distinguish locomotor and nonlocomotor skills.

WORKING THROUGH THIS COURSE

This course is arranged in units. Each unit deals with a specific sub-heading that will help you achieve the course objectives. Every unit has specific objectives and contents arranged to meet the unit objectives. Within the contents are in text questions, and discussions designed to help you think along the line of the objectives of the particular unit or related content. You will also come across some self-examination

exercises that will guide you in determining whether you are achieving the unit's objectives.

STUDY UNITS

Module 1 Kinesiological Concepts

Unit 1 **M**eaning and Importance of Kinesiology to Human Kinetics
Unit 2 **F**undamental Concepts
Unit 3 **M**ovements Description
Unit 4 **C**omponents of Kinesiological Analysis

Module 2 Mechanical Aspects of Kinesiology

Unit 1 **M**eaning, Types and Application of Force to Sports Activities
Unit 2 **M**eaning, Types and Application of Friction to Human Movement.
Unit 3 **M**eaning, Types and Application of Lever to the Human Body
Unit 4 **N**ature and Types of Motion
Unit 5 **A**pplication of Newton's Laws of Motion to Sports Activity

Module 3 Posture and Movement

Unit 1 **N**ature of Posture
Unit 2 **M**ovement Skills, (**L**ocomotor)
Unit 3 **N**on-locomotor and Manipulative skills
Unit 4 **B**ody Awareness Activities
Unit 5 **K**inesiological Perspectives of Exercise and Fitness

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https://youtu.be/rCg-MkVkxyU?t=360. (locomotor skills)

https://www.dreamstime.com/stock-photo-jump-phases-man-different jumping-image87446956.

https://www.canstockphoto.com/images-photos/leaping.html.

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ASSESSMENT

The course will be assessed in two parts. Part 1 will be the in-course assessment which will be done during facilitation, and may involve quizzes, take home assignments and term papers. Part 2 will be the end of course examination.

PRESENTATION SCHEDULE

Units 1, 2, and 4 of Module 1 are to be covered on a two-hour weekly contact respectively. Units 3 of the same module and unit 1 of module 3 will be covered in two weeks of two-hour weekly contact. Other units will be covered in two-hour weekly contact.

HOW TO GET THE MOST FROM THE COURSE

Follow this guide to get the most from this course:

1. Read the objectives of the course very carefully to learn what is expected of you at the end.
2. Read the units as arranged.

3. Read the unit objectives very carefully to learn why the unit is important.
4. Whenever you meet an in-text question, pause and thoughtfully consider the question before reading the next sentence.
5. Attempt all the self-assessment exercise without viewing the solutions to them.
6. Then review the solution to the self-assessment to see how you are progressing.

FACILITATORS/TUTORS/TUTORIALS

You will be guided in a tutorial by a facilitator/tutor, who is trained in this course, as you read the course.

COURSE INFORMATION

Course Code: KHE 335
Course Title: Kinesiology
Credit Unit: 2
Course Status: Elective
Semester: First
Course Duration: One Semester
Required Hours for Study: 30

MAIN COURSE

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MODULE 1 KINESIOLOGICAL CONCEPTS

MODULE INTRODUCTION

This module introduces you to the knowledge and understanding of Kinesiology. You will learn the importance of Kinesiology to Human Kinetics. You will also learn fundamental concepts in Kinesiology and perform fundamental movements. The units under this module are:

Unit 1 Meaning and Importance of Kinesiology to Human Kinetics
Unit 2 Fundamental Concepts
Unit 3 Movements Description
Unit 4 Components of Kinesiological Analysis

UNIT 1 MEANING AND IMPORTANCE OF KINESIOLOGY TO HUMAN KINETICS NOMENCLATURES

CONTENTS

1.0 INTRODUCTION

Man, which includes you, interacts with his environment through different kinds of movement. Hence, the needs for you to well understand the science of human movement. This unit will introduce you to the basic understanding of Kinesiology. It will also help you to see why it is important to study it in Human Kinetics. It will also introduce you to the three basic sciences that form the foundation of Kinesiology.

2.0 INTENDED LEARNING OUTCOME (ILO)

By the end of this unit, you will be able to:

- describe the term Kinesiology
- identify three basic sciences that form kinesiology
- mention three specific contributions of Kinesiology to Human Kinetics.

3.0 MAIN CONTENT

3.1 Meaning and Importance of Kinesiology to Human Kinetics

Kinesiology is a broad sphere of human enquiry that has been see from different perspectives by different professionals. It therefore becomes very important that you are helped to have a meaning of it that represents what it is in Human kinetics. Human kinetics is an applied science that studies human movement and the forces that bring about such movements. Knowing the importance of Kinesiology to Human Kinetics will deepen your appreciation of human movement.

3.1.1 Meaning of Kinesiology

Kinesiology is the multidisciplinary study of physical activity or Movement. Vincent, Winningham, and Caldwell, (1988), define kinesiology as the study of the art and science of human movement. Knudson, (2007), saw it as the term referring to the whole scholarly area of human movement study. It encompasses anatomy, biomechanics, physiology, and psychomotor behaviour, as well as various social and cultural factors. The focus of Kinesiology is physical activity. The study of kinesiology focuses also on exercise stress, movement efficiency, and fitness.

The term Kinesiology came from two Greek verbs, *kinein* and *logus*, which mean “to move” and “to discourse.” Modern phrasing has changed the meaning of the suffix *logus* to “the study of,” making kinesiology to literally mean “the study of movement”, (Knudson, 2007: 3). Kinesiology encompasses both the theory and practice of movement. The study of movement in physical activity has a long history in American higher education institutions dating to the late nineteenth century. The field of study was primarily oriented to the practice of movement, such as physical training and the playing of sports. The beginning of the study of movement from a disciplinary perspective was a fragmented effort driven

by the insight of a few individuals operating as individual scholars, practitioners of medicine, or aspiring academics in universities. All the various approaches to the study of movement come under the single umbrella called kinesiology, (Atare and Mong, 2005; Knudson, 2007; France, 2009).

In Human Kinetics, Kinesiology is seen as the study of human movement from the standpoint of physical sciences. It studies the human body as a machine for doing work which has its foundation in three major areas of scientific study. These areas of science, though have earlier been mentioned are mechanics, (specifically biomechanics); anatomy, (musculoskeletal anatomy) and physiology, (neuromuscular physiology), (Hamilton and Luttgens, 2002). They apply these sciences to better understand how the human body responds to physical activity. Can you from this see why kinesiology is defined as a science? Yes. Kinesiology is the traditional name of a course concerning the anatomical, physiological and mechanical bases of human movement related to sports, games, dance and adapted movements. The foundation of kinesiology is a combination of mechanics, anatomy and physiology, which gave it that scientific status. Bearing all these in mind, Kinesiology can be described as the branch of science that concerns itself with the understanding of the interrelationship between body structures and functions with respect to the kinematics and kinetics of human movement. This is an expanded definition of kinesiology that you are to use as a student of Human Kinetics, (Atare and Mong, 2005).

Biomechanics is the study of motion and its causes in living things. Biomechanics provides key information on the most effective and safest movement patterns, equipment, and relevant exercises to improve human movement. In a sense, kinesiology professionals solve human movement problems every day, and one of their most important tools is biomechanics, (Knudson, 2007). So your gaining good understanding of biomechanics will help you to properly apply kinesiological principle in solving human movement-related problems.

Musculoskeletal Anatomy is the scientific study of the structures of the muscular and skeletal systems of the human body. Anatomy, generally, explains the structure and location of the different components of an organism to provide a framework for understanding. Human anatomy studies the way that every part of a human, from molecules to bones, interacts to form a functional whole. Anatomy provides information about structure, location, and organisation of different parts of the body. Thus, you can say that it is the study of the structure and relationship between body parts.

Physiology is the science of the normal function of living systems. Physiology studies the processes and mechanisms that allow an organism to survive, grow, and develop. Physiological processes are the ways in which the organ systems, organs, tissues, cells, and bio-molecules which makeup of the body work together to accomplish the complex goal of sustaining life. Human physiology studies the functions of humans, their organs and cells, and how all of these functions combine to make life, growth and development possible. Thus, you can say that physiology is the study of the function of body parts and the body as a whole. **Neuromuscular Physiology**, on its own, studies the functions of the neuromuscular system of the human body. It is because Kinesiology applies principles from these basic sciences that it is described as a science.

3.1.2. Importance of Anatomy and Physiology to Kinesiology

The knowledge of anatomy and physiology is essential for you as an intending professional in Kinesiology or Human Kinetics, whether you want to be a physical educator, coach or sport scientist. You need this knowledge to function very well in many areas of kinesiology, such as:

1. Evaluating Capacity: Knowledge of anatomy and physiology will help to evaluate the capacity of an athlete in terms of anaerobic and aerobic capacity, for instance.

2. Determining the Effects of Exercise**:** Knowledge of anatomy and physiology is important in studying the effects of exercises on human body or its parts, such as, muscular system, skeletal system, cardiovascular system, respiratory system, circulatory system, digestive system, among others.

3. Studying Body Structure: Your knowledge of anatomy and physiology will help you to provide information on every aspect of athlete's body. For example, you can determine whether body structure of an athlete such as height, weight, body types is either positive or negative.

4. Sports Injury Prevention**:** Knowledge of anatomy and physiology helps to preventing sports injuries during physical activity or competition.

5. Uses of Food**:** Anatomy and physiology helps to provide adequate information about sports nutrition. It gives the information of food nutrients and its uses. It provides information on the benefits of balanced diet, uses of protein in strength development in sports.

This information is very helpful in the enhancement of sports performance.

6. Selection of Sports: Anatomy and physiology helps in selection of sports for individuals based on their structural composition. For instance, weightlifting can be selected for athletes with short structure; tall athletes go for volleyball and basketball, an athlete who has more fast twitch fibre (white muscle) is good for 100 m dash and 110 m hurdle race while an athlete who has more slow twitch fibre (red muscle) is good for endurance activities like marathon,

Kinesiology prepares you to benefit from the knowledge of anatomy and physiology from three (3) different yet related sources. These sources according to Hoffman, (2009) are:

1. Experiencing (or doing) physical activity. This is also called experiential knowledge;
2. Studying the theoretical and conceptual bases of physical activity. This is the theoretical knowledge, and
3. Professional practice centred in physical activity, (called professional practice knowledge).

In the course of your training in Human Kinetics, you will participate in physical activities. This will help you experience physical activity or acquire experiential knowledge. You will also be taught theories and concepts underlying physical activities. This aspect of the programme will help you to acquire theoretical knowledge. When you have acquired experiential and theoretical knowledge, you are equipped to practice physical activity as a profession in any organisation.

3.1.3. Importance of Kinesiology to Human Kinetics

Have you ever marveled at the ability and beauty in human movement? You may have ignored or taken these movements for granted. Now, as a student of Human Kinetics, you cannot help being impressed not only by the beauty of human movement but the meaning and organisation. Are you learning Kinesiology just to keep yourself busy or just for the sake of studying? The answer is, No! It is of very great importance to your understanding and practice of Human Kinetics. Therefore, you study Kinesiology for these reasons and many more:

1. Kinesiology is studied to improve performance by learning how to examine the movement of the human body and to discover their underlying principles.

2. The study of kinesiology is an essential part of the education experience of students of Human kinetics and physical medicine.

3. Its knowledge enables practitioners in these fields to help their students, or clients perform with optimum safety, effectiveness and efficiency. Knowledge of kinesiology has a threefold purpose – safety, effectiveness and efficiency. Safety is of greater concern in all movement programmes. Hence, you need to organise your programmes in such a way as to avoid doing harm or causing any injury to the body.

4. Furthermore, the knowledge of kinesiology helps in the modification of vocational and home making activities that are as a result of the limitations imposed on an individual's neuromuscular function or skeletal structure.

5. It prepares physical education teachers, coaches, athletic and fitness trainers to teach their students and clients to effectively perform fundamental and complex motor skills.

6. The actual study of this course, kinesiology, can lead you to multiple careers and experiences, which include becoming a physical educator. You can not only be a teacher of the science, but may do research with it, go into coaching, fitness leadership and delivering special services related to health promotion, sports medicine, rehabilitation, and high-performance athletic competitions. You can also manage sport-related enterprises. Although some of these professions may overlap or seem as if they are all similar, they have their differences. For instance, these professions are located in different settings which include schools, colleges, universities, public and private organisations, businesses, government, military, clinical environments and hospitals.

You can see from these contributions kinesiology makes in the field of Human Kinetics that two things stand out. They are:

1. Kinesiology contributes to successful participation in physical activities.
2. Kinesiology improves human structure and function through the intelligent selection of activities and the efficient use of the body, (Atare and Mong, 2005).

Case Studies

Locate a group playing any sports in your neighbourhood. Spend 10 to 20 minutes to observe one of the players. As you observe, please, write out the body parts or regions used most by the player. Then, draw one of such regions and describe the physiology of the joints in the region.

SELF-ASSESSMENT EXERCISE

i. Which of the following terms describes the science of human movement?

a. Anatomy
b. Biomechanics
c. Kinesiology
d. Physiology

ii. What is the focus of kinesiology?

a. Exercise,
b. Sports,
c. Muscle building,
d. Physical Activity.

4.0 CONCLUSION

You have read that understanding the mechanics, structures and functions of the human body that are regularly involved in sport is very critical to understanding kinesiological principles in human movement. A thorough understanding of these various aspects of human movement may facilitate better teaching, successful coaching, more observant therapy, knowledgeable exercise prescription, and new research ideas. This is because these three areas of science form the foundation of kinesiology.

5.0 SUMMARY

In summary, you have learnt the nature and the meaning of kinesiology. Generally, kinesiology is the science of human movement. This unit also taught you that kinesiology is studied to enhance your appreciation, understanding and application of scientific principles that help humans perform physical activities without injuries, but with safety, efficiency and effectiveness. These will help you to intelligently select physical activities that will benefit the body.

6.0 TUTOR-MARKED ASSIGNMENT

1. Kinesiology applies the knowledge of the science of the functions of the body structure from which or the following disciplines?
   e. Experience,
   f. Anatomy,
   g. Practice,
   h. Physiology

2. All these sources are used to acquire the knowledge of kinesiology except---

   i. Expert Knowledge
   j. Experiencial Knowledge
   c Theoritical Knowledge
   d Professional Practice.

7.0 REFERENCES/FURTHER READING

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UNIT 2 FUNDAMENTAL CONCEPTS IN KINESIOLOGY

CONTENTS

1.0 INTRODUCTION

Your understanding kinesiology is highly dependent on your being able to identify, understand and apply its concepts. This unit will present those concepts that are fundamental to your learning of kinesiology. In the previous unit you were exposed to the meaning and importance of Kinesiology. This unit will teach you some basic scientific terms from the areas of science that form the foundation of Kinesiology.

2.0 INTENDED LEARNING OUTCOME (ILO)

By the end of this unit, you will be able to:

- demonstrate the anatomical reference position
- identify the three cardinal planes of the body
- mention the three axes of motion
- describe relationship between two body structures based on location.

3.0 MAIN CONTENT

3.1 Fundamental Concepts

The study of kinesiology requires that you understand some basic or fundamental concepts. These concepts are very important in your application of scientific principles in the understanding of human movement. Some of these concepts include reference positions, body planes with their corresponding axes of motion, and reference terms among others.

3.1.1. Reference Positions

In order to understand the origins of human movement, it is essential to understand anatomy. Do you recall the meaning of anatomy? You have learnt that anatomy is the study of the structure of the human body. It provides essential labels for musculoskeletal structures and joint motions that are relevant to human movement. Knowledge of anatomy also provides a common "language" of the human body and motions for kinesiology and medical professionals, (Knudson, 2007). A common language of the human body is made possible by the reference positions. These positions include fundamental and anatomical reference positions. See figure 1for the illustration of these positions.

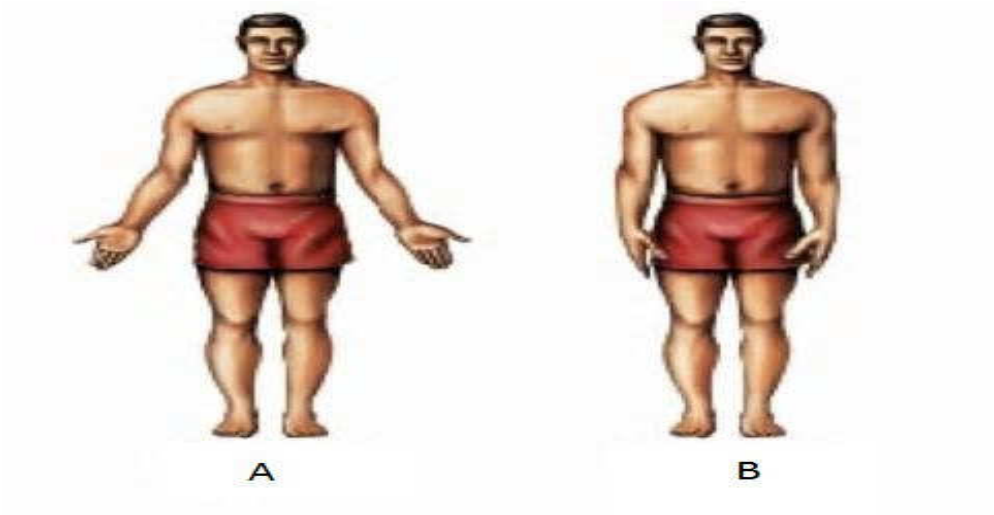

Figure 1: A shows Anatomical Position; B shows Fundamental Position

Fundamental Position is a position you assume when standing erect with feet slightly apart, face looking forward, arms hanging relaxed by the side with the palms facing the body. In this position, the hand is facing the body, (fig. 1B). In the event of describing the front of the hand, confusion will set in. In other to end this confusion, the anatomical reference position was introduced.

Anatomical Position: What is anatomical position? See figure 1A that illustrates the anatomical reference position. It is a position you assume when standing erect with the face directed forward, upper limb freely hanging to the sides and the palm of the hands facing forward, (Vanputte, Regan and Fusso, 2016). Figure 2 shows the front and back of this position. Try to assume these positions bearing in mind the various body regions mentioned and their positions.

Did you notice any difference in the two positions in figure 2? The position of the body can affect the description of the body parts relative to each other. When you assume the fundamental position, the palm of your hands is facing your body, while in anatomical position, the palms are facing forward. What is the confusion? The front of the hand in the fundamental position is its side. Hence, it is used to describe other body parts without the hand. To avoid this confusion, all relational description of the body parts in kinesiology is based on the anatomical position, no matter the actual position of the body. Anatomical reference position is the standard reference position for the body when locations, positions, or movements of body segments or other anatomical structures are described.

Figure 2: Front and back of the anatomical position. Source: www.ilustracionesaturaleza.com

3.1.2. Directional Terms

These are universally accepted terms used to describe the relationship between two body parts or segments based on location, (Watch the video of the directional terms from www.youtube.com/directionalterms). Therefore, when describing the relative positions of the body parts or relationship between the various parts of the body, it is important that you use standard terminology. The following are some of the directional term you may frequently use in kinesiology:

1. Anterior (Ventral): This means toward or on the front of the body. The toes are anterior aspect the heel. This means that the toes are in front of the heel.

2. Posterior (Dorsal): Toward or on the back of the body: that is, behind. The heels are posterior to the toes. This means that the heels are behind the toes.

3. Superior: Toward the head or upper part of a structure: The word, above comes to your mind when you use the term superior. For instance, the humerus is superior to the radius. What does this mean? It means that the humerus is above the radius. Can you identify these bones?

4. Inferior: This is the opposite of superior. It means toward the lower part of a structure or foot, signifying below or under. The tibia is inferior to the femur. This means that the tibia is below or under the femur. Can you give other examples?

5. Medial: Toward, nearer or at the midline of the body. The adductors for example, are medial to the abductors. That is the adductors are nearer to the midline of the body than the abductors.

6. Lateral: Away from the midline of the body or outer side. You can reverse the example use for medial. What will it be? The abductors are lateral to the adductors, meaning that the abductors are farther away from the midline of the body than the adductors.

7. Proximal**:** Closer to the origin of a point of reference or point of attachment to the trunk of the body. The elbow is proximal to the wrist. The message here is that, the elbow is nearer to the trunk than the wrist.

8. Distal**:** Further from the origin or point of reference or attachment. This is the case when describing the location of the foot in relation to the knee. In such description, you say, the foot is distal to the knee, meaning that the foot is further from the point of attachment to the trunk than the knee.

3.1.3. Body Planes and Axes

A system of planes and axes is the universally used method of describing human movements. What is a plane? A plane is a flat, two-dimensional plane or surface running through an object. Motion occurs in the plane or parallel to it. Motion in the plane is often called planar, (Hamill, Knutzen and Derrick, 2015; Bartlett, 2007). Anatomists have developed names to identify specific planes that pass through the body. Each plane has a corresponding axis that passes perpendicularly through the plane. An axis, (axes- plural) of a revolving body or object is a straight line, itself at rest, about which other parts of the body rotate in a plane at right angle, (Atare and Mong, 2005). These planes are useful to anatomists in describing planes of dissections or imaginary dissections. The planes are also useful in kinesiology, where they are used in describing relative movements of body parts, while the axes are used to describe the lines around which these motions occur, (McGinnis, 2013).

In anatomical position, there are three planes of the body. The planes are known as cardinal planes and they are– the sagittal, frontal and horizontal planes, (Bartlett, 2007). Figure 3 shows you those planes.

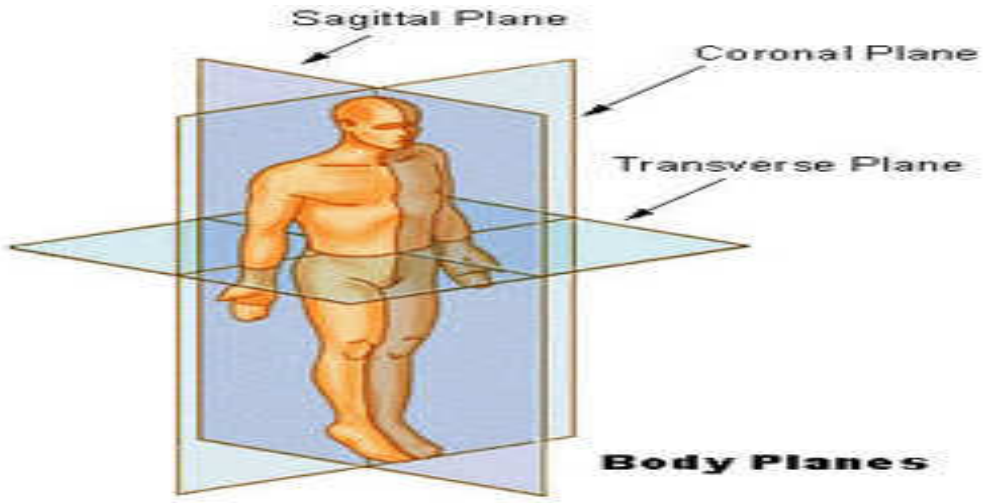

Figure 3: The three Cardinal Body Planes

3.1.3.1 Sagittal Plane and the Corresponding Axis

The sagittal plane is a vertical or longitudinal imaginary surface that bisects the body into right and left halves. Movements in the sagittal plane occur about a *mediolateral or frontal-horizontal axis* running side to side (left-right) through the center of mass of the body, (Hamill, Knutzen and Derrick, 2015). Mass is the amount of matter contained in the body. The centre of mass is the center of the mass of a body, (Kreighbaum and Barthels, 1990). Sagittal plane movements involving the whole body rotating around the centre of mass include somersaults, backward and forward handsprings, walking, running, cycling and roles. Joint movements here are flexion and extension.

3.1.3.2 Frontal Plane and the Corresponding Axis

The frontal, also called coronal plane, is also a vertical (lengthwise) plane that bisects the body to create front and back halves. The axis about which frontal plane movements occur is the sagittal-horizontal or anteroposterior axis that runs anterior and posterior from the plane. Frontal plane motions of the whole body about the centre of mass are not as common as movements in the other planes. Examples are cartwheels and jumping jack. The joint or segment movements include abduction and adduction.

3.1.3.3 Transverse Plane and the Corresponding Axis

A transverse plane, also known as an axial plane or cross-section, is a horizontal plane that divides the body into upper (head) and lower (tail) portions. It is parallel to the ground, which (in humans) separates the superior from the inferior, or put another way, the head from the feet. It is at right angle to the sagittal and frontal planes. Movements occurring in this plane are primarily rotations about a longitudinal axis. Spinning vertically around the body, as in a figure skating spin, is an example of transverse plane movement about the body's centre of mass.

This system of planes is applied to the body as a whole, but an also be applied to the body segments. When describing anatomical motion, these planes describe the axis along which an action is performed. So by moving through the transverse plane, movement travels from head to toe. For example, if you jump up directly and then down (with whole body), your body will be moving through the transverse plane in the coronal and sagittal planes. Watch the video, Axis of Movement animation, available from http://www.youtube.com/watch?v=aDxfe5Ny6zM. Figure 4 illustrates

the planes and their corresponding axes.

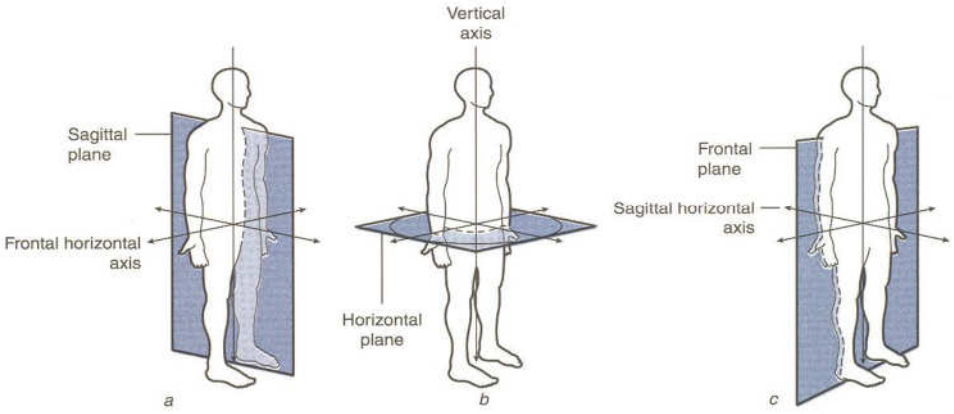

Figure 4: Planes and their corresponding axes. (A) Sagittal plane, (B) Transverse or Horizontal Plane, and (C)

Frontal Plane. Source: www.physical-solutions.co.uk.

For a quick follow up, table 1 provides basic presentation of the plane, movement, axis and their activity examples.

Table 1: Basic Presentation of Planes and Axes

Plane	**Movement**	**Axis**	**Example**
Sagital	Flexion/extension	Horizontal	Walking Squatting Overhead press
Frontal	Abduction/abduction Side flexion Inversion/eversion	Sagital	Star jump Lateral arm raise Side bending
Transverse	Int rotationn/ext rotation Horizontal flexion/extension Supination/pronation	Longitudinal	Throwing Baseball swing Golf swing

SELF-ASSESSMENT EXERCISE

1. What type of position is illustrated when you stand erect with your palm facing your thigh?

(a) Anatomical Position,
(b) Absolute Position,
(c) Fundamental Position
(d) Local Position.

2 The horizontal axis corresponds to which one of these planes?

(a) Sagittal Plane,
(b) Longitudinal Plane,
(c) Frontal Plane,
(d) Horizontal Plane.

3. The transverse plane corresponds to which of the following axes?

(a) Anterio-posterior Axis
(b) Sagittal Axis,
(c) Longitudinal Axis,
(d) Horizontal Axis.

4.0 CONCLUSION

One of the ways you can understand kinesiology is to learn its fundamental concepts. These concepts will help to make universally acceptable analysis of human movement. There are fundamental and anatomical positions, but in kinesiology, anatomical reference position is widely used. The directional terms and body planes are based on the anatomical position. Therefore, regularly use these terms when appropriate in your daily activities.

5.0 SUMMARY

This unit has presented the anatomical reference position as the universally accepted position for describing human movement. It has also taught you that the three cardinal planes that originate at the centre of mass are: the sagittal plane, which divides the body into right and left; the frontal plane, dividing the body into anterior and posterior; and the transverse plane, dividing the body into superior and inferior portions. You have also learnt that movement takes place in or parallel to the planes about a mediolateral axis (sagittal plane movements), an anteroposterior axis (frontal plane movements), or a longitudinal axis (transverse plane movements).

6.0 TUTOR-MARKED ASSIGNMENT

1. Your eyes are what to your ears?

(a) Medial
(b) Lateral
(c) Superior
(d) Anterior

2. Your elbow is what to your hand?

(a) Superior
(b) Distal
(c) Better
(d) Proximal

3. Which term describes what your thumb is to your index finger?

(a) Superior
(b) Medial
(c) Inferior
(d) Lateral

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UNIT 3 MOVEMENTS DESCRIPTION

CONTENTS

1.0 INTRODUCTION

This unit will help you to learn terminology for describing the movements of the body. In unit 2, you have already acquired some knowledge of anatomy and anatomical terminology in human movement. This unit presents the system used by anatomists and other human movement professionals to describe movements of the body and its parts. It will also build on your understanding of body planes and axes.

2.0 INTENDED LEARNING OUTCOME (ILO)

By the end of this unit, you will be able to:

- describe two sagittal plane movements at different joints
- practice a whole body frontal plane movement
- highlight three transverse plane movements
- demonstrate two transverse plane movements.

3.0 MAIN CONTENT

3.1 Movements Description

Have you ever played a game? Can you mention the body parts that were primarily involved in that game? Try to describe the movements performed by those body parts. As you answer these questions, you begin to learn and appreciate human movement. The human body is a multi-jointed structure. It is made up of many movable joints. In the consideration of the range of movement that the body can perform, it is

therefore necessary to consider the structure of the joint where the movement takes place, (Atare and Mong, 2005). As you may have learnt in your anatomy and physiology lecture, some of these joints are limited only in one direction, whereas others permit movement in several directions. Certain terms are used to describe the types of movements possible at a joint in relation to the anatomical position. The terms are grouped under: sagittal, frontal and transverse plane movements, (McGinnis, 2013). Please, note that all body movements occur at the joints, not body segment. So, it is kinesiologically incorrect to say, flex or bend your hand. Instead, say, flex your elbow.

3.1.2. Sagittal Plane Movements

These are movements along the sagittal plane about the mediolateral or transverse axis. These movements occur at the wrist, elbow, shoulder, hip, knee, and intervertebral joints and include flexion, extension, and hyperextension. Remember that all these movements start from anatomical position. Figure 5 shows examples of these movements in various joints of the body.

Flexion (Bending) is the joint movement that occurs around the transverse axes through these joints and causes limb movements in sagittal planes through the largest range of motion. When this movement occurs, the angle formed at the joint is reduced and the body segment moves away from anatomical position, (Hamill, Knutzen and Derrick, 2015; McGinnis, 2013). For example, elbow flexion occurs when your forearm is moved forward and upward and the angle between the forearm and the upper arm at the anterior or front side of your elbow joint gets smaller.

Extension is a reverse from flexion**.** It is the movement that occurs around the transverse axes through these joints and causes the opposite limb movements in sagittal planes that return the limbs to anatomical position. Extension is a straightening movement in which the relative angle of the joint between two adjacent segments increases as the joint and body segments returns to the zero or anatomical reference position**.** You perform this movement at the elbow when your forearm is returned to anatomical position from flexion. Motion into the extremes of the range of motion is often noted as “hyper,” (Knudson, 2007). You will come across hyperextension and hyperflexion in this unit.

Hyperextension is a movement around the transverse axes and is a continuation of extension beyond the anatomical position. When you move your extended elbow backward beyond the line of the anatomical position, you have performed hyperextension of the elbow. You can also perform another movement along the sagittal plane called **hyperflexion,**

if the flexion movement goes beyond the normal range of flexion. For example, this can happen at the shoulder only when your arm moves forward and up in flexion through 180° until it is at the side of your head, and then continues to move past the head toward your back or hyperflexes, (Hamill, Knutzen and Derrick, 2015; Hamilton and Luttgens, 2002).

Dorsiflexion and Plantar Flexion are other joint movements along the sagittal plane. They take place at the ankle, the joint between your leg and foot. *Dorsiflexion* is the movement that occurs around the transverse axis through the ankle joint and causes the foot to move forward and upward toward the leg, in a sagittal plane. When you lift your toes off the ground and put your weight on your heels, you are dorsiflexing at your ankles. *Plantar flexion*, on the other hand**,** occurs around the transverse axis through the ankle joint and causes the opposite movement of the foot in a sagittal plane so that the foot moves downward away from the leg. When you stand on your toes, you are plantar flexing at your ankles, (McGinnis, 2013). See figure 5g for illustration plantar flexion.

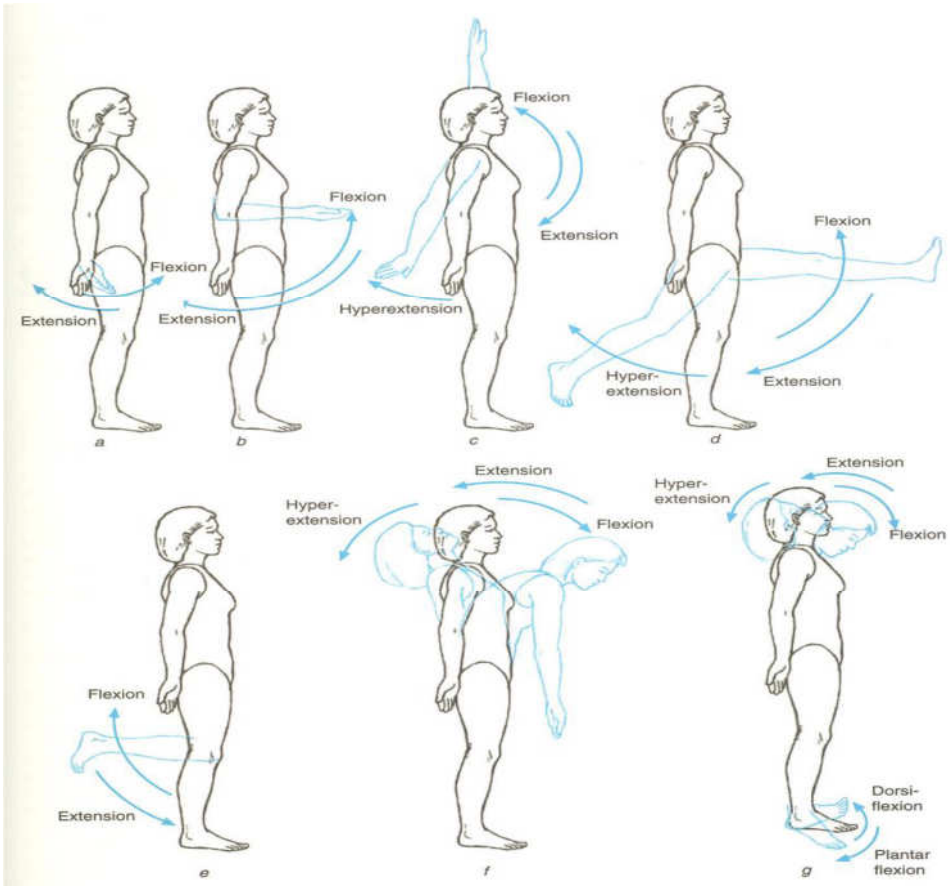

Figure 5: Flexion and Extension at different joints in the body. (a) wrist; (b) elbow; (c) shoulder; (d) hip; (e) knee; (f) trunk, and (g) neck and ankle

(Follow the arrows to perform these movements). *Source:* McGinnis, (2013); www.physical-solutions.co.uk.

3.1.2. Frontal Plane Movements

Recall that frontal plane divides the body into front and back portions. It is perpendicular to the anterior-posterior axis. Movements along this plane are side to side movements like, abduction and adduction. These movements are common at the shoulder and hip joints.

Abduction is the movement that occurs and causes limb movement away from the midline of the body. Abduction literally means to take away. Do you remember what happens when someone is abducted or kidnapped? He or she is taken away from his or her family, for instance. So, when you move your limbs sideways, you have taken that limb away, thereby, performed abduction. Abduction pairs very well with adduction.

Adduction is another frontal plane movement about the anterior-posterior axis. It is a joint action that is performed when abducted limb returns to the anatomical position. Abduction and adduction are illustrated when you perform star jump, jumping jack or astride jump. In this movement the upper limbs are moved at the shoulder, first, away from the anatomical position (abduction), and later returned to the anatomical position, (adduction).

Eversion and Inversion form another pair of movements along the frontal plane that occur at the ankle joint. Eversion is the movement of the foot beyond anatomical position where the lateral side (outside) of the sole of the foot is lifted. The return to anatomical position is **Inversion,** which occurs when the medial side (inner side) of the sole of the foot is lifted. See figure 6 for illustration of these movements and other frontal plane movements.

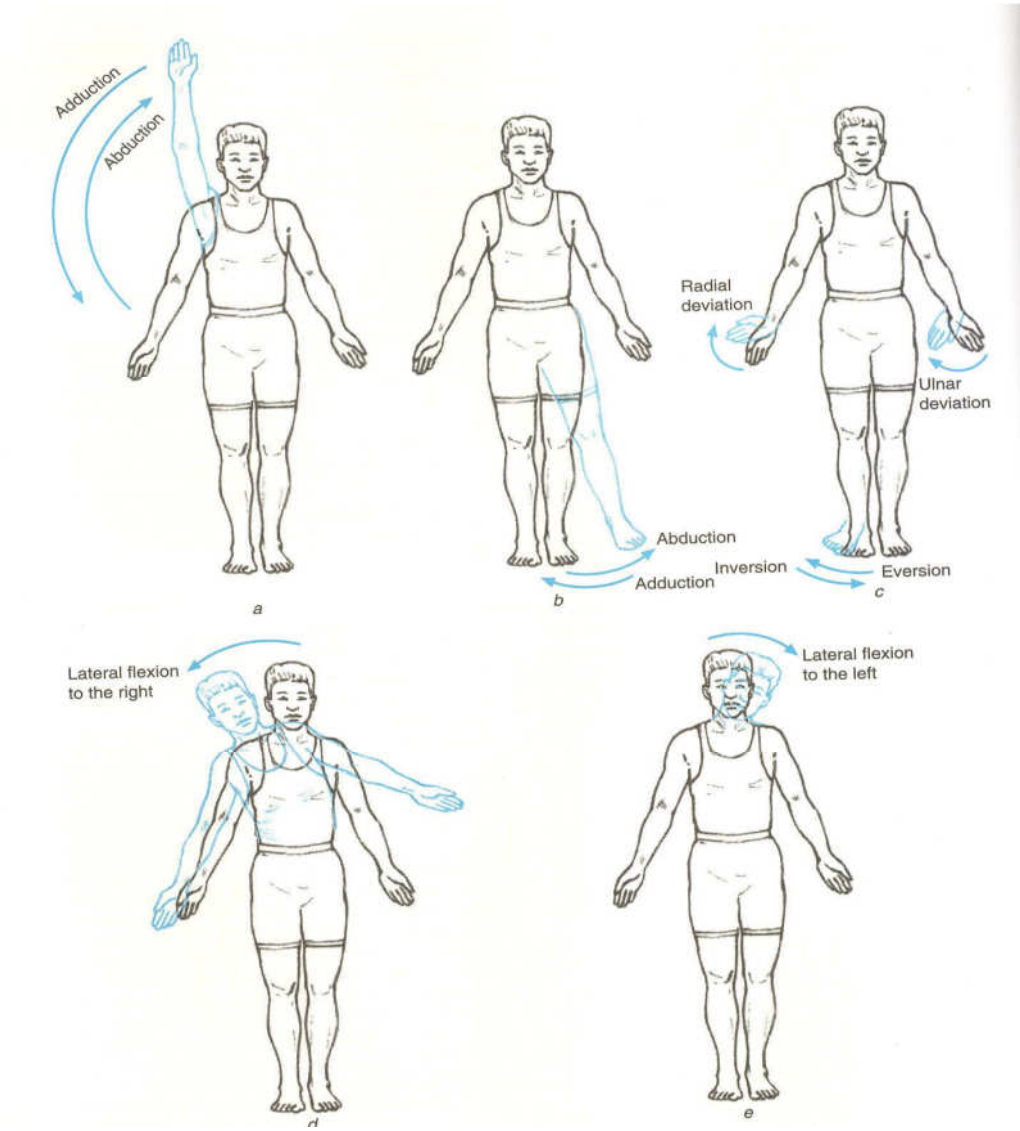

Figure 6: Illustration of Frontal Plane Movements at (a) the shoulder, (b) hip, (c) wrist and ankle, (d) trunk, and (e) neck. Source: McGinnis, (2013).

Case Study

Have a friend make a video of you walking from one end of your room to the opposite end. Watch the video three times, then, pick your pen and paper. Watch the video again, this time watch to observe the different frontal movements you performed while walking. Make a list of these movements and the joints where they occurred. Relate your observation to the illustration in figure 6.

3.1.3. Transverse Plane Movements

Transverse plane movements are motions that involve twisting. They occur about a longitudinal or vertical axis. The most basic movement in this category is rotation.

Rotation is the turning of a body structure or segment around its longitudinal axis. It is a basic movement. Joints which permit rotation include the shoulder and hip. These are both ball and socket joints. We can also rotate our necks and backs due to a series of smaller joints, including the atlantoaxial joint which is a pivot joint in the neck between the first two vertebrae. Rotation of the hip and shoulder can be broken down into internal or external rotation (also sometimes known as medial and lateral rotation respectively).

Internal rotation is the movement which occurs when the knees turn inward toward each other or the palms of the hands turn toward the body from anatomical position. External rotation on the other hand occurs when the limbs return to anatomical position or move beyond anatomical position. Rotations are named right and left when it takes place within the joints of the head and trunk only. The movements of the whole arm forwards from a 90° abducted position are horizontal flexion in a forward direction and horizontal extension in a backwards direction, (Hamill, Knutzen and Derrick, 2015; Hamilton and Luttgens, 2002).

Pronation and **Supination** are a pair of transverse plane joint motions that occur at the radioulnar joint in the forearm. From anatomical position, pronation is the movement that turns the forearm, causing the palm to turn toward the body. This motion is similar to internal rotation at the shoulder joint except that it occurs at the radioulnar joint. Supination**,** on the other hand**,** is the joint motion that returns the forearm and hand to anatomical position or moves them beyond anatomical position, (McGinnis, 2013; Atare and Mong, 2005).

Circumduction, is a multiple-axis, specialised (not basic) movement of the transverse plane. It can be created in any joint or segment that has the potential to move in two directions, such that the segment can be moved in a cyclical fashion as the end of the segment moves in a circular path forming a cone. An example of circumduction is placing your arm out in front of you and drawing an imaginary circle in the air. Try it and you will notice that circumduction is not a simple rotation. How many movements did you notice? What are their names? It is a combination of four (4) movements in sequence. The movement of the arm in the creation of the imaginary cone or 'O' is actually a combination of (1) flexion, (2) adduction, (3) extension, and (4) abduction. Circumduction movements are possible in the foot, thigh, trunk, head, and hand, (Hamill, Knutzen and Derrick, 2015; McGinnis, 2013). Figures 7 and 8 present the illustration of some of these movements along the transverse plane.

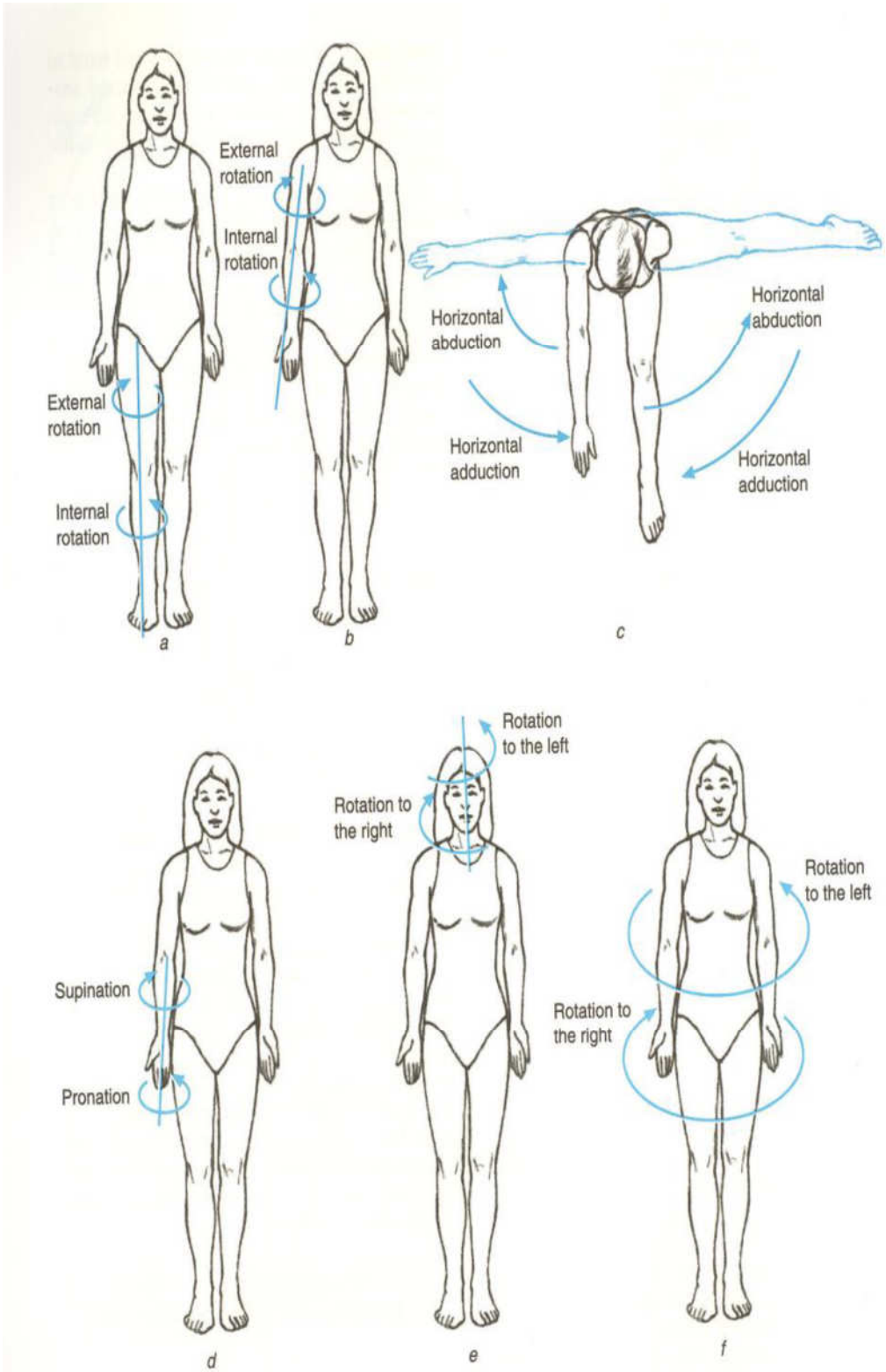

Figure 7: Illustration of Movements along the Transverse Plane

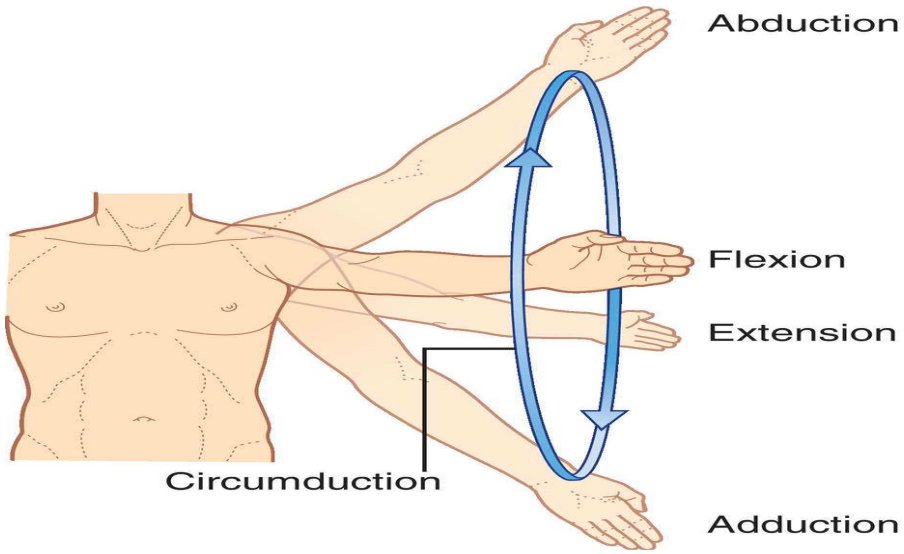

Figure 8: Illustration of Circumduction. Follow the direction of the arrow and notice the combination of the four (4) movements.

SELF-ASSESSMENT EXERCISE

1. What movement do you perform when stand on your toes?
(a) Standing Flexion.
(b) Dorsiflexion
(c) Planta flexion
(d) Elavation.

2. When you straighten your hand, what movement do you display?
(a) Extension
(b) Circumduction
(c) Flexion
(d) Abduction

3. What type of movement is flexion?

(a) Frontal Plane Movement
(b) Transverse Plane Movement
(c) Sagittal Plane Movement
(d) Cardinal Plane Movement

4. What type of movement is jumping jack?
(a) Transverse Plane Movement
(b) Sagittal Plane Movement
(c) Frontal Plane Movement
(d) Longitudinal Plane Movement

5. What movement is performed by your knee at the ending phase of a free kick in soccer?
(a) Rotation
(b) Flexion
(c) Extension
(d) Elevation

6. The sagittal plane bisects the body into _____.
(a). Right and left portions
(b). Top and bottom portions
(c). Front and back portions
(d). None of the above

5.0 CONCLUSION

At this point, you have become familiar with basic kinesiological concepts. As you went through this unit, you learnt how some joint movements are classified and described. When you learn and perform these movements, you will readily remember their names and descriptions, and you will come to appreciate them.

6.0 SUMMARY

In this unit you have learnt that all movements take place at the joints. The unit also taught you that joint motions are classified as sagittal, frontal and transverse plane movements. To remember these movements, you must constantly practice them. Always start the movements from anatomical reference position.

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UNIT 4 COMPONENTS OF KINESIOLOGICAL ANALYSIS

CONTENTS

1.0 INTRODUCTION

Your understanding of the components of kinesiological analysis of motion will help you to know the best ways to describe and appreciate human movements. This unit is designed to teach you the three basic components of kinesiological analysis of motion. It will also prepare you to understand that your role in sports and exercise prescription of corrections when your client violates any anatomical, physiological or mechanical principles.

2.0 INTENDED LEARNING OUTCOME (ILO)

By the end of this unit, you will be able to:

- discuss the meaning of kinesiological analysis.
- mention the basic components of kinesiological analysis.
- describe the four elements in the description of a motion, and
- perform a kinesiological analysis of standing long jump or broad jump.

3.0 MAIN CONTENT

Kinesiological analysis is the application of kinesiological facts in assessing the effectiveness of a given motor performance. The kinesiological facts are concepts and principles in anatomy, physiology and mechanics, hence, it is also called anatomical and physiological analysis of motion. This analysis will help you to know what skills to emphasise during teaching either in the laboratory or field of play. A kinesiological analysis has the following components: description of a motion; evaluation of performance and prescription of correction.

3.1 Description of Motion

This is the breaking down of a motion into its constituent components. It is done in a logical and systematic fashion. According to Hamilton and Luttgens, (2002), the description of a motion involves four aspects that will help you focus on the essential nature of the motion you are analysing. The four aspects are primary purpose of the motion; phases of the motion; classification of the motion, and simultaneous-sequential makeup of the motion.

3.1.1 Primary Purpose of the Motion

Every movement related to sports, dance and exercise is performed for a purpose. Therefore, if you do not understand why a motion is being performed, you will not be able to evaluate how effective it is performed. Principally, speed, distance, coordination, form or accuracy, form the primary purpose of most movements. What is the primary purpose of 100 m dash? The focus is to cover 100 meter within the shortest possible time. So, emphasis is placed on speed. A standing long jump or broad jump is a movement where you take off with two, jump up and forward, landing on two feet. What will be the primary purpose of this motion? It will be to cover as much distance in the air from takeoff before landing on the two feet. So, distance is the focus. Identify other five motions and try to describe their primary purposes.

3.1.2. Phases of a Motion

This is the second element in the description of a motion during analysis. It recognises that motion analysis is best done when the motion is broken down into separate but observable parts or phases. In some motions, like throwing, these phases are easily separated. Have ever thrown a ball? If you have not, try it. You will observe that you easily identified where the throwing started.

A throw has the following phases: (1) Windup or preparatory phase, where your hand goes up and backward; (2) Throwing or propulsion phase, where your hand goes forward, and (3) Follow-through phase. Try throwing a ball again, this time bearing these three phases in mind. Standing long jump also has easily observable parts – the takeoff, flight in the air and landing. For this jump, you take off with two feet, project yourself into the air as you move forward, finally, you land on both feet. See figure 9 for the illustration of the standing long jump. You can see that the motion has a clear beginning and ending. Such motion is called discrete motion, (Hamilton and Luttgens, 2002). Motion like walking or running may not be easily broken into phases. This is because the motion appears to be continuous and usually repetitive in nature.

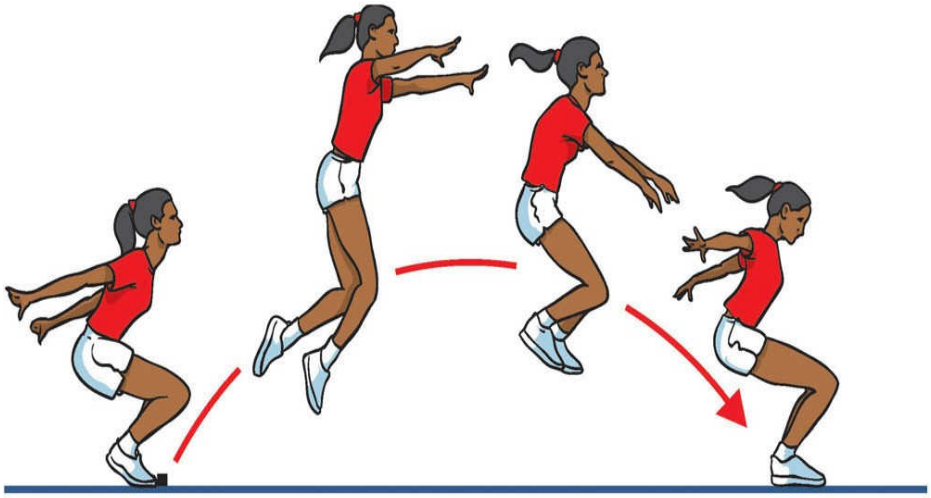

Figure 9: Illustration of the standing broad jump.

3.1.3. Classification of the Motion

In human kinetics, movements occur in many different forms and can serve many useful purposes. For instance, the teacher uses them to promote health, learning and in play. The coach athletic trainer uses them to produce beautiful performance. Each of these activities requires good understanding of the body (anatomy and physiology) and the mechanical laws involved in the motion.

Classification of motion involves determining first, the major category of the motion, then its secondary and where necessary, tertiary category of the motion. For example, the standing broad jump shown in figure 9, belongs to the major category giving motion to your body. The stance and repeated squatting on the solid base for takeoff belongs to the secondary category. The flight phase, starting from the takeoff and ending at the

moment the feet make contact with the surface (landing) belongs to the unsupported category.

There are many good reasons for you to consider classification of motion very important. Some of the reasons are:

1. It permits the organisation of the variety of potential movements into a manageable grouping.
2. Classification of motion facilitates the recognition of commonalities across movements.
3. It also fosters increased understanding by enabling you to focus on either difference or similarities in movement patterns.
4. When movement patterns and skills are properly classified, it provides additional clues to the nature of both the anatomical and mechanical demands of a given motion.

3.1.4. Simultaneous-Sequential Nature of the Motion

Your body can move in a variety of ways because your body is made up of joints. These joints are formed by bones. When the body moves in a variety of ways, the movements formed are usually complex, and need to be simplified for possible analysis. To do this simplification, it is important to understand that when motions are combined, as it is the case with many human movements, such movements may be classified as occurring on a continuum ranging from the simultaneous to the sequential use of the body segments. In simultaneous use of the body parts, many segments of the body move as one entity. This is seen when you push, pull or lift an object. Movement can occur anywhere along the simultaneous-sequential continuum. The movements like pushing and pulling occur at the simultaneous end of the continuum, and are classified as push-pull motions. Movements as striking, kicking and throwing occur at the sequential end of the continuum.

To help you understand and appreciate the nature of motion at any given stage of performance, movement will be broken down into phases. Using the standing long jump, the analysis of the nature of this motion follows this pattern:

1. Preparatory Phase: This involves simultaneous action of the joints of the lower limbs into a semi-squat position;
2. Take off Phase: This the execution or force phase that involves the simultaneous extension of the body segments in a forward-upward direction;

3. Flight Phase: This is also called the unsupported phase. It involves the sequential action of the lower limb which results in whipping the legs forward, and
4. Landing Phase: Here there is simultaneous flexion of the lower limb to absorb the force of the landing force.

Now that you have followed through the description of standing long jump as a motor skill, you have known the primary purpose of the motion, classified the motion and established the simultaneous-sequential nature of the motion. You are now prepared for the next component of kinesiological analysis which is the evaluation of the performance.

3.2. Evaluation of the Performance

Motion is analysed in terms of (1) the joint action, muscle action and function, and (2) the mechanical principles applied, (Honeybourne, Hill and Moors, 1996). In evaluating the motion from the starting point, you must consider the extent the performer conforms to the anatomical and mechanical requirements necessary to achieve the stated purpose of the motion. Violation of these principles during performance will produce a less than optimal performance on the part of the performer. Therefore, you need to be conversant with the anatomical and mechanical principles that are critical to the successful performance of the motion under analysis. Using the standing long jump, during the take-off, the following joint and muscle action are evaluated. Table 1 presents the joint and muscle activities during standing long jump.

Table 2: Joint and Muscle Action During Standing Long Jump Take-off

Joint	Joint Type	Movement to observe	Muscle involved	Muscle Function	Contraction
Elbow	Hinge	Extension	Triceps brachii	Primemover/agonist	Concentric
Shoulder	Ball and socket	Flexion	Anterior deltoid	Primemover/agonist	Concentric
Shoulder Girdle	Gliding	Upward rotation, abduction	Trapezius, seratus anterior	Primemover/agonist	Concentric
Spine	Gliding and cartilaginous	Extension	Sacrospinalis	Primemover/agonist	Concentric
Hip	Ball and socket	Extension	Gluteus maximus	Primemover/agonist	Concentric

Knee	Hinge	Extension	Quardriceps	Primemover/agonist	Concentric
Ankle	Hinge	Plantar flexion	Soleus	Primemover/agonist	Concentric

Source: Honeybourne, Hill and Moors, (1996).

Table 2 provides anatomical analysis of standing long jump take-off. The analysis is of a process rather than a product, that is, it is a review of how the body as a unit or its segment accomplishes the task rather than an in-depth examination of the performance, (Atare and Mong, 2005).

From Table 2, you can answer the following questions and many more:

1. What joints are involved in a standing long jump take-off?
2. What are the types of joints involved in the take-off?
3. What joint movements are involved in the take-off?
4. Which muscles are responsible for the joint movements?

In mechanical analysis of a given movement, the body is viewed as a machine. So, the body is subject to the mechanical laws and principles that govern machines. Honeybourne, Hill and Moors, (1996) provides the following tips to mechanical analysis of the standing long jump take-off:

1. The application of force at take-off needs to be in line with the center of gravity of the performer's body. If this is violated, the performer will jump slightly to one side, and then the horizontal distance jumped will be less than expected performance.

2. The horizontal distance expected in standing long jump is covered with the body in flight. Therefore, the speed of projection depends on the total impulse generated at take-off. Impulse is the product of force and time, (force x time). The force here is the combination of the forces exerted at the ankle, knee, hip and shoulder, (as shown in Table 1). The strength and speed of the contraction of the muscles around these joints determine, to a great extent, the distance jumped. Therefore, careful timing of the joint action is critical to optimise the applied force. For the standing long jump, the hip should initiate the movement, followed by the shoulders, knees and ankles.

3. The take-off is very important in optimum performance of the standing long jump. The amount of force that can be generated at take-off will increase the upward reaction force. This is the application of the Newton's law of motion. You will learn about the Newton's laws of motion in Unit 3 of Module 2.

4. The standing long jump has a preparatory phase that involves the swinging of the arms and flexion of the knees. If this is properly done before take-off, it will help to overcome inertia. Law of inertia is the Newton's first law of motion.

5. The swinging of the arms before take-off will increase momentum, (velocity x mass). This will add to the overall force of the take-off.

3.3 Prescription of Correction

Now that you have done the analysis of the standing long jump take-off, you are prepared to observe when anatomical and/or mechanical principles are violated. When any violation that makes for poor performance is observed, it's important that you make prescription for correction or improvement of performance. This prescription is usually made through instructions. Focus your instruction on the cause of the error rather than the result or signs of the error. With a sound knowledge of the cause of the error, be it anatomical and/or mechanical, you are better situated to make an intelligent prescription of correction.

SELF-ASSESSMENT EXERCISE

1. Which of the following is not part of the description of a motion?

(a) Simultaneous sequential nature of the motion
(b) Classification of the motion,
(c) Performance of the motion,
(d) Movement phase.

5.0 CONCLUSION

The coach, Human Kinetics or any other sports practitioner functions better if he possesses sound knowledge of anatomy and mechanics of human motion. The understanding of the meaning, objectives and principles underlying human movement are very critical in analysing and improving human movement.

5.0 SUMMARY

In this unit, you have learned the nature of kinesiological analysis of motion. This unit has exposed you to the components of kinesiological analysis. You are now prepared to describe a motion, anatomically and mechanically evaluate motion and prescribe correction when necessary. This unit also made it clear that you must work hard to have sound knowledge of the anatomical and mechanical principles that apply in human movement.

5.0 TUTOR-MARKED ASSIGNMENT

1. These are the stages of kinesiological analysis of motion except----------

(a) Correction of error,
(b) Description of the motion,
(c), Execution of the motion
(d) Evaluation of the motion.

2. When performing kinesiological analysis of motion, a motion with a defined beginning and ending is called----------

(a) Non-elastic motion,
(b) Discrete Motion,
(c) Continuous motion,
(d) None of the above.

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MODULE 2 MECHANICAL ASPECTS OF KINESIOLOGY

MODULE INTRODUCTION

This module will introduce you to the meaning, types and application of force to sports activities. You will learn about the internal and external forces and how you can apply then in human movement. You will also learn the meaning, types and application of lever to the human body. This module will further teach you Newton's laws of motion and their application. The units under this module are:

Unit 1 Meaning, Types and Application of Force to Sports Activities
Unit 2 Meaning, Types and Application of Friction to Human Movement
Unit 3 Meaning, Types and Application of Lever to the Human Body
Unit 4 Nature of Motion in Sports
Unit 5 Application of Newton's Laws of Motion to Sports Activity

UNIT 1 MEANING, TYPES AND APPLICATION OF FORCE TO SPORTS ACTIVITIES

CONTENTS

1.0 INTRODUCTION

Your understanding of motion analysis will help you to become interested in the cause of motion which is force. This unit is designed to teach you the meaning, and types of force as an important part of your effort to understand kinesiology. It will also prepare you to understand how force affects motion of an object.

2.0 INTENDED LEARNING OUTCOME (ILO)

By the end of this unit, you will be able to:

- discuss the meaning of force
- enumerate the types of force
- describe the features of force
- identify the major effect of friction on human movement.

3.0 MAIN CONTENT

3.1 Meaning of Force

Defining force has been seen as a near impossible task. Force is best described than defined. In fact, force can generally be defined by describing what a force can do. According to Newton's principles, objects can only move when acted upon by a force greater than the resistance to movement provided by the object. A force involves the interaction of two objects and produces a change in the state of motion of an object by pushing or pulling it. The force may produce motion, stop motion, accelerate, or change the direction of the object. In each case, the acceleration of the object changes or is prevented from changing. A force, therefore, may be thought of as any interaction, a push or pull, between two objects that can cause an object to accelerate either positively or negatively. It is the pushing or pulling action that one object exerts on another, (Bartlett, 2007).

A force is that which alters or tends to alter a body's state of rest or of uniform motion in a straight line. For example, when you push on the ground, you generate a forceful knee and hip extension, this may cause your body to accelerate upward and leave the ground. This is what Hamill, Knuzten, and Derrick, (2015), called a jump. Your body changed direction and position. If your body changes direction or speed, a force has been applied. The Standard International (SI) unit of force is the Newton (N) and the symbol for a force vector is ***F***. One Newton is the force that when applied to a mass of one kilogram (1 kg), causes that mass

to accelerate at 1 m/s2 in the direction of the force application, (Bartlett, 2007).

A force is also seen as a straight-line push or pull, usually expressed in kilograms (kg) or Newtons (N), as you have seen. The symbol for force is F. Recall that this push or pull is an interactional effect between two bodies. Sometimes this "push" appears obvious as in a ball hitting the goal post, while other times the objects are quite distant as with the "pull" of magnetic or gravitational forces. Forces are vectors, and vectors are quantities where size, units, and direction must be specified, (Knudson, 2007).

Consider some sports examples of the effects of force. This consideration will be guided by the following five effects of force on an object:

1. A force can cause a body at rest to move.
2. A force can cause a moving body to change its direction.
3. A force can cause a moving body to accelerate or move faster.
4. A force can cause a moving body to slow down or decelerate.
5. A force can also cause a body to change its shape. You can see this clearly in a balloon. Hold an inflated balloon between your palms. Now, apply a force on it by pressing your palms together (see figure 10). What did you observe? You must have observed that on pressing the balloon, its shape changed. So, can you now see that when force is applied on a body or an object, the shape of such a body or object can be changed? Can you try this with another object?

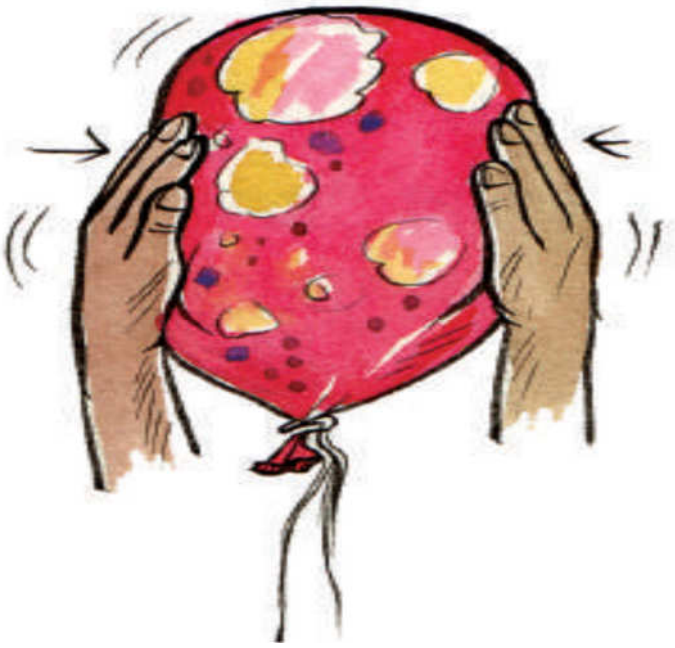

Figure 1: The Shape of a Balloon Changes when Force is applied

In athletics, a sprint, (100 m dash) starts on a starting block. The runner in figure 11 will remain on the block unless force acts on him. With the force from the muscles of the lower limb and the arm, he pushes on the starting block. In a swift reaction, the block pushes back on the sprinter causing him to change direction from the block. A greater force out of the block will make the runner to accelerate down the track. Most sprints are run outdoors or in open air stadium. This exposes the sprinter air resistance. This air resistance will decelerate or slow down the sprinter unless he has greater force. As the sprinter exerts great force on the block, his shoes will expand thereby changing shape. You will also notice this change in the shape of the shoes when the foot hits the ground depending on the size of the force.

Figure 11: A Sprinter in a Starting Position on the Starting Block

Soccer is an exciting and most popular sport in this part of the world. One of its exciting features is the penalty kick. In a penalty kick, two players are involved: the one kicking the ball and the goal keeper who tries to stop or change the direction of the kicked ball. Force affects many aspects of the penalty kick. For instance, the ball is at rest, but only moves when the foot exerts force on it. As the ball move, the force from the goal keeper's hand will cause it to change its direction. The force from the keeper's hand can also decelerate or slow down the movement of the ball. The air resistance (wind) can even decelerate the ball. A greater force from the foot will accelerate the ball. When the foot kicks the ball with great force, the ball changes its shape at the point of contact.

Figure 12: A Goal Keeper Stopping a Moving Ball from a Penalty Kick with Force He Generated

Now you have seen the effect of force during a sprint start and a penalty kick, have your friend execute volleyball service under your watch and record the action with your video recorder. Watch the video and describe the effect of force on the ball.

3.1 Types of Force

Now you are going to consider the different types of forces and how they are classified. Forces can be classified as internal or external. The human body in general and a sports performer, in particular, experience the effect of both internal to and external to the body.

3.2.1. Internal Forces

Internal forces are forces that act within the body, an object or system whose movement is under investigation. With internal forces, the action and reaction forces act on different parts of the body or object. Each of these forces may affect the part of the body it acts on, but the two forces do not affect the motion of the whole body because the forces act in opposition, (McGinnis, 2013).

The muscle is the major source of internal force on the human body. The human body is a system of structures—organs, bones, muscles, tendons, ligaments, cartilage, and other structures. Though the structures exert forces on one another, internal forces are generally generated by the muscles and transmitted by the other structures - tendons, bones, ligaments and cartilage. For example, when muscles pull on tendons, they pull on bones. At joints, bones push on cartilage, which pushes on other cartilage and bones. If pulling forces act on the ends of an internal structure, the internal pulling forces are referred to as tensile forces, and the structure is said to be under tension. If pushing forces act on the ends of an internal structure, the internal pushing forces are referred to as compressive forces, and the structure is said to be under compression. Do you remember these forces? They were discussed under sports injury mechanisms in KHE 256 – First Aid and Prevention of Sports Injuries.

Internal forces hold things together when the structure is under tension or compression. Sometimes the tensile or compressive forces acting on a structure are greater than the internal forces the structure can withstand. When this happens, the structure fails and breaks. Structural failure in the body occurs when muscles pull, tendons rupture, ligaments tear, and bones break. If any of these takes place during exercise or sports, what injury occurs? It is called sports injury. When you land on the ground after jumping upward, the bones of your legs are compressed because of the vertical impact pushing upward on your body and the inertia of your body’s momentum pushing you downward. The compression, if excessive, could cause injury when they act on structures, such as ligaments, tendons, and bones.

Internal force can also be illustrated using a snooker game. Snooker is played on a board and balls. One of the balls is white in colour and is called the cue ball. When the play hits the cue ball, if the cue ball hits a ball that hits another ball directly, it is internal force, because it is within the same system, but if the cue ball or another ball hits the wall of the board before hitting any other ball, it is external force. Figure 13 shows a snooker board with the balls.

Figure 13: A Snooker Board showing the Cue Ball (White)

3.2.2. External Forces

When you are asked to mention forces, the forces that will come to your mind are usually external forces. These are forces that act on the body or object from outside. External forces act on a body or an object as a result of its interaction with the environment surrounding it. McGinnis, (2013), classified external forces as noncontact forces or contact forces. Noncontact forces are forces that occur even if the objects are not touching each other. The gravitational attraction of the earth is a noncontact force and it is the one that concerns you in sports and exercise. Other noncontact forces include magnetic forces and electrical forces. The force of gravity acting on an object is defined as the weight of the object.

Most of the forces you remember or think about are contact forces. Contact forces occur when objects are in contact or touching each other. The objects in contact can be solid or fluid. Air resistance and water resistance are examples of fluid contact forces. The most important contact forces in sport and for your attention occur between solid objects, such as the athlete and some other objects. For instance, when an athlete

hits the ground with the foot, the foot causes an action downward and backward, and then the ground reacts by pushing the foot upward. The ground in this instance is producing a reaction force called ground reaction force, (GRF). Reaction forces are the forces that the ground or other external surface exerts on the sports performer as a reaction to the force that the performer exerts on the ground or surface. This principle will be explained in the Newton's third law of motion also called the law of action–reaction, (Bartlett, 2007). A ground reaction force is generated any time you push against the ground because the ground pushes back. When you push against the ground, it is action and when the ground pushes back, this is reaction. Ground reaction forces can be created in any direction—sideways, vertically, forward, or backward, (Hoffman, 2009). Figure 14 illustrates a contact force with a ball. The ball is on the ground (contact) and pushing down on it (action) and the ground is pushing up on the ball (reaction).

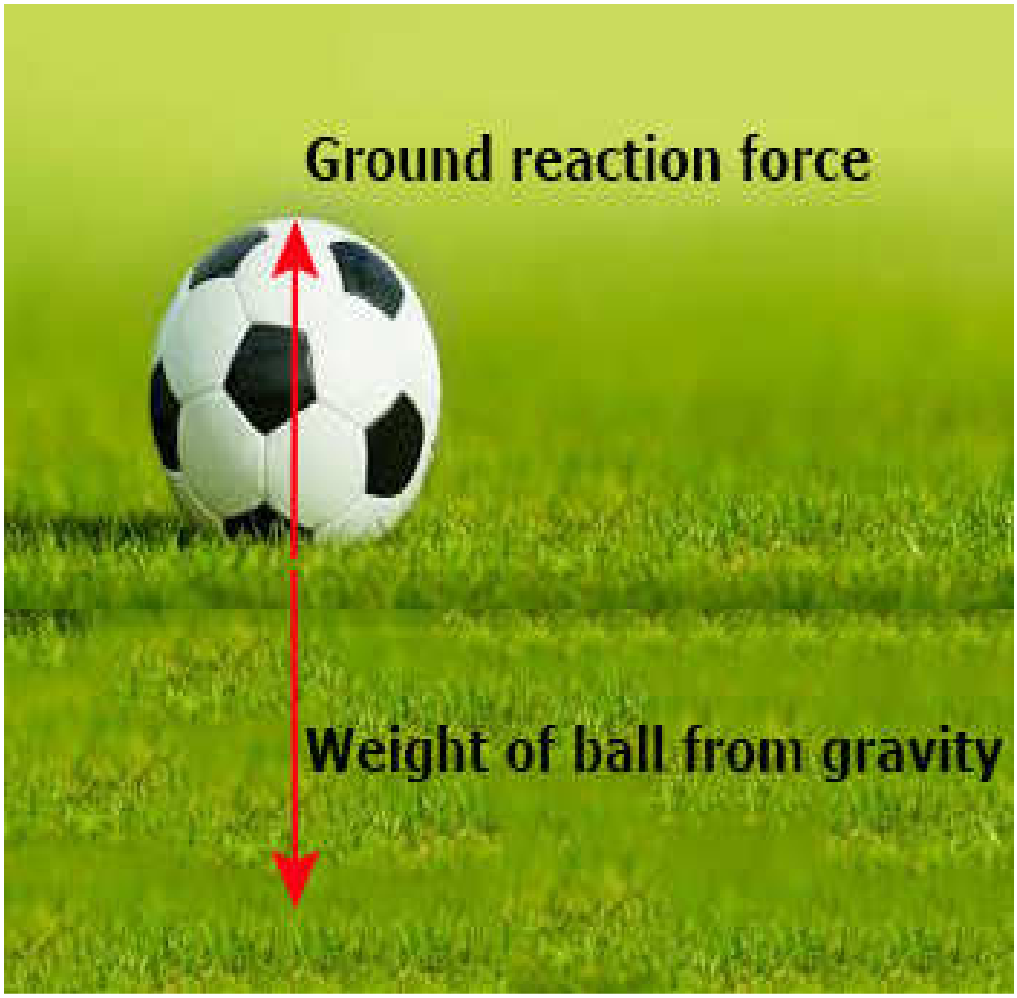

Figure 14: A ball as an object in contact with the ground showing contact force

You have learnt that the most important contact forces in sport occur between solid objects, such as the athlete and some other object. Consider

the shot-putter – for a shot-putter to put the shot, he must apply a force to it, and the only way the athlete can apply a force to the shot is to touch it, (contact). You may have tried jumping, to jump up in the air; you must be in contact with the ground and push down on it. The reaction force from the ground pushes up on you and accelerates you up into the air. To accelerate yourself forward and upward as you take a running step, you must be in contact with the ground and push backward and downward against it. You also experience contact force while walking.

Contact forces are expressed in two components or forms – normal contact force and friction, (you will consider friction in Unit 2).

Normal contact or reaction force is the component of contact force that acts perpendicular to the surfaces of the objects in contact and the component of force that acts parallel to the surfaces in contact. The word normal refers to the fact that the line of action of this force is perpendicular to the surfaces in contact. Simply put, the normal reaction is the force at right angles to the surfaces in contact. Recall what you learnt about the sprinter and the ground, illustrated in figure 11. When the runner hits the foot on the round, he pushes down and backward on the ground, the normal contact force is the component of force that acts upward on the runner and downward on the ground.

3.3 Features of Force

You have learnt that forces are vectors. They possess both a magnitude and a directional quality as other vectors. The directional quality is indicated by the direction in which the force acts and by the point on an object at which the force acts, called point of application. Alternatively, the total directional quality of the force can be given by its line of action. So, force has four features that influence its effect on an object. These four features are the unique properties or characteristics of force. All these characteristics must be identified and taken into consideration when describing force. This is because a change in any of them will change the nature of the movement. For you exert a force of little magnitude on the book in the case study, you will produce no movement. Now, consider the unique properties of force, they are as follows:

Magnitude of Force: This is the size or amount of force that is being applied. The magnitude of force is measured in Newtons (N) in the metric system or pounds (lb) in the English system as used in United States of America. It shows how much force is applied. The magnitude of force refers to the weight of a body or an object. Weight is expressed as mass multiplied by the acceleration due to gravity. Symbolically, weight (w) = mass (m) x acceleration due to gravity (g), or

$$w = m \times g \text{ or } w = mg$$

When you hold, for instance, a ball in your hand, you feel the pull of gravity as the weight of the ball. This ball will remain in your hand as long as an equal and opposite force acting between your hand and the ball balances the downward force of gravity. When the force from the hand, which is muscular, is reduced or even removed, the ball will drop downward off the hand to the ground. This downward drop of the ball is as a result of the force of gravity. A muscle's force or magnitude of muscular force is determined by the size and the number of the fibres contained in the muscle generating the force under consideration.

Direction of Force: This is the sense of a force along its line of action. Recall that force is a push or pull, so, force is applied by pushing or pulling. These two directions (sense) produce different effects. It describes the way the force is applied, which can be forward, vertically upward or perpendicular to surface. If a single force is applied to a body or an object through its centre of gravity, the body or object will move in the same direction as the force. Force of gravity has been described as pulling objects towards the earth. Therefore, the direction of the force of gravity is vertically downward.

Point of Application: This is the point on an object where force is applied. Where gravity is a concern the point or position is always through the center of gravity of an object. When you apply the force slightly off the center of gravity, it will produce an angular motion. For example, if you hit a snooker ball off-centre, it will spin. You observe this also in soccer when players execute direct free kicks. When the player applies the force slightly off the centre of the ball, it spins and curves.

Line of Action of Force: This is the action line of force. It can be upward or horizontal. For instance, 5N force acting on a body downward on a table will produce an entirely different effect from that of 5N force acting on a table horizontally.

These features of force must be supplied for full description of force. Sports performers must through training learn to gauge how much force to apply in any given situation. If you are performing a free throw in basketball, which is a closed skill, you are at an advantage because these properties will the same each time you perform the throw. Hence, practice is highly recommended. If you are coaching soccer player to play free kicks, which is an open skill, very well, you will observe that these features of force will not be the same each time the player executes the kick. They will vary each time the kick is performed and errors can be made. The player may not connect with the ball correctly, causing the ball

to veer off to one side. You can correct this error by pointing out the basic mechanical weaknesses in the free kick technique.

SELF-ASSESSMENT EXERCISE

1. Which of the following is not a feature of force?

(a) Direction of force
(b) Power of force
(c) Point of application
(d) Line of action

4.0 CONCLUSION

As a Human Kinetics practitioner, coach or any other sports practitioner, you can only function better if you possess a sound knowledge of the nature of force. The understanding of the meaning, types and features of force are very critical in responding to training issues related to human movement.

5.0 TUTOR-MARKED ASSIGNMENT

1. The following are the effects of force on an object except---

(a) A force can cause a moving body to change its direction,

(b) A force can cause a moving body to slow down,

(c) A force can cause a moving body to move faster.

(d) A force can cause a body at rest to sleep.

2. The force at right angles to the surfaces in contact is called---------

(a) Surface force
(b) Moving force
(c) Normal reaction
(d) Normal action

6.0 SUMMARY

In this unit, you have learned the ways to describe force. This unit has also exposed you to the classifications and features of force. It also made clear the various things to observe when you want to identify the effect of force on a body or an object. The object or body may accelerate, slow down, change direction, move or stop moving**.**

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UNIT 2 MEANING, TYPES AND APPLICATION OF FRICTION IN SPORTS ACTIVITIES

CONTENTS

Your understanding of the meaning, types and application of frictions in sports activities will help you to become interested in the cause of friction. This unit is designed to teach you the meaning, and types of friction as an important part of your effort to understand kinesiology.

2.0 INTENDED LEARNING OUTCOME (ILO)

By the end of this unit, you will be able to:

- discuss the meaning of friction
- enumerate the types of friction
- describe the features of friction
- identify the major effect of friction on human movement.

3.1 Meaning of Friction

Remember, you have been made to learn that normal reaction is the force at right angles to the surfaces in contact. In that same contact, friction is the force acting in parallel to the surfaces. Friction is the force resisting the sliding of the surfaces past each other. It is tangential to the contact surface. Take your mind back to the sprinter, when he pushes down and backward on the ground during a running step, the frictional force is the component of force that acts forward on him and backward on the ground. The frictional force is the component of the contact force responsible for changes in the runner's horizontal motion. Frictional forces are primarily responsible for human locomotion, so it is very essential that you understand friction, (McGinnis, 2013).

Friction is also called traction. Traction is the term used when the force is generated by interlocking of the contacting objects, such as spikes

penetrating a Tartan track used for track events in athletics. This interaction between objects is known as form locking. In friction, the force is generated by force locking, in which no surface penetration occurs. Without friction or traction, movement in sport would be very difficult, (Bartlett, 2007). Figure 15 shows your foot of the sprinter pushing downward and backward on the ground. The frictional force is parallel to the two surfaces, that is, the shoe and the ground which produced a form locking. Without friction, the foot would slide to the side, forward or any direction. When that happens sports injury might occur.

Figure 15: A Sprinter's Foot Exerting Force Downward and Backward on the Ground

3.2 Types of Friction

Friction is described in two forms – dry and fluid friction. Dry friction is the friction that acts between dry or non-lubricated surfaces of solid objects or rigid bodies in contact and acts parallel to the contact surfaces. Friction arises as a result of interactions between the molecules of the surfaces in contact. There are two types of dry friction – static and dynamic.

(1) Static (non-moving) friction which is the friction that occurs when dry friction acts between two surfaces that are not moving relative to each other. Static friction is also referred to as limiting friction when we describe the maximum amount of friction that develops just before two surfaces begin to slide.

(2) Dynamic friction is the second type of dry friction. It occurs when dry friction acts between two surfaces that are moving relative to each other. Other terms for dynamic friction are sliding friction and kinetic friction.

Note that when the two surfaces are dry, the force of friction is equal to the product of the coefficient of friction and the normal reaction. The coefficient of friction is the ratio of friction force over normal contact force. The coefficient of friction depends on the nature including the texture of the two surfaces in contact, and is established through experiment. There are coefficients of static (non-moving) friction and dynamic or kinetic (sliding) friction. The coefficients of dynamic friction are typically 25% smaller than the maximum static friction.

In human movement, typical coefficients of friction vary widely. Athletic shoes have coefficients of static friction that range from 0.4 to over 1.0 depending on the shoe and sport surface. In tennis, for example, the coefficients of friction range from 0.4 to over 2.0, with shoes responding differently to various courts, (Knudson, 2007). There are artificial turf, clay court and cement base courts. It has been shown that playing on clay courts which are lower-friction courts had a lower risk of injury. While many teams that play on artificial turf use flat shoes rather than spikes to lower friction thereby decreasing the risk of severe injury.

Fluid friction is that which develops between two layers of fluid and occurs when dry surfaces are lubricated. The behaviour of fluid friction is complicated; and because fluid friction occurs less frequently in sport, you will not consider it in detail at this level.

3.2 Application of Friction to Human Movement

Friction is an important force in every sport and human movement. Every motion that makes you move from point “A” to “B” (Locomotion) requires frictional force; hence, the shoes players wear are designed to provide proper frictional forces between their feet and the supporting surface. Consider some sports examples that show how frictional forces are manipulated (that is: increased or decreased):

1. In most athletic events, shoes are worn. These shoes are to provide large frictional forces, so the materials used for the soles must have large coefficients of friction.

2. In some activities, sliding is desirable. Examples of such activities include dancing and bowling. The soles of the shoes used for these activities have smaller coefficients of friction.

3. In snow skiing, small frictional forces are needed, so to get it, the skiers wax the bottoms of their skis to decrease the coefficient of friction.

4. In racket sports and other sports involving implements, large frictional forces are desirable so that the players don't lose hold of the racket or implement. The grips are made of material such as leather or rubber, which have large coefficients of friction. The grips can even be manipulated to increase their coefficients of friction by wrapping athletic tape on them, spraying them with tacky substances, or using chalk on our hands. You may have seen weightlifters apply chalk powder on their palms before holding the bar. The powder is applied to increase the coefficients of friction.

In everyday activities, the friction between your footwear and floors is important in preventing slips and falls. So, always make sure that your footwear is always appropriate and proper for the floor or ground it is contacting.

Place one of your textbooks on a flat tabletop. Push sideways against the book and try to feel how much force you can exert before the book begins to move. Did you notice that a force is resisting the force that you exert on the book and prevents the book from sliding? What force is that? The resisting force is static or non-moving friction, which is exerted on the book by the table. If the book does not move or slide, then know that the static friction force acting on the book is the same size as the force you exert on the book, but in the opposite direction. Add two more books on the one on the table, push again and see if you will move them with the same amount of force or not.

SELF-ASSESSMENT EXERCISE

1. The force acting in parallel to the surfaces in contact is called----
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(a) Contact force
(b) Power force
(c) Normal force
(d) None of the above.

4.0 CONCLUSION

As a Human Kinetics practitioner, coach or any other sports practitioner, you can only function better if you possess a sound knowledge of the nature of force. The understanding of the meaning, types and features of

force are very critical in responding to training issues related to human movement.

5.0 SUMMARY

In this unit, you have learned the ways to describe force. This unit has exposed you to the classification and features of force. It also made the various things to observe when you want to identify the effect of force on a body or an object. The object or body may accelerate, slow down, change direction, move or stop moving.

6.0 TUTOR-MARKED ASSIGNMENT

1. Shoes that have smaller coefficients of friction are suited for ----------

(a) Sprinting

(b) Boxing

(c) Dancing.

(d) Jumping.

2. The friction that occurs when two moving surfaces are in contact is called---

(a) Elastic friction
(b) Plain friction,
(c) Static friction
(d) None of the above

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Bartlett, R. (2007). *Introduction to Sports Biomechanics: Analysing Human Movement Patterns*, (2nd ed.). United Kingdom: Routledge.

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UNIT 3 MEANING, TYPES AND APPLICATION OF LEVER TO HUMAN BODY

CONTENTS

1.0 INTRODUCTION

Your body has the skeletal and muscular systems which work together to move your whole body or its parts. Some of your body parts can be thought of as simple machines or levers. So, the human body moves through a system of levers. Levers cannot be changed, but they can be utilised more efficiently. In the previous unit, you learnt that the body exerts force to move the body. When muscles contract, they pull on the bones to bring about movements. The muscles alone will not bring about the movement of your body parts, the bones are usually involved in producing movement. The bones are known as anatomical levers. This unit will teach you the lever and its application in human movement. You will learn the meaning of lever and its classifications. You will also identify the human body and mechanical examples of the three classes of lever.

2.0 INTENDED LEARNING OUTCOME (ILO)

By the end of this unit, you will be able to:

- describe a lever system
- illustrate the three classes of a lever system
- identify one human example for each of the three classes of lever

- explain the condition for gaining mechanical advantage.

3.0 MAIN CONTENT

3.1 Lever System

When force is generated, such force produces motion in the form of rotation about an axis. If the rotation is about a fixed point, it introduces the concept of lever. What then is a lever? A lever is a rigid plank, bar or rod that rotates about a fixed point or axis called the fulcrum or pivot. A lever is made up of the following components, (see figures 16 and 17):

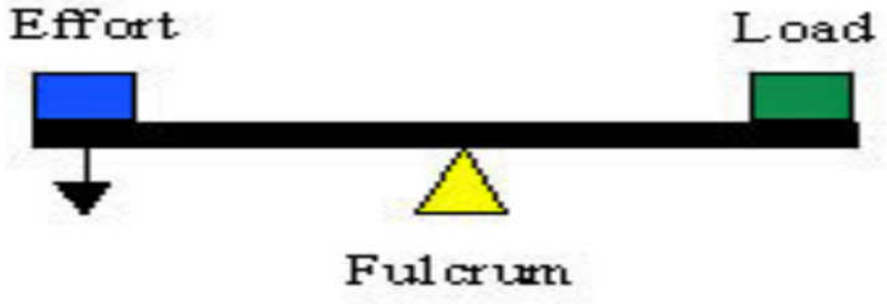

Figure 26: A Simple Lever showing effort, fulcrum and load.

1 Resistance Force: This is the output force (also called the load). It is the force applied by the lever to move the load.

2 Applied Force: This an input force (also called the effort) applied to the lever.

3 Bar-like Structure: This is the rigid bar, which, in your body is represented by your bones. Remember your bones have been described as anatomical levers. Your Joints are the axes and Muscles contract to apply force. Note that for your arm, leg or any body part to move, the appropriate muscles and bones must work together as a series of levers, (Tabassun and Mondal, 2016).

4 . A Fulcrum: This is the point at which the lever rotates. It is the axis is a point of rotation about which lever moves. Levers rotate about an axis when force is applied to it. This force is also called the effort, (E) and it is being applied to cause the movement of the lever against a resistance or load.

5 Moment or Lever Arms: There are two moment or lever arms designated as the effort arm and the resistance arm. The effort arm is the perpendicular distance from the line of action of the effort force to the fulcrum. The resistance arm is the perpendicular distance from the line of action of the resistance force to the

fulcrum. The effort and resistance forces act at a distance from the fulcrum; hence, they create torques about the fulcrum.

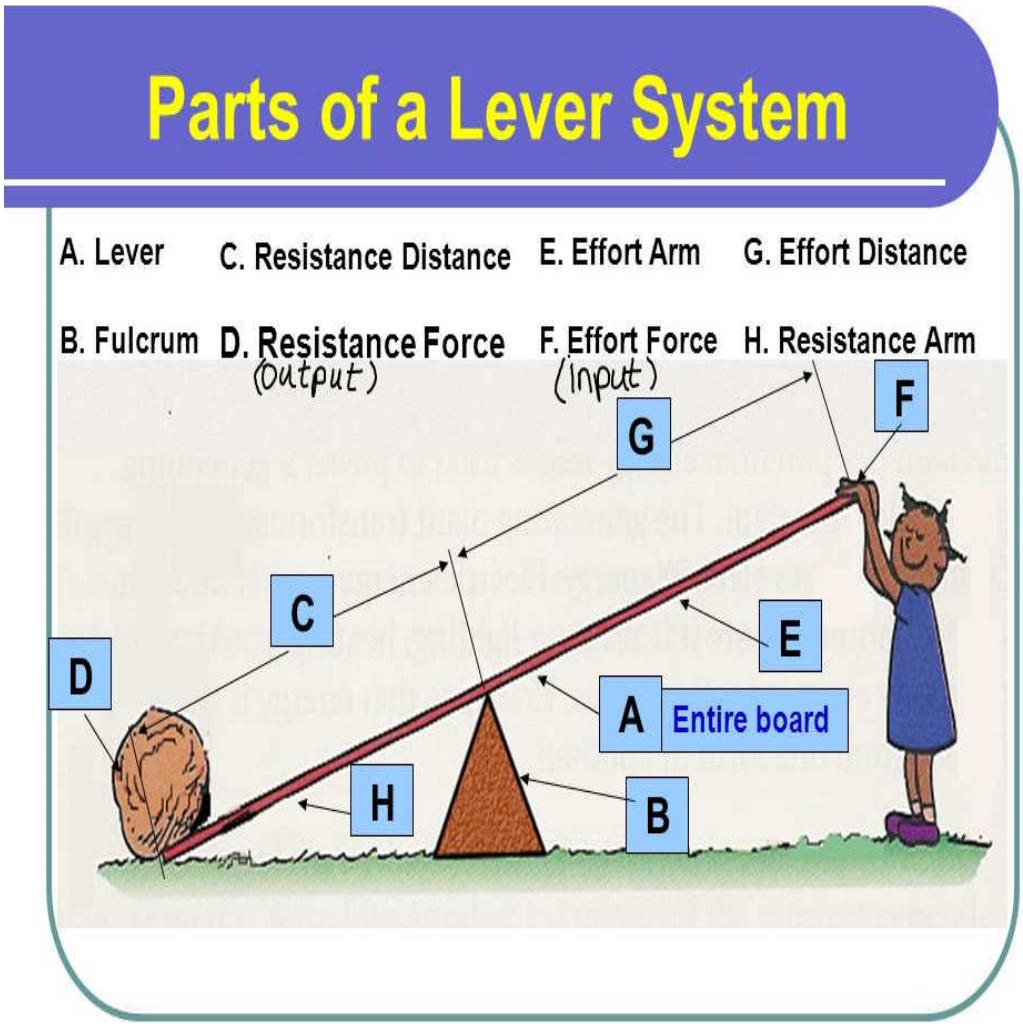

Figure 17: Illustration of the various components of a lever**.**

3.1.1 Functions of Lever

"Give me a lever long enough, and a prop strong enough, and I can single-handedly move the world".

This statement is credited to Archimedes by Johnson, (1991; 31) when he, that is Archimedes, talked about lever action, torques, and forces.

The statement shows the lever functions it performs in movement of the body or an object. You use lever in your everyday life, no matter where you are or what you do. How do you open your tin of liquid milk? Very likely, you pick may be a knife, place the pointed end on the top of the tin and then punch it. You may have used the bottle opener to open your drink instead of using your hand. You may have also used a screw driver to pry open a tin of your favourite beverage. These openers are simple external levers used in domestic activities. In the workshops or around your house,

it is very likely that you have seen workers use the crowbars, pliers or wheelbarrows to make their work easier. These are also levers. Each of them has applied force (effort), point of rotation (fulcrum) and a load or resistance to overcome which is usually greater than the force applied. Lever has two basic functions –

(1) To overcome a resistance larger than the applied force or effort, and
(2) To increase the distance a resistance can be moved by applying an effort or force greater than the resistance or load, (Atare and Mong, 2005). The second function is simply saying that lever provides strength or improves the range of motion.

You have learnt that levers are normally used to make physical work easier. It makes it easier for you to move something that is heavy, or to move something quickly. When you exercise or engage in physical activities most of your movements will involve the use of levers. This is very evident when you run, lift weights, kick or throw a ball. A lever system within the body (called internal lever) would use a lever (bone) to move an object. This is the case when you run where your body is the object being moved, but when you kick a ball, the object being moved is the ball.

3.2 Principles of Lever

The principle of lever states that, a lever will balance or turn uniformly about the point of support when the product of the force or effort and (×) force arm equals (=) the product of the resistance or load and (×) load or resistance arm, (F × FA = R × RA). This principle is applied in the two basic functions of lever as explained in the following two purposes of lever.

1. Whenever the moment arm of an applied force is greater than the moment arm of the resistance, the magnitude of the applied force (effort) needed to move a given resistance is less than the magnitude of the resistance or load.

2. When the resistance arm is longer than the force arm, the resistance or load may be move through a relatively larger distance, (Hall, 1995).

The principle of lever will help you to calculate the magnitude or size of force needed to balance a known load or resistance by means of a known lever. It will also help you to calculate the point at which to place the fulcrum in order to balance a known resistance with a given force or

effort, (Hamilton and Luttgens, 2002). So, when you have any three of the four values in the principle, you can calculate the unknown value using the equation of the principle –

$$F \times FA = R \times RA$$

This equation is also called the lever equation. It further shows the importance of the length of lever arm determining the magnitude of force required to balance a given load or resistance. If you increase the length of force arm (FA) without adjusting R × RA, you will see that the size of force needed to balance the lever must decrease. On the other hand, if you increase the resistance or load arm (RA) the magnitude of applied force must increase. When force arm is longer than the resistance arm, the lever will favour force. Such a lever will require less force to move a resistance, (mechanical advantage). Such a lever will not favour speed or range of movement (distance). A lever will gain speed or range of movement when you increase the resistance arm to be longer than the force arm. In such a lever mechanical advantage is lost as speed and distance are favoured. With this lever, you can move a light weight object faster and to a greater distance.

3.2.1. Mechanical Advantage

Lever is a machine that makes it easy for you to do work by reducing the magnitude of force you have to apply to do the work. How will you feel if you acquire a machine that does not do what you want? No doubt, you will not be happy. This is because the machine is not efficient or good or is not making it easier for you to do your work. From what you have learnt about lever, you can actually determine if a machine is efficient or inefficient, in other words, good or poor. There are two ways you can do that: (1) Measure the efficiency of the machine in terms of its mechanical advantage, and (2) Show the output of the machine in relation to the input.

In a lever, the force applied is the input while the output is the load or resistance, (See figure 15). So, the efficiency of a machine is the ratio between the force applied to the lever and the resistance the lever is to overcome. This ratio is the mechanical advantage. Mechanical advantage (MA) is a quantitative expression of the mechanical effectiveness of a lever to move a load or resistance, (Hamilton and Luttgens, 2002; Hall, 1995; Hall, 2004).

The mechanical advantage of levers may be determined using the following equations:

Mechanical advantage = Resistance (F_{out}) / Force (F_{in})

Or

Mechanical advantage = Length of force arm/ Length of resistance arm

Example:

You pried open a small tin of paint by applying a force of 50 N to the handle of your screwdriver and the screwdriver overcame a resistance of 250 N. What is the mechanical advantage of the screwdriver?

Solution:

You know F_{out} as 250 N; F_{in} as 50 N; But MA =? (Unknown)

MA = Resistance (F_{out}) / Force (F_{in})
= 250 / 50
= 5 N.
You can confirm if this answer is correct by simply multiplying it by F_{in} (50 N). The result will be the F_{out} (250 N).

Practice:

You opened a bottle of your favourite drink by applying 45 N to the bottle opener which in turn overcame a load of 355 N. What is the mechanical advantage of the bottle opener? Remember to confirm your result.

3.3 Classification of Lever

There are three types of levers usually called first class, second class and third class levers. The difference between the three classes of lever depends on where each of the components (force, fulcrum and load) is located in the system.

3.3.1. First Class Lever

In the first class of lever the fulcrum (axis or pivot) is located between the applied force or input and the load or resistance or output, (See figure 18). The applied force and the resistance are situated at the opposite ends of the fulcrum. Mechanical examples of a first class lever are a crowbar, pliers, seesaw and scissors.

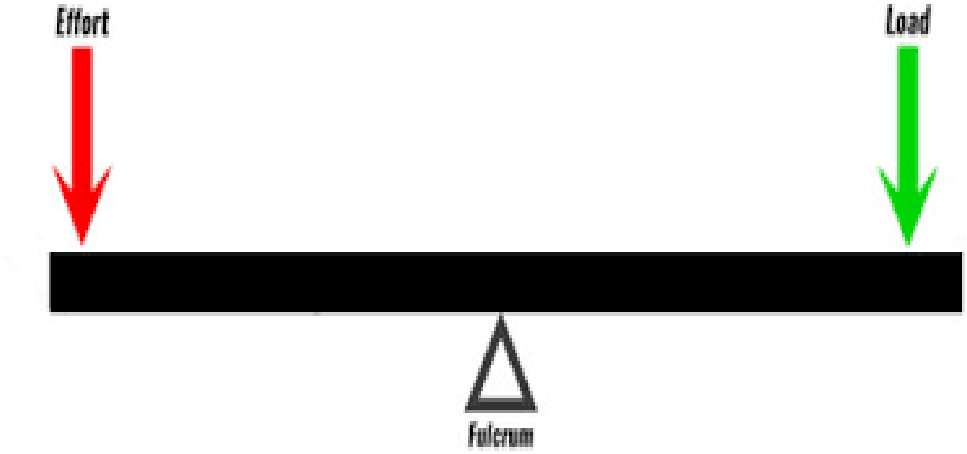

Figure 18: Arrangement of First Class Lever.

In a first class lever, the applied force and the effort may be at equal distance from the fulcrum 0r axis, or one may be further away from the other. A first class lever will produce balanced motion when the fulcrum (axis or pivot) is at the middle of the applied force (effort) and resistance (load). This is the case with the seesaw shown in figure 19.

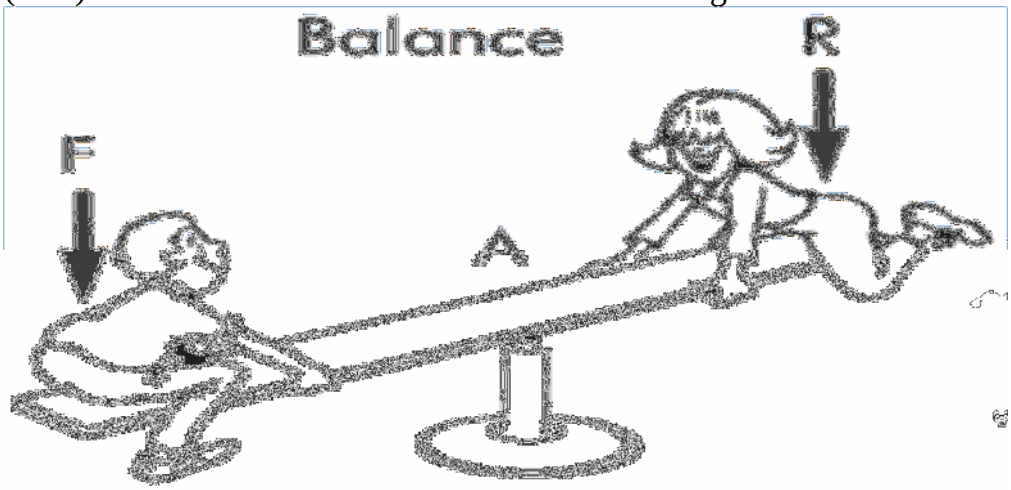

Figure 39: A Balanced First Class Lever showing the Axis (A) or Fulcrum at the Middle of Applied Force (F) and Effort (E) in a Seesaw.

A first class lever will produce speed and range of motion when fulcrum or axis is close to force, as in the case with scissors. This is illustrated in figure 20.

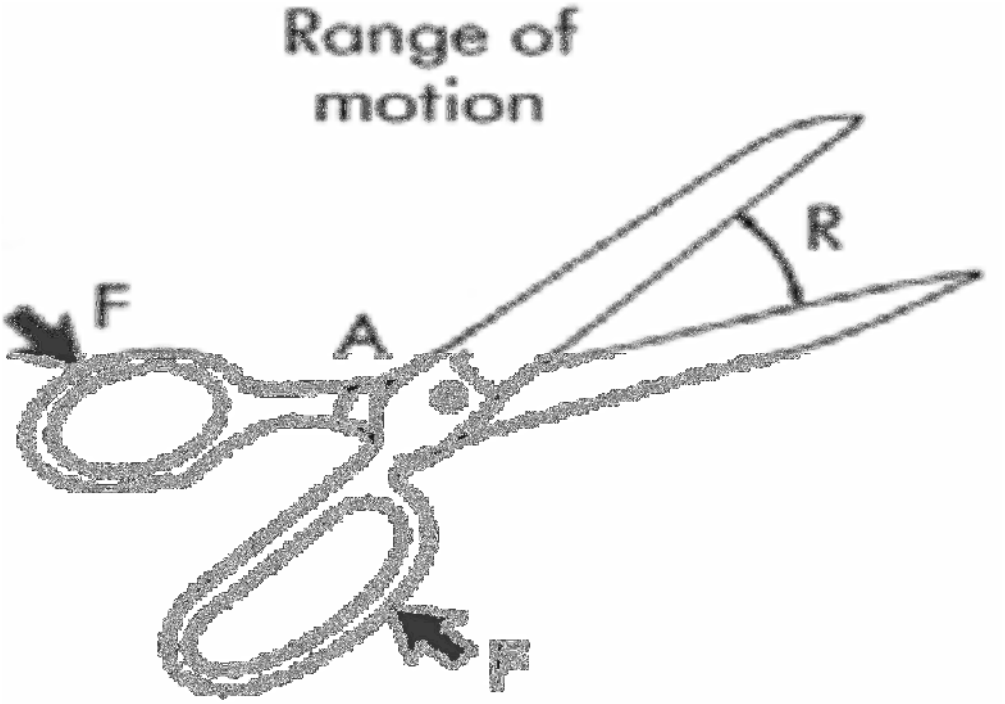

Figure 20: Scissors showing the axis closer to the Applied Force than the Effort.

The resistance or load may also be closer to the axis or fulcrum than the effort. This arrangement will produce force, (see figure 21). Such a lever favours mechanical advantage.

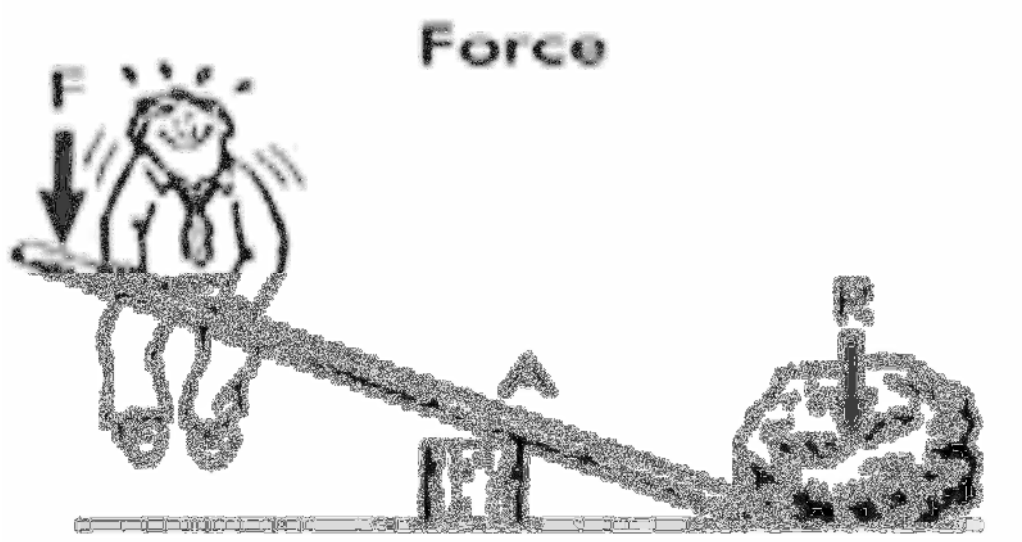

Figure 21: A First Class Lever showing the Axis Closer to the Resistance than the Applied Force.

The human body has very scanty number of the examples of the first class lever. It is only in the extension of the elbow and the in the nodding of the head that you can see arrangements of structures in the body similar to the arrangement of the components of the first class lever. Remember that in the first class lever, the fulcrum or axis is placed between the applied force

and the resistance. Now, consider the examples mentioned – the elbow extension and the nodding of the head. The elbow extension involves the triceps (that applies the force), elbow (the fulcrum or axis) and the forearm and the hand as the load, (See figure 22). The triceps applies force to the olecranon process of ulna behind the axis of elbow joint. As the applied force exceeds the amount of forearm resistance, the elbow extends.

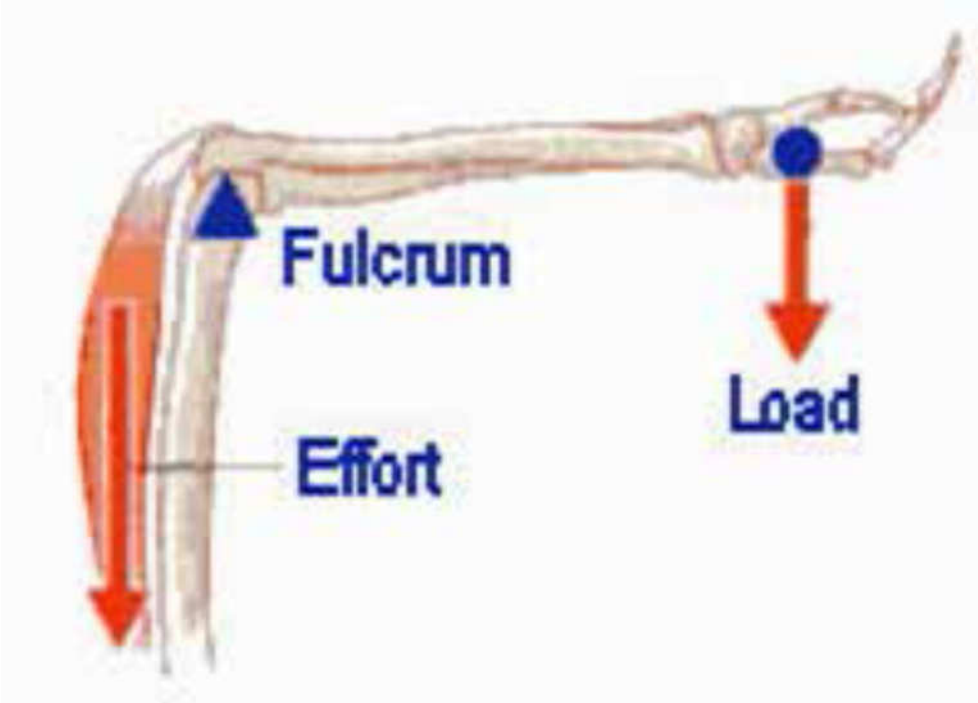

Figure 22: The Structures that form the elbow showing the Effort (Triceps), Fulcrum (Elbow) and Load (Hand).

Nodding of the head is another example of a first class lever system in the body. This movement is important in sport where you watch the flight of an object like a ball in the air. In this instance, the load will be the weight of the head. Nodding means tipping of the head forward and backward. The applied force is generated by the extensors of the head, while the resistance or load to the movement is from the weight of the head and the tension of the antagonistic muscles, (see figure 23). The joint formed by the atlas and the occipital, called the atlanto-occipital joint, is the fulcrum or axis in nodding, (Hamilton and Luttgens, 2002; Hall, 1995). Figure 23 illustrates nodding as a first class lever.

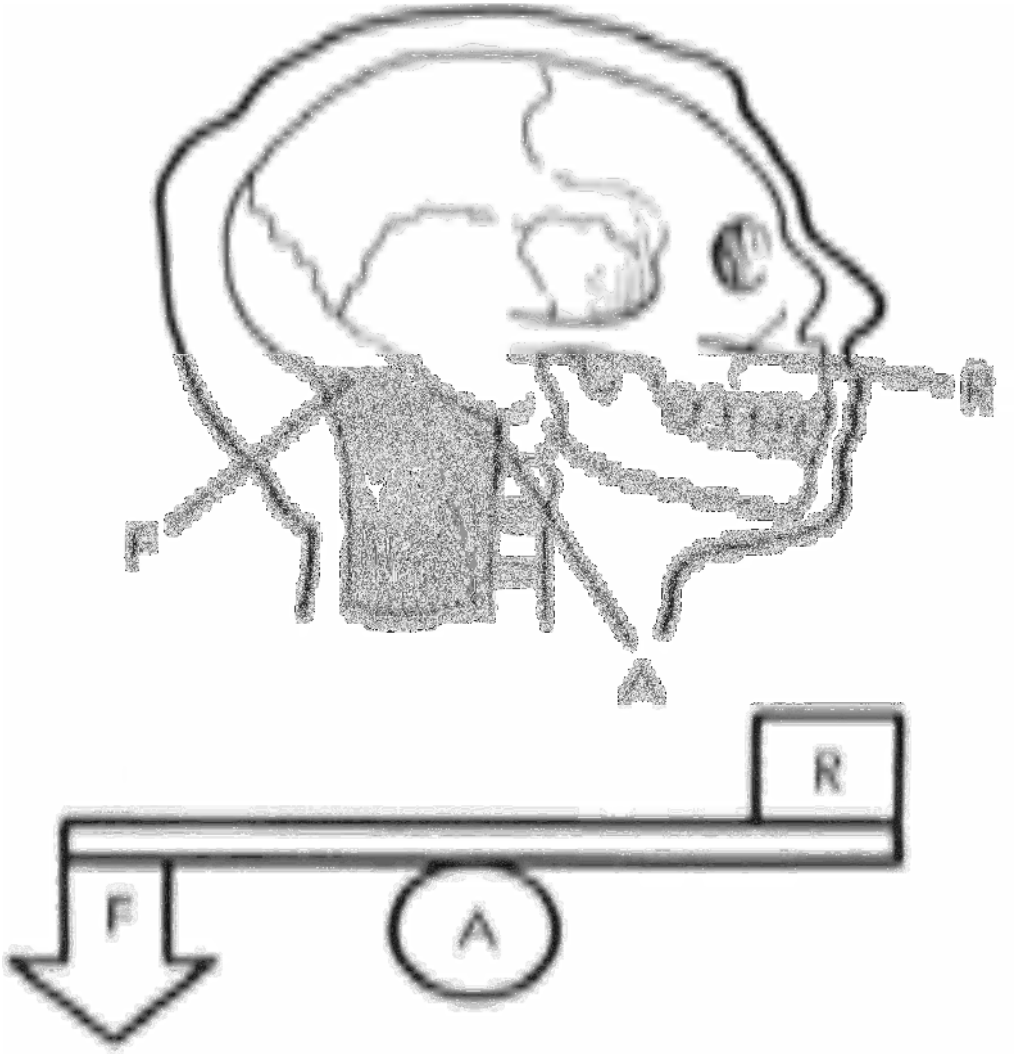

Figure 23: Illustration of Nodding as a First Class Lever, (F is Applied **Force, A - Axis or Fulcrum, and R- Resistance or Load).**

3.3.2. Second Class Lever

In the second class of lever, the resistance, weight or load is lying at a point between the axis or fulcrum and the applied force or effort, (see figure 24).

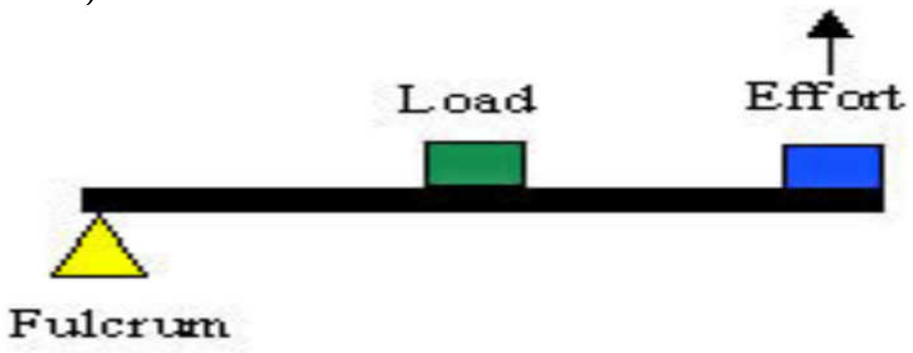

Figure 24: Arrangement of the Components of a Second Class Lever**.**

In this class of lever, the effort arm is always longer than the resistance arm making it have the advantage of magnifying the effect of the applied force. This arrangement makes it to gain mechanical advantage rather than range of motion. So, this lever favours the use of small magnitude of force to move a resistance or load. Examples of external or mechanical second class levers are wheelbarrow (figure 25), nutcracker (figure 26) and loosening a lug nut or lug nut wrench (figure 27).

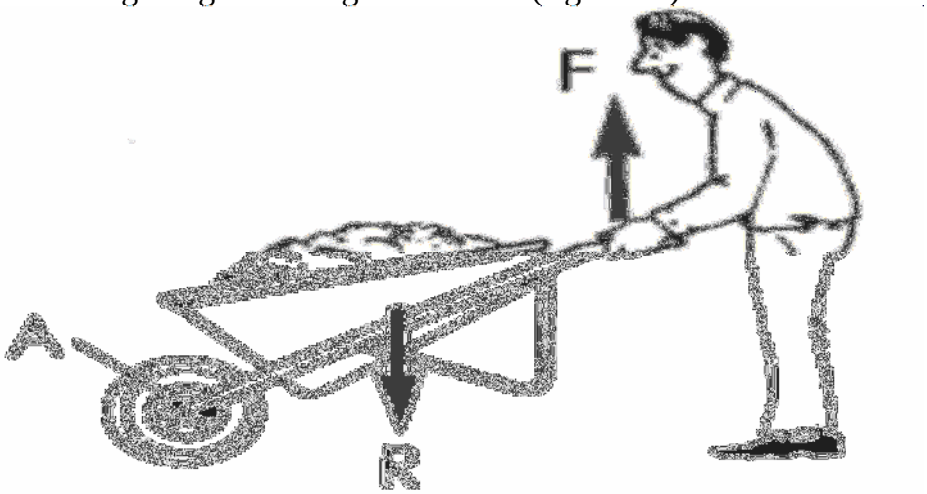

Figure 25: A Wheelbarrow illustrating second class lever**.**

In figure 25, the resistance or load of the wheelbarrow is at the middle of the fulcrum or axis (A) and applied force (F). This arrangement produces a balanced lever.

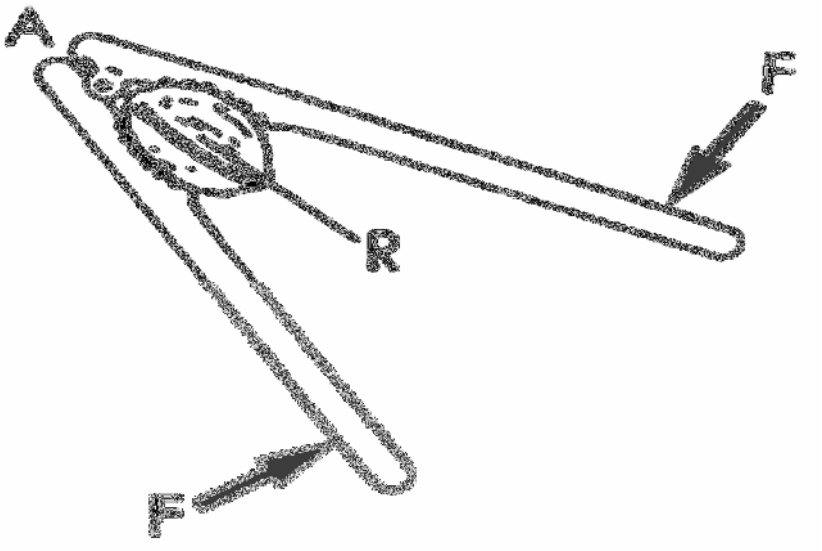

Figure 26: A Nutcracker.

The nutcracker in figure 26 has the resistance (R) or load closer to the fulcrum or axis (A) than the applied force or effort (F). This arrangement favours force rather than range of motion.

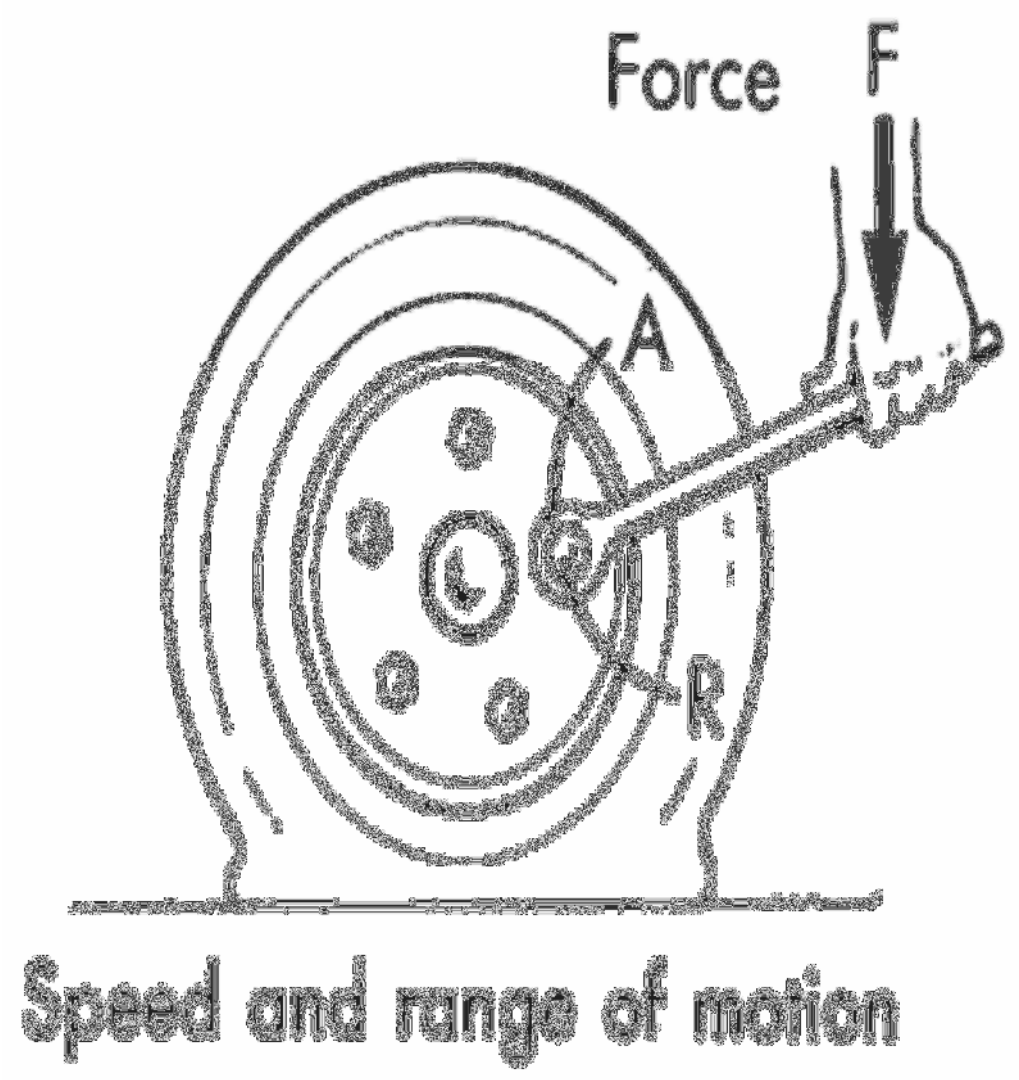

Figure 247: Loosening Lug Nut**.**

In loosening the lug nut, the resistance (R) is very close to the axis (A) and very far away from the applied force (F), making the arrangement to favour range of motion.

In the body, there is a limited number of examples of the second class lever. The one with possibly the greatest application for sport, which should be of great concern to you, is the second class lever system formed between the ball of your foot, gastrocnemius and the load of the bodyweight as you point your toes, or go onto our toes. In this instance, the foot is the lever bar. Figure 27 illustrates human body example of second class lever.

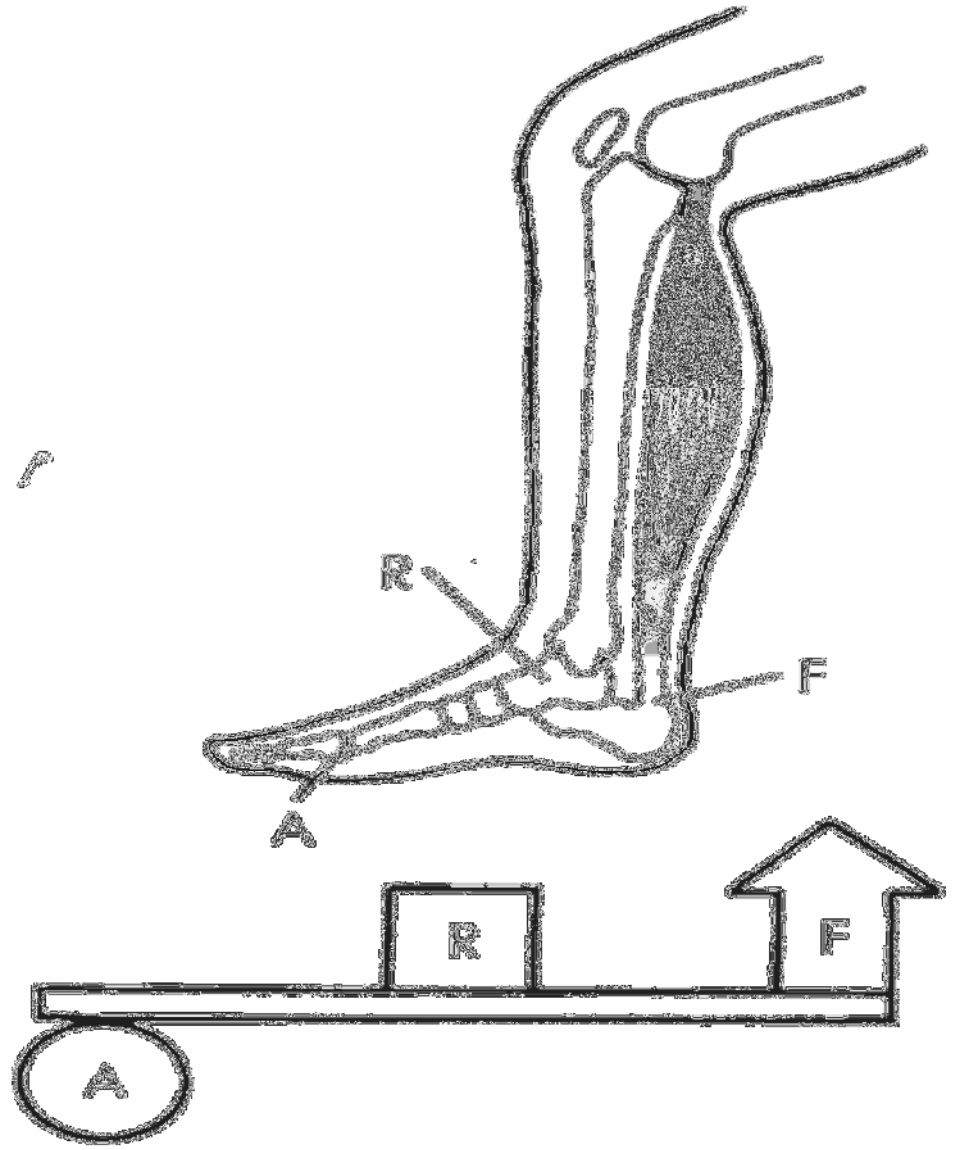

Figure 28: Illustration of the Human Body Example of Second Class Lever.

When the foot in figure 28 performs plantar flexion or stands on the toes, the movement will raise the body up on the toes where the ball of the foot serves as the axis (A) as ankle plantar flexors apply force (F) to the calcaneus of the foot to lift the resistance (R) of the body at the tibial articulation with the foot or ankle.

3.3.3. Third Class Lever

The third class of lever has the effort or applied force situated between the fulcrum or axis and the resistance or load, (see figure 29). The applied force and the resistance are placed on the same side of the axis or fulcrum. The applied force is closer to the axis or fulcrum, thereby producing a shorter force arm (AM) which favours speed and range of motion. So, because the resistance arm (RA) is longer than the AM, it will take greater

effort to overcome a given resistance, (Hamilton and Luttgens, 2002). It is the most common class of lever in the body, but externally there are fewer examples. The canoe paddle (Figure 30) and the shovel (figure 31) are good examples of the third class lever.

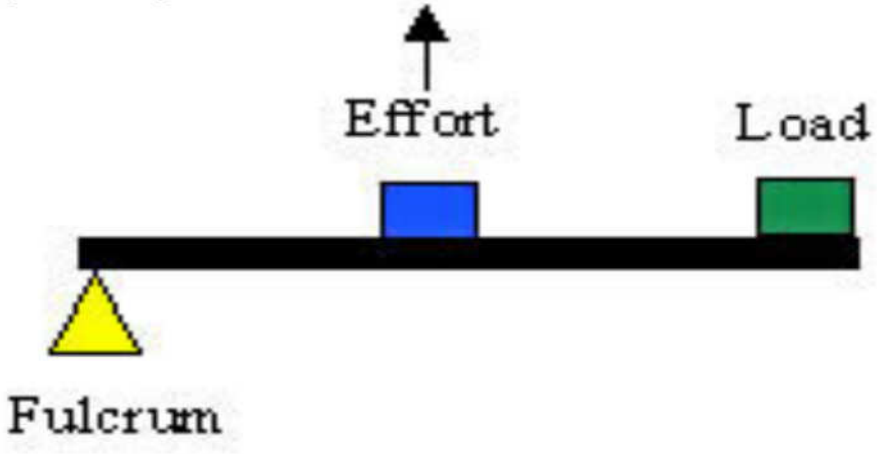

Figure 29: Arrangement of the Third Class Lever.

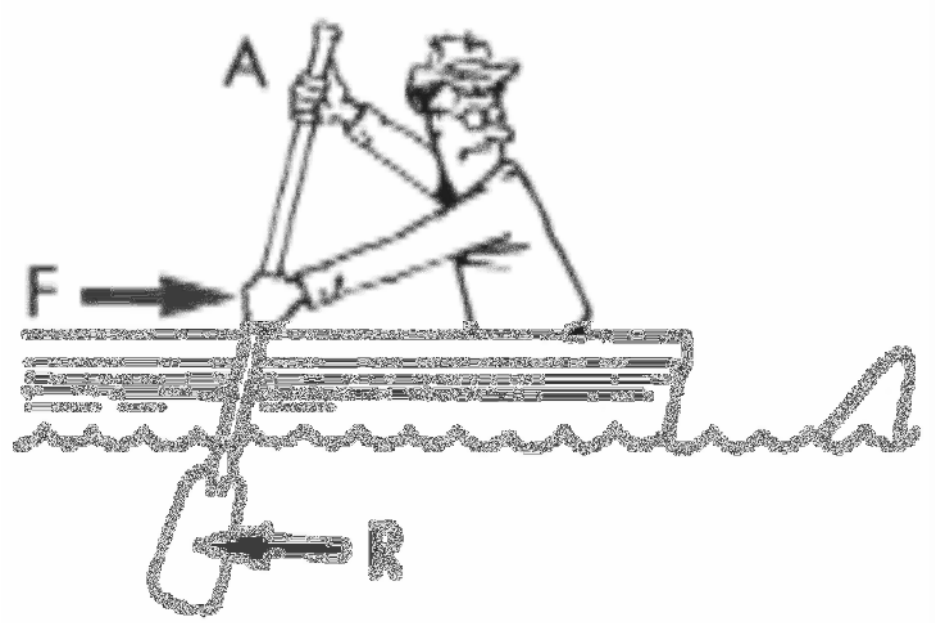

Figure 30: Illustration of Third Class Lever with Canoe Paddling.

In figure 30, the lower hand is the source of the effort or applied force (F) while the upper hand is not applying force but serves as the axis or fulcrum. If you have tried paddling canoe, you will see that the arrangement of the components of this lever requires a great deal of force to move even a small resistance.

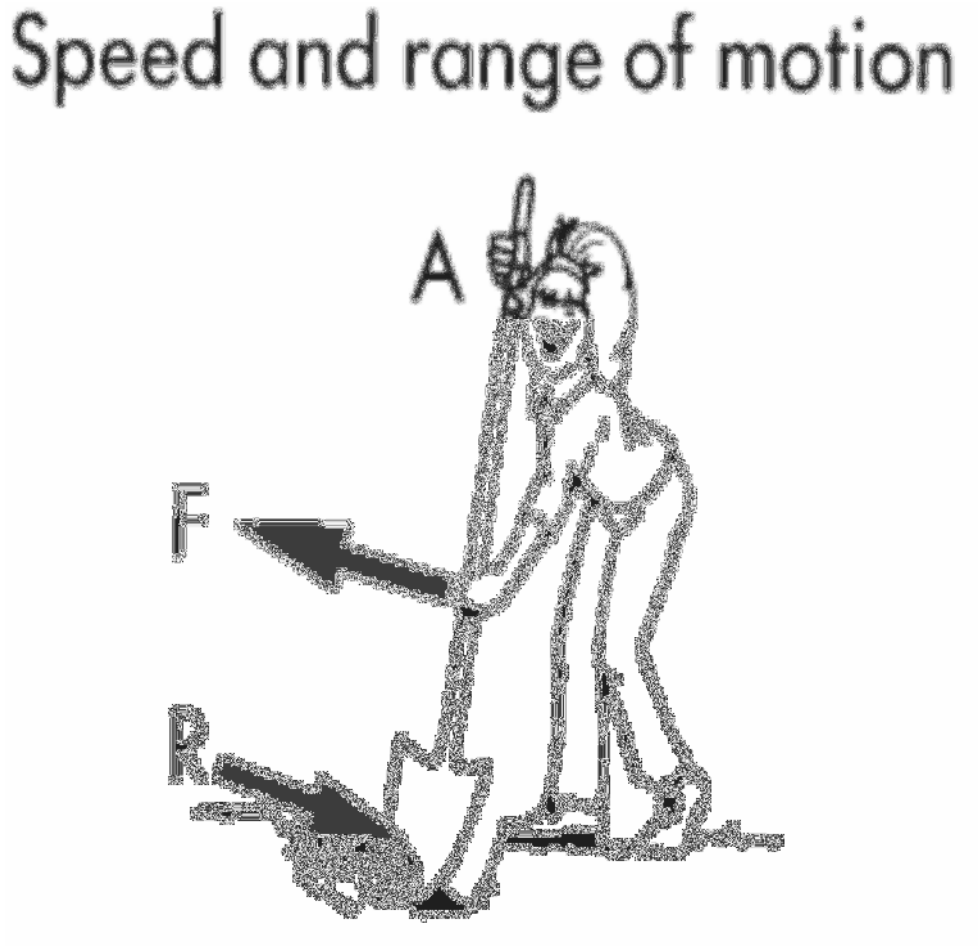

Figure 31: Shovelling.

Have you used shovel in your home or somewhere else? No doubt, you have used it, or perhaps you have seen others use it. Shovelling is the application of lifting force to a shovel handle with lower hand while upper hand on shovel handle serves as axis of rotation. When you use the shovel, the hand applying the force (F) is closer to the resistance (R) the axis (A) (figure 31). This arrangement favours speed and range of motion rather than force or mechanical advantage.

In the human body, there are many examples of anatomical third class levers. Most musculo-skeletal lever systems of the body are third class levers. The muscles provide the applied force, the bone where the muscle is attached forms the fulcrum or axis, while the segment of the body move by the contracted muscle is the load or resistance. The forearm is a very good example of the third class lever when the elbow is flexed by the contraction of the biceps. Figure 32 shows the arrangement of the third class lever in the flexion of the elbow.

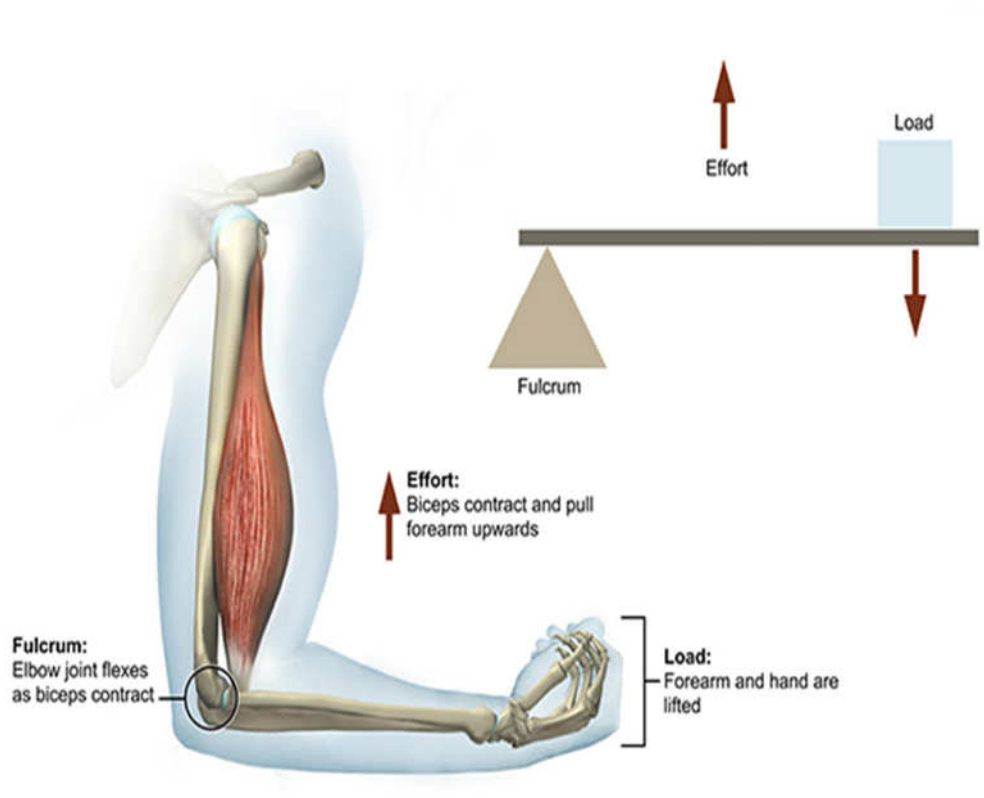

Figure 32: Illustration of the Third Class Lever in the Body using the Forearm

SELF-ASSESSMENT EXERCISE

1. Which one of the following describes a second class lever system?

(a) The load is in the middle of the lever
(b) The fulcrum is in the middle of the lever
(c) The load is at the right-hand end of the lever
(d) The load and the fulcrum are at the same point on the lever

2. Which one of the following describes a first class lever system?

(a) The fulcrum is in the middle of the lever system
(b) The load is at the right-hand end of the lever
(c) The load and the fulcrum are at the same point on the lever
(d) The load is in the middle of the lever

4.0 CONCLUSION

The bones in your body form a system of levers. Levers aid you carry out activities that will be very difficult for you if not impossible. You are able to cut your nail with ease when you use nail cutter because the nail cutter is a good external or mechanical lever. You are also able to an object with ease the arm is a good example of anatomical lever. The knowledge lever you have acquired in this unit will help you know situations where mechanical or external levers will make task performance more economical for you.

5.0 SUMMARY

This unit has discussed the three classes of lever, how they are arranged and their mechanical and anatomical examples. You have also learnt the functions of the lever system. Your knowledge of the principles of lever and mechanical advantage acquired in this unit is important in performance of physical activities.

6.0 TUTOR-MARKED ASSIGNMENT

1. The following are the components of a lever except-----

(a) Lever arm
(b) Fulcrum
(c) Effect
(d) Load

2. Which one of these formulas calculates the mechanical advantage of a lever?

(a) Length of force arm x length of resistance arm
(b) Length of force arm ÷ length of resistance arm
(c) Length of force arm + length of resistance arm
(d) Length of resistance arm – length of force arm

3. What is the mechanical advantage of a lever that applied a force of 30 N to overcome a load of 150 N?

(a) 5
(b) 50
(c) 5.5
(d) 15

7.0 REFERENCES/FURTHER READING

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UNIT 4 NATURE OF MOTION IN SPORTS ACTIVITY

CONTENTS

1.0 INTRODUCTION

In units 1 and 2 of this module, you learnt the role forces play in human movement and how the lever systems help make movement of objects or body segments easier. If you are to understand the movements of the human body and the object put into motion by the body, it's important you learn about motion. This unit will discuss the nature of motions that force bring about. It will also expose you to the basic types of motion. It will further relate distance to displacement.

2.0 INTENDED LEARNING OUTCOME (ILO)

By the end of this unit, you will be able to:

- discuss the two types of motion
- differentiate between distance and displacement
- explain the sequence of actions that cause motion.

3.0 MAIN CONTENT

3.1 Nature of Motion

Your body benefits from the movement or motion you perform. What is motion? Motion is the process or act of changing place or position with respect to some reference objects, (Hamilton and Luttgens, 2002). The implication of motion is a change in place or position. Like force, motion is a vector quantity which involves direction. Body motion is produced or

started by some action of muscular system. When these muscles contract, they generate the cause of motion called force.

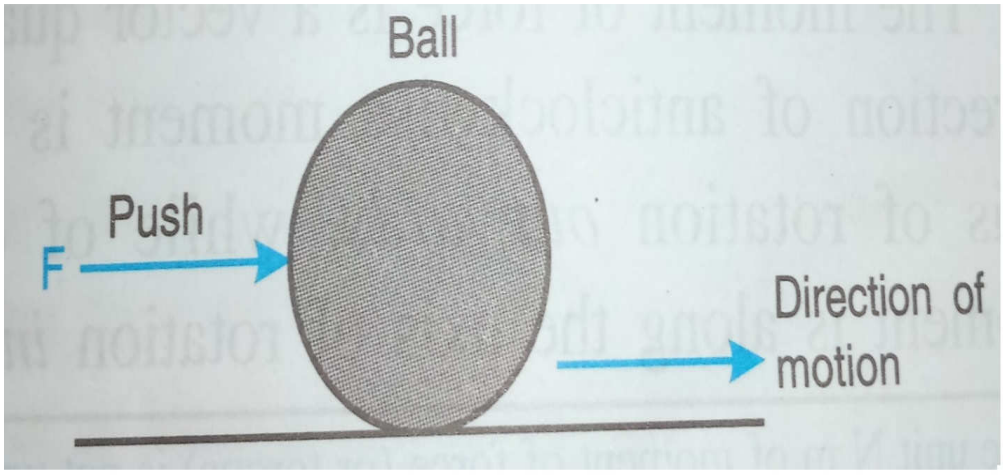
What is the cause of motion? It is very likely that you have seen number of things moving around you. For instance, bicycle, motorbike, car, bus moving on a road, train moving on rails, aeroplane flying in the sky, blades of an electric fan and a child on a swing. Every of these actions results in change of position or place and is caused by force. So force is the cause of motion. You can then rightly say that motion cannot occur without force. A force can only move an object when it is sufficiently greater than the resistance of the object. That is why you can push a building all through the day without pushing it down or moving it. Do you know why it will take a bulldozer just seconds of the time to push down the same building? This is because the magnitude of the force applied by the bulldozer is greater than the magnitude of the resistance. Therefore, the magnitude of the applied force relative to the magnitude of the resistance is the all important factor in every motion.

3.1. Types of Motion

When a body does not change its position or place with time, you can say that the body is at rest, while if a body changes its position or place with time, it is said to be in motion. In what ways do objects move? Balls for example, move through the air in an arc formation, a jumper also moves through the air in a similar fashion. Such movement is called parabola. You may have seen humans or objects move in different ways. Objects move in straight lines, curved path, roll, bounce, swing back and forth among many other possible ways. Most human motions are seen in two major kinds. These are linear and angular motions. When these two kinds of motion are combined, they form a complex motion called general motion.

3.2.1 Linear Motion

Linear motion is a motion of a system (an object or a body) in a uniform motion with all the components of the system moving in the same direction and speed. The system is forced to move in a line. This type of movement is also called translatory motion. This is because the body or object is forced to move or translate from one point to another as a unit or a whole, (see figure 33).



translational motion

Figure 33: A Ball moving from one point to another, (Translation).

The ball in figure 33 is moving in a straight line. The same ball could have also moved in a curved path. When a body or an object moves as a whole in the same direction, it is a pure linear motion. Depending on the nature of the path (straight or curved), linear motion is categorised as rectilinear or curvilinear motion, (see framework in figure 34).

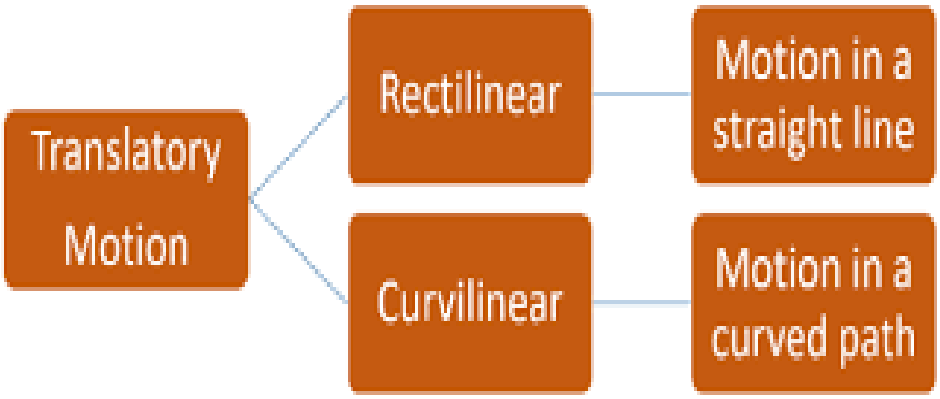


Figure 54: A Framework of Linear or Translatory Motion.

Rectilinear motion is the motion where the whole object or body moves with its components in a straight line, in the same direction and speed. A bowling ball moving in a straight line as shown in figure 35 is an example of rectilinear motion.

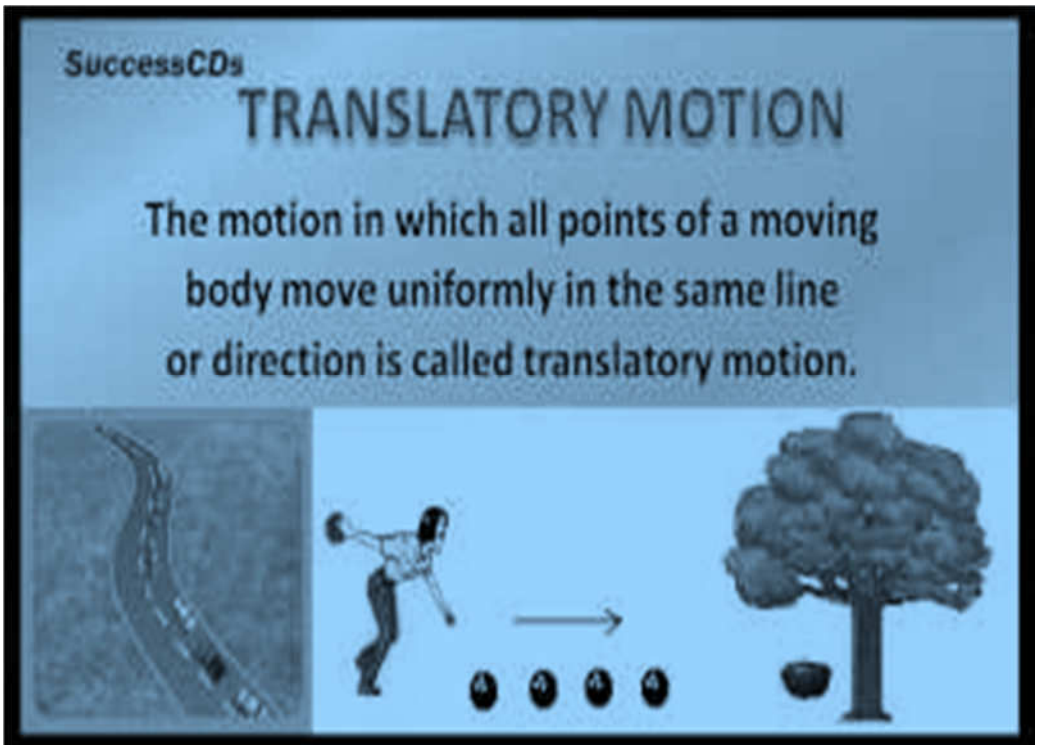


Figure 35: A Bowling Ball in a Rectilinear Motion**.**

Other examples are a vehicle moving in a straight road, a cyclist moving in a straight path while maintaining a motionless posture as the bicycle moves, a train moving on a straight rail, an athlete running a sprint race (100 m dash) and march-pass of soldiers in a straight line parade among others, (Hall, 1995). Figure 36 illustrates some of these examples of rectilinear motion.

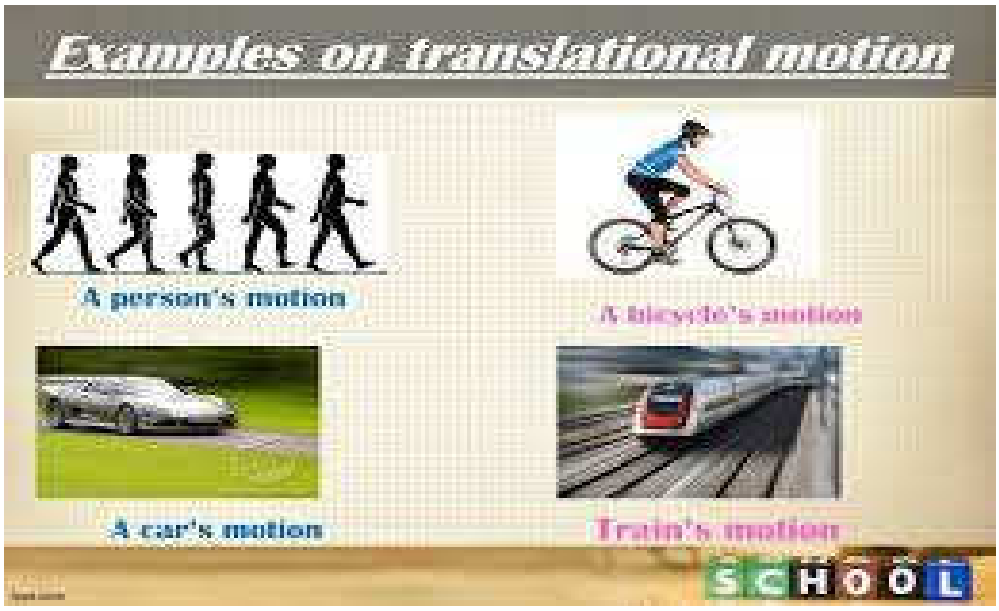


Figure 36: Rectilinear Motions

Curvilinear motion is the translatory motion performed when a body or object moves as a whole or unit in a curved path or line, (see figure 37). This is the path maintained by a ball or any other object (shot put, discus or javelin) in flight, (Hamilton and Luttgens, 2002). An athlete running in a curved pathway is also performing a curvilinear motion. So, when you run a 200m race and go through the curve as shown in figure 38, you perform a curvilinear motion. Further, when you perform a high jump or long jump, (remember the standing long jump), you also perform curvilinear motion.

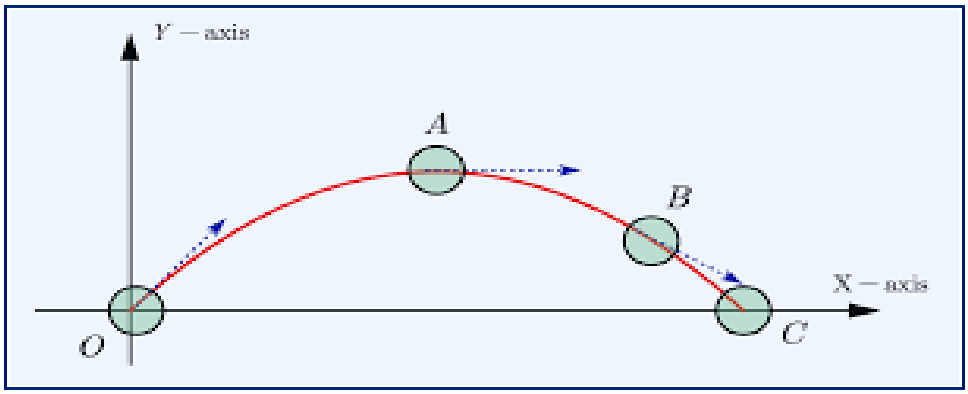


Figure 37: A Ball in a Curvilinear Motion.

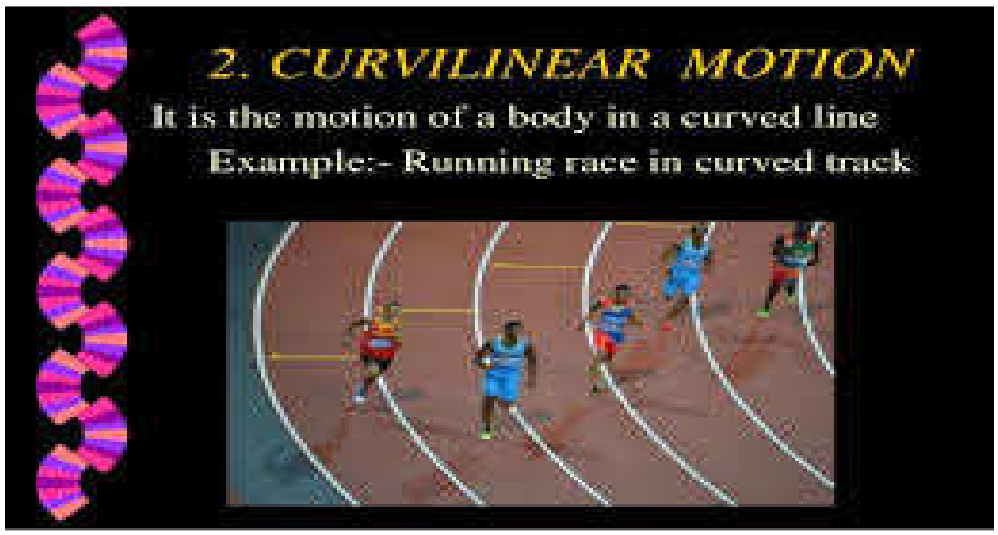


Figure 38: Athletes Performing Curvilinear Motion

Some other examples of curvilinear motion include the trajectory of a motor cyclist in the air, (figure 39), the trajectory of a passed ball, (figure 40)

Figure 39: An Airborne Motor Cyclist Illustrating Curvilinear Motion.

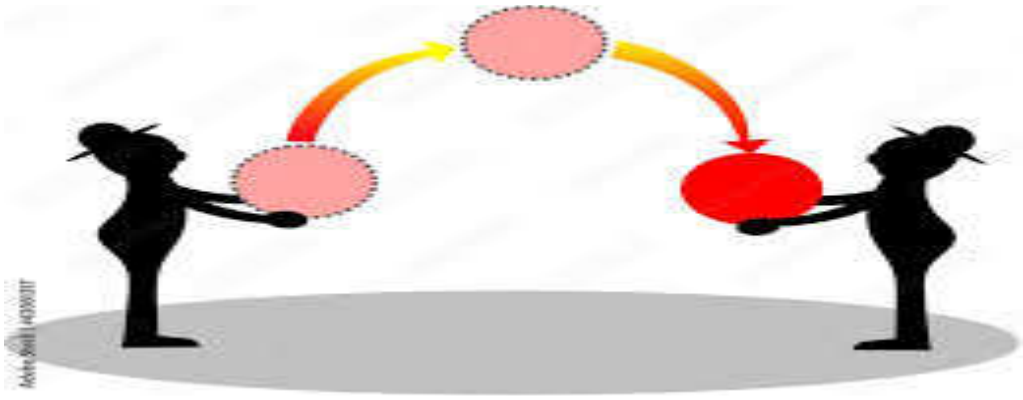


Figure 40: A Passed Ball Forming a Curvilinear Pathway

There is a special kind of curvilinear motion that is called circular motion. This motion takes place when an object or body segment moves along the circumference of a circle which is a curved path of constant radius (r). The object is constantly moving in a circular path and the speed of the object should be constant. Few examples of circular motion are- movement of the earth on its axis, a bicycle or a car moving on a circular track, and the motion of the moon around the earth.

The hammer throw is a classic example of circular motion, (see figure 41). Hammer is one of the throw events in athletic field events. In the hammer throw, an object is tied to the end of a string and swings in a circle around the head. When the hammer is released after a swing, it flies of in a straight line. The hammer, that is, the object in this example, follows a circular pathway until when released. At release, its flight is along a curvilinear line which ends when the object lands.

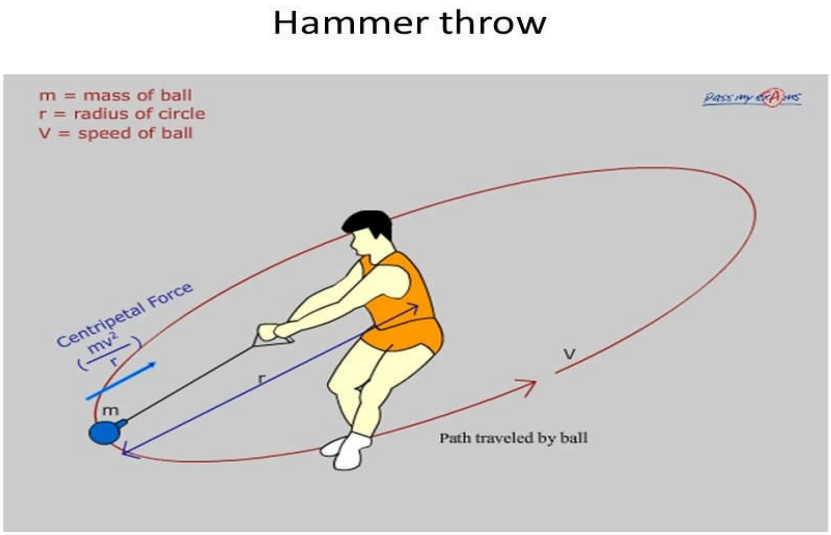


Figure 41: The Swing of a Hammer Illustrating Circular Motion.

Can you think at least two more other example that will fit this motions? Have you observed the motion of time hands of a clock, motion of child sitting on a merry go-round in a nearby park, or motion of the blades of an electric fan in your house of office? In such a motion, you will notice that the object follows a circular pathway during motion. So, you have more examples of the circular motion.

Try these activities in your environment. (1) Force a ball to roll on a horizontal table surface, (2) Pick up a stone and release it so that it falls from your hand. In all these activities, what did you notice in the position of the objects?

3.2.2. Angular Motion

Angular motion is rotation around a central imaginary line called axis of rotation. In his motion, a point within the system in motion is secured, fixed or restricted so that the system rotates around this point (axis of rotation) when the system receives a turning force. The turning force that causes this rotation is called torque. This motion is typical of the lever system. The axis of rotation is situated in the joint for the segments of the body. The joint in the body is the point where segments of the body are connected. Angular motion also called rotator motion occurs when any object acting as a radius moves about a fixed point. This movement covers a distance and the distance travelled may be a small arc or a complete circle, which is presented as an angle of a degree.

Most of the movements of your body are performed by body segments that are fixed or restricted. So, most of your body's movements are angular movements. For instance, when you move your head to indicate "No", move your leg to kick a ball or move your hand and forearm to turn your doorknob, you are performing an angular motion. You are not to confuse these motions with circular motion. Remember that circular motion describes the motion of any point on the radius. Angular motion on the other hand is the motion of the entire radius, (Hamilton and Luttgens, 2002). A gymnast who is circling around a bar, which is the axis of motion in this movement, is performing an angular motion. Other examples of angular motion are spinning, swinging, twisting and rotating. Figure 42 illustrates some examples of angular motion. Remember, angular motions are most observable in sports or exercise during movements of the legs and hands as segments of the body.

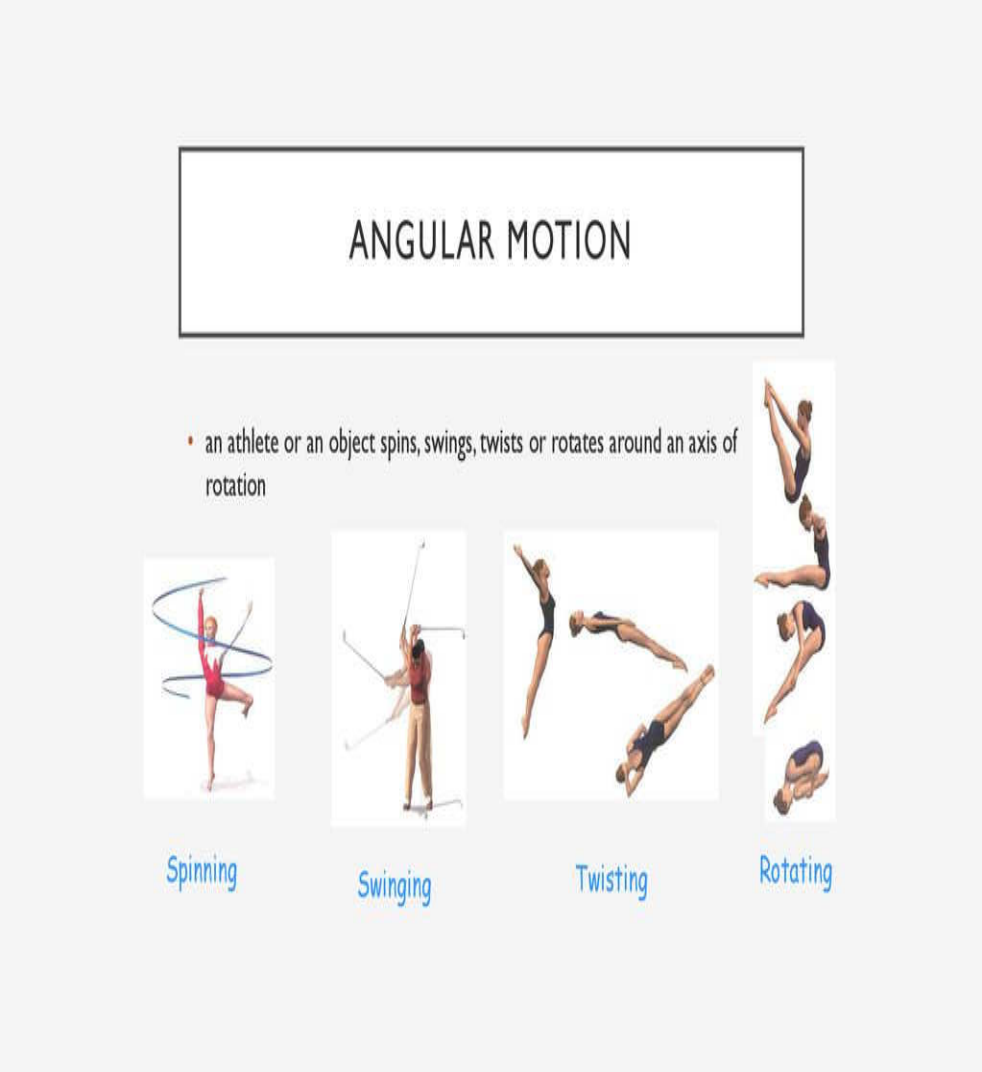


Figure 42: Illustration of some Angular Motions in Sports. Source: www.slideplayer.com.

3.3. Distance and Displacement

In the kinematic description of motion, distance and displacement are very important concepts. Kinematics is a branch of biomechanics that studies the appearance or form of motion. It is the study of the geometry form or structure of motion with reference to time. It studies the beauty and gracefulness of motion. It does not concern itself with the study of force which the cause of motion. This later point distinguishes it from kinetics which is the study of motion and the forces that bring about such motion, (Hall, 1995).

For an object in motion, there are two very important points to bear in mind when considering the distance and displacement of the object. One of these points is the point of start (beginning of the motion) or origin of the object's motion and the other point is the point where it reaches after certain interval of time or point where the motion finished or stopped, called destination. Points of start and destination are connected by a path taken by the object during its motion. The length of the path travelled by object is called distance. If you travel from your house to the school, distance tells you how far you had travelled. There may be a number of paths between your house (the point of start) and the school (point of destination). So, you may cover different distances between your house and school.

In the metric system, the unit of distance is metre (m) or kilometre (km). A kilometre is 1000 m. Distance is a scalar quantity- it emphasises just the length of the path travelled. So, in that your trip from your house to school, you may have moved from your house (point A) to the junction (point B), then to your school (point C). This path may be a straight or zigzag line. Assume that the length from point A to point B is 7 m and from point B to point C is 500 m, what is the distance you had travelled? To get the distance from point A to point C, add 7 m to 500 m. The product is 507 m. So, the distance you travelled from your house to school is 507 m. Similarly, a soccer player who runs up and down the field from a particular point in the field has covered a measurable distance.

Displacement is noticed in sports when an object gets displaced while it changes its position. The change in position of the object is called displacement. Basically, it is the shortest distance between initial and final position of the object. It is the path followed by the object between starting or initial and final positions or destination which may or may not be straight line. Hence, the length of the path does not always represent the displacement. Displacement is represented as a straight line between the start of a motion and its destination.

The units of displacement are the units of length as in distance. The units of length in the metric system are meter (m), kilometer (km), centimeter (cm) which is 1/100 m and millimeter (mm) which is 1/1000 m. Displacement is a vector quantity, implying that it has both magnitude and direction. Hence displacement is the length of a straight line between the start and finish of a journey. In your journey to the school, a straight line from point A to point C will be the displacement. A soccer player who runs up and down the field may have zero (0) m as his displacement but 200 m as distance. This is possible if he starts and ends the run at the same spot. This is because displacement is the smallest distance between the start or origin of a journey and the destination. As long as there is change in position, distance cannot be zero (0).

Now, consider some of the facts you have learnt about distance and displacement. Do remember that:

(1) Displacement may be smaller or equal to the distance.
(2) Displacement is equal to distance, only if the body moves along a straight line path and does not change its direction.
(3) If a body does not move along a straight path its displacement is less than the distance.
(4) Displacement can be zero but distance cannot be zero.
(5) Displacement is the minimum distance between the start of a journey and destination.
(6) Distance is the length of the path travelled by the body or object.
(7) Distance is path dependent while displacement is position dependent.

SELF-ASSESSMENT EXERCISE

1. Motion is performed when ----------

(a) There is change in position
(b) There is change in direction
(c) All of the above
(d) None of the above.

4.0 CONCLUSION

You can do little or nothing without movement. You walk from your bed to your door, your car moves from your house to the school; you climb the stairs to get to an appointment in a multi- story building. Each of these is a change in position or place, which is motion. As you move, you form a straight line, a curve or a circle. All these forms of motion are caused by force. Your understanding of motion-force relationship is important in

Human Kinetics, where efforts are made to know the magnitude of force needed to move a particular load.

5.0 SUMMARY

In this unit, you have learnt that motion is performed when a body or an object changes place or position. While changing this position, the motion may be a linear or angular motion. The unit also carefully provided explanation on the circular motion which has repeatedly been confused with angular motion.

6.0 TUTOR-MARKED ASSIGNMENT

1. Motion in a straight path is called — motion.

(a) Translation
(b) Rectilinear
(c) Curvilinear
(d) Linear

3. When you travel along a straight line without changing your direction, the

(a) Distance travelled is greater than displacement
(b) Distance travelled is less than displacement
(c) Distance travelled is equal to displacement
(d) Distance is not zero but displacement is zero

7.0 REFERENCES/FURTHER READING

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UNIT 5 NEWTON'S LAWS OF MOTION AND THEIR APPLICATION

CONTENTS

1.0 INTRODUCTION

In units 3 of this module, you learnt the nature of motion and its types. If you are to understand the motions of the human body and that of the objects, it is equally important you learn about the scientific laws of motion. This unit will discuss the laws that guide the application of these forces in human movement. The specific laws you will consider are the Newton's laws of motion.

2.0 INTENDED LEARNING OUTCOME (ILO)

By the end of this unit, you will be able to:

- discuss the relationship between laws and principles in kinesiology
- state the three laws of motion from Newton
- demonstrate the application of the third law of motion.

3.0 MAIN CONTENT

3.1 Laws of Motion

You have in the course of consideration of previous units of this course come across terms like principles and laws. Yes, there many forms of general principles related to human movement; you have also learnt that kinesiology is a science. It is important that you realise that principles for application are not the same as scientific laws. Science is defined as a systematic method for testing hypotheses with experimental evidence for the purpose of improving our understanding of reality. Science uses a

process, known as the scientific method, for testing a theory about a phenomenon with measurements, then reevaluating the theory based on the data, (Knudson, 2007).

Science uses experimentation to establish facts or truth. So, when experimentation, which is a major scientific tool, shows that data are always consistent with a theory (given certain conditions), then the theory becomes a law. Law, therefore, is a true theory. There is a term that has made the meaning of science more concise – technology. Look at the definition of science again, this time more carefully. You will notice that science is not defined as a method for making practical applications of knowledge. This is where technology comes in. Technology**,** according to Knudson, (2007: 29) is the term usually used to refer to the tools and methods of applying scientific knowledge to solve problems or perform tasks.

The scientific laws that technology provides methods of application are translated to principles the help improve our understanding and practice of human movement. A principle is general rule for the application of science that is useful for human movements. Some of the principles are based on major laws of mechanics, for example, Newton's laws of motion which are hundreds of years old.

3.1.1 Newton's Laws of Motion

Who is Newton? McGinnis (2013:88) provides great insight into the background of Newton. The author said that Isaac Newton was an English mathematician who was born on the 25th day of December, 1642 and died on March 20, 1727, (in the Julian calendar) or Newton was born on January 4, 1643, and died on March 31, 1727 in the Gregorian calendar. Newton was a student at Cambridge University and subsequently became a professor there. Many of his ideas about mechanics (and calculus) were conceived during a two-year retreat to his family's estate in Lincolnshire when he was in his early 20s. This retreat was prompted by a plague epidemic in England, which caused temporary closings of the university in Cambridge between 1665 and 1667. Despite the devastation it caused, one benefit of the plague was that it allowed Isaac Newton an uninterrupted period of time to establish the groundwork for his version of mechanics. About 20 years later his works were made public and they included his three laws of motion and his law of gravitation. These laws form the basis for modern mechanics. It is these laws that provide the basis for the sub-branch of mechanics called kinetics. Hence they can be applied to sports and exercise performance. The three laws of motion are (1) Newton's first law of motion, (2) Newton's second law of motion and (3) Newton's third law of motion. The importance of these laws cannot

be overemphasised in kinesiology, for they are the keys to understanding how human movement occurs.

3.1.1.2 Newton's First Law of Motion

Newton's first law of motion is also called the law of inertia. The law states that a body continues in its state of rest or uniform motion unless an unbalanced force acts on it. This law means that an object or a body at rest will remain at rest and one already in motion will also remain in motion at a constant speed in the same direction (usually a straight line) unless a greater force acts on it, (Hamilton and Luttgens, 2002). So, the law explains what happens to an object or a body if no external forces act on it or if the net external force (the resultant of all the external forces acting on it) is zero, it will remain the way it is. More simply stated, Newton's first law says that if no net external force acts on an object, that object will not move (it will remain in its state of rest) if it wasn't moving to begin with, or it will continue moving at constant speed in a straight line (it will remain in its state of uniform motion in a straight line) if it was already moving.

The Newton's first law of motion explains the concept, inertia which is the tendency of an object or a body to stay at rest or to keep moving with the same velocity. You can find out some examples of inertia from your daily life. In fact, it is the inertia that makes a sprinter to keep running for some time even after crossing the finish line. Do you know why if you are on a motor bike and the operator moves forward suddenly, you tend to jerk backward or resist the movement? It is the quality or property in you that resists motion, called inertia that makes you want to fall off the bike. Can you now see why the law is called law of inertia? When you moving on a bike and the operator applies the brake suddenly, or the motorbike suddenly stops, how does your body react? Or what happens to the operator? It wants to continue moving or refuses to stop moving due to inertia, (see figure 43).

Figure 43: A body that refused to stop due to inertia. Source: www.pinterest.com.

Now, take a very close look at figures 44 and 45. Can you tell what is happening to the passenger in the bus?

Figure 44: A passenger in a bus that stopped suddenly.

In figure 44 the passenger is standing in the moving bus. Suddenly the car stopped and the passenger falls in the forward direction. If the passenger was not holding the bar, perhaps, it would have been a serious fall. This

is because the body already moving resisted stopping as a result of its inertia.

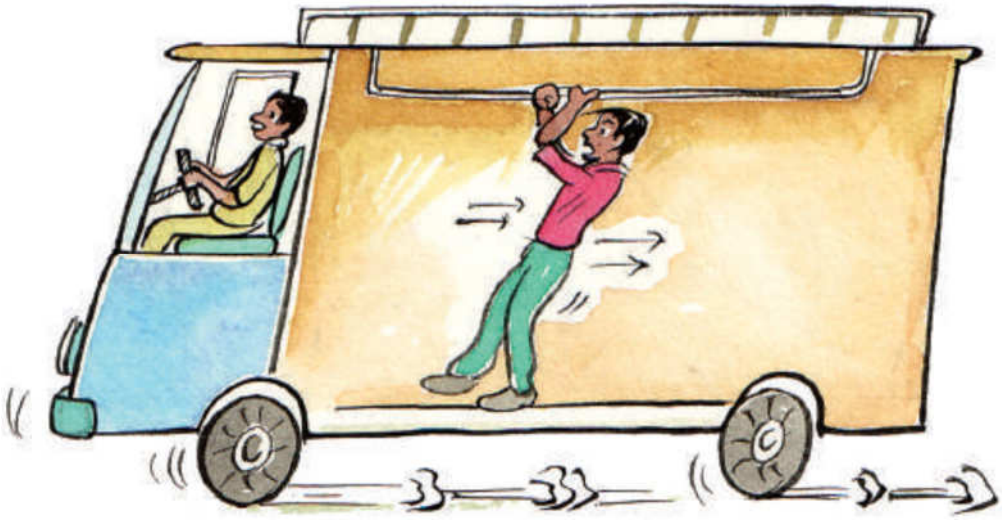

Figure 45: A passenger standing in a bus that moved suddenly.

In figure 45, the bus that stopped suddenly here moved suddenly. The feet of the passenger started moving with the bus, but the upper part of his body resisted the forward motion by trying to remain at rest due to inertia. Hence, the passenger tends to fall in the backward direction. You may have had the experiences in figures 44 and 45.

There are several interpretations of Newton's first law of motion. Consider some of them:

1. If an object is at rest and the net external force acting on it is zero, the object must remain at rest.
2. If an object is in motion and the net external force acting on it is zero, the object must continue moving at constant velocity in a straight line.
3. If an object is at rest, the net external force acting on it must be zero.
4. If an object is in motion at constant velocity in a straight line, the net external force acting on it must be zero.

Two things stand out in these interpretations. The first is that Newton's first law of motion applies to the resultant motion of an object and to the components of this resultant motion. The second is that Newton's first law is applied to any direction of motion, because forces and velocities are vectors. Therefore, if no external forces act, or if the components of the external forces acting in the specified direction sum to zero, there is no motion of the object in that direction or the velocity in that direction is constant, (Hamilton and Luttgens, 2002; McGinnis, 2013).

3.1.1.2. Newton's Second Law of Motion

"The change of motion of an object is proportional to the force impressed; and is made in the direction of the straight line in which the force is impressed". This is the Newton's second law of motion as directly translated and expressed in McGinnis, (2013: 98). More simply stated, Newton's second law says that the acceleration of an object is directly proportional to the force causing it, is in the same direction as the force, and is inversely proportional to the mass of the object, (Hamilton and Luttgens, 2002). This law is saying that if an external force is exerted on an object, the object will accelerate in the direction of the external force, and its acceleration will be directly proportional to the external force and inversely proportional to its mass. In other words, you exert a large push on a small object, it will accelerate the object rapidly. On the other hand, if a small push is exerted on a large object, the object will accelerate slowly.

Newton's second law appears to be the most important law of motion because it shows how the forces that create motion are linked to the motion. The second law is called the Law of Momentum or Law of Acceleration. Momentum according to McGinnis (2013) is the product of an object's mass and its velocity. The faster an object moves, the more momentum it has. The larger a moving object's mass, the more momentum it has. So, momentum is a way of quantifying the motion and inertia of an object together in one measure. In sports, hockey for example, the defender usually uses a heavier stick than a forward. Do you know why it is so? The defender needs to hit the ball farther, so, using heavier stick allows him to transfer more momentum to the ball. In a vertical jump, swinging the arms back and forth before takeoff, transfers momentum to the rest of the body.

In kinesiology, movements can be qualitatively broken down with Newton's second law. Large changes in the speed or direction (acceleration) of a person means that large forces must have been applied. If in an athletic contest the agility of an athlete is a major concern for optimum performance, the coach must select the lightest and quickest player. An athlete with a small mass is easier to accelerate than an athlete with a larger mass, provided they can create sufficient forces relative to body mass. In soccer or many other contact team sports, if a smaller player is being overpowered by a larger opponent, the coach can change the positions of the players such that a larger more massive player will defend against this opponent. Note that increasing force or decreasing mass are both important in creating acceleration and movement, (Knudson, 2007).

In many situations in sports players try to decrease or increase the rate of change of momentum by changing the time in which the change of

momentum takes place. For instance, in cricket fielder moves his hands backward and downward while catching a fast moving ball, (see figure 46). This backward arm movement is also observed while soccer goal keeper catches a fast moving volley. By doing so the cricket fielder or soccer goalkeeper increases the time duration in which the momentum of the ball becomes zero. As the rate of change of momentum decreases, a small force is required for holding the catch. So the hands of the fielder do not get hurt.

Figure 46: A cricket fielder moving his hands backward while catching a ball. Source: www.chegg.com.

3.1.1.3. Newton's Third Law of Motion

This is Newton's third law of motion in Latin as presented in Principia. It is commonly referred to as the law of action-reaction. Translated directly, this law states, "To every action there is always opposed an equal reaction: or the mutual actions of two bodies upon each other are always equal and directed to contrary parts", (McGinnis, 2013). This law is most often translated as: for every action there is an equal and opposite

reaction. This means that for every force exerted, there is an equal and opposite force being exerted. Therefore, when two bodies are in contact, they exert equal forces on each other but in an opposite direction. For example, if you push down on your desk with a force of 5kg magnitude, the desk will push back up against you with 5kg force.

In human movement, an important implication of the law of reaction is how reaction forces change the direction of motion opposite to your applied force when you exert your force on objects with higher force or inertia. During push-off in running an athlete exerts downward and backward push with the foot, which creates a ground reaction force to propel the body upward and forward. The extreme mass of the earth easily overcomes the athlete's inertia, and the ground reaction force accelerates his body in the opposite direction of force he applied to the ground, (see figure 47). When you walk, you push down on the, this is action. The ground responds by pushing you in opposite direction which is reaction. It is the same in swimming. When the swimmer pushes against the wall of the pool (action), the pool in return pushes back at the swimmer (reaction) as shown in figure 48.

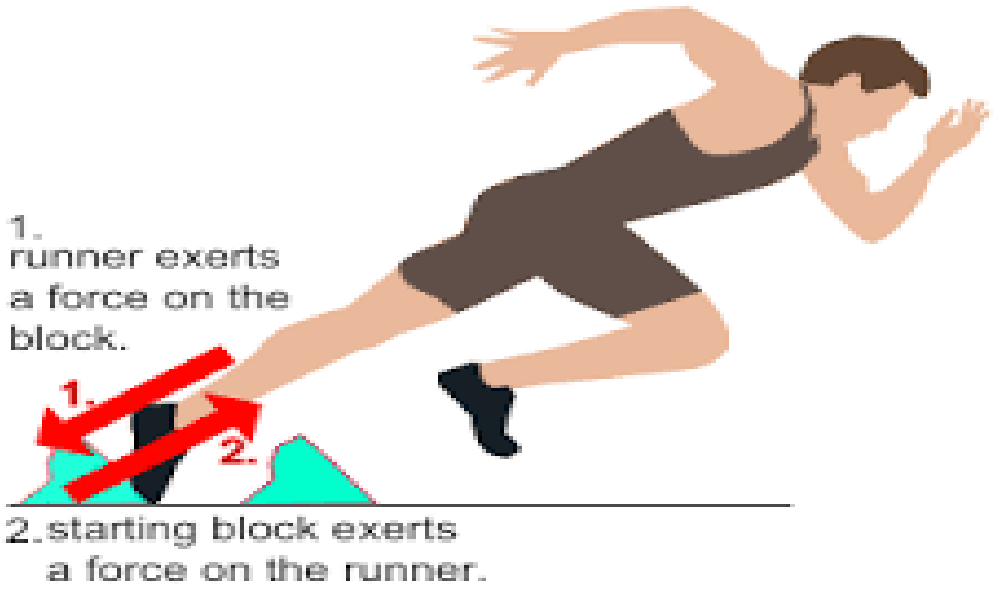

Figure 47: An athlete pushing down on the starting block (1) which pushes back up against the athlete (2).

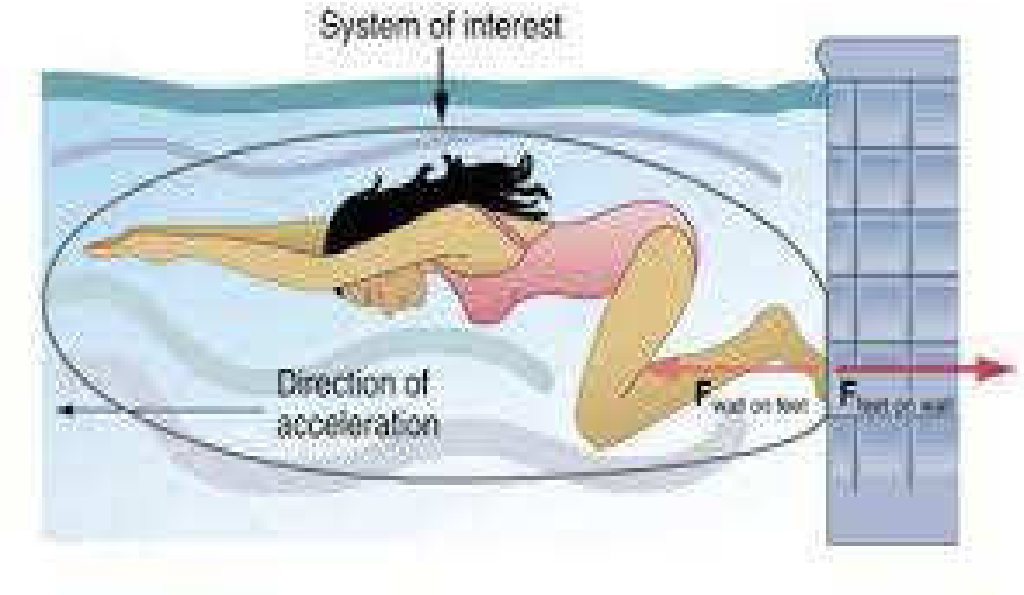

Figure 48: A swimmer pushes backward against the wall of the pool which pushes forward against the swimmer. Source: www.khanacademy.org.

SELF-ASSESSMENT EXERCISE

1. A true theory is called ----------
(a) Experimentation
(b) Law
(c) Principle
(d) Inertia

2. What makes a sprinter to keep running for some time even after crossing the finish line?
(a) Motion
(b) Force
(c) Inertia
(d) Reaction

4.0 CONCLUSION

Virtually all aspects of human events are governed, controlled or influenced by one law or the other. You have seen that human movement is not an exception. Whenever you perform a movement, one law or the other is applied. Your understanding of Newton's laws of motion is very necessary for your proper appreciation of movement.

5.0 SUMMARY

In this unit, you have learnt that motion is governed by laws and principles. The most considered laws of motion are the three Newton's laws of motion. These laws are applied at different stages of motion – at the start, during and towards the end. The unit carefully provided explanations on the three Newton's laws of motion. It further applied these laws to movement.

6.0 TUTOR-MARKED ASSIGNMENT

1. The law says that the acceleration of an object is directly proportional to the force causing it, is in the same direction as the force, and is inversely proportional to the mass of the object, is the ----------
(a) Newton's third law of motion.
(b) Newton's law Translatory Motion.
(c) Newton's second law of motion
(d) Newton's first law of motion.

2. Which of the following laws explains that when two bodies are in contact, they exert equal forces on each other but in an opposite direction?

(a) Newton's third law of motion.
(b) Newton's law Translatory Motion.
(c) Newton's second law of motion
(d) Newton's first law of motion.

7.0 REFERENCES/FURTHER READING

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MODULE 3 POSTURE AND MOVEMENT

MODULE INTRODUCTION

This module will introduce you to posture and movements that you may have ignored. In this module you will learn about the locomotor and non-locomotor movements that you can use to design very interesting exercise programmes. You will also learn the place of kinesiology in fitness. This module will further teach you Newton's laws of motion and their application.

The units under this module include:

Unit 1 Nature of Posture
Unit 2 Movement Skills, (Locomotor)
Unit 3 Non-locomotor and Manipulative skills
Unit 4 Body Awareness Activities
Unit 5 Kinesiological Perspectives of Exercise and Fitness

UNIT 1 NATURE OF POSTURE

CONTENTS

1.0 INTRODUCTION

Take a moment to look at your sitting posture as you go through this unit. Imagine also your standing, lying, walking, running and lifting postures. At the end of this unit, you will be able to tell whether your postures in these various situations are good or poor. Good posture is perhaps more than just standing up straight so that you can look your best. It is a critical and important part of your long-term health. So, taking pains to hold your body the right way, can prevent pain, injuries, and other health problems. This applies in every condition of your body, whether you are moving or still. In your daily life including sports or human movement situations, due consideration must be given to posture. It is important that you and those around you desire to maintain good posture. Previous unit taught you about motion. This unit has been arranged to present discussions and demonstrations on good posture in relation to motion.

2.0 INTENDED LEARNING OUTCOME (ILO)

By the end of this unit, you will be able to:

- discuss the value of good posture
- demonstrate a good standing posture
- highlight two characteristics of a good lying posture
- differentiate active and inactive posture.

3.0 MAIN CONTENT

3.1 Nature of Posture

Every breathing human will want to have a good health condition. I know you do too. To achieve and sustain optimum health, you need to consider maintaining a good posture. You are to value it the way you value a healthy diet, sleeping comfortably and exercising. It ensures that your body is well poised to undertake daily tasks with more vigour and vitality, without fatigue. So, view it as a very strong pillar to your overall physical health and performance.

Now, what is posture? Posture refers to the relative arrangement of the various segments of the body. It is the attitude assumed by your body either when it is stationary or it is moving. It can also be described as the position of all the segments of the body relative to each of the other body parts. Posture is simply the position our bodies adopt in response to the effects of gravity. It is the way we hold ourselves, in sitting,

standing or even lying down. In more basic terms, posture is the position you hold your body in while standing, seating and even when lying down. A good posture ensures that your entire body is properly and symmetrically aligned with the right muscle tension. Good posture allows you to move in the way you want, causing your body the least amount of strain and damage. Poor posture can develop gradually, often without you noticing, until it interferes with your daily tasks or causes pain, (Conyers and Webster, 2015). Simple changes in posture can be beneficial and these you can incorporate into everyday activities. Figure 49 illustrates good and poor postures.

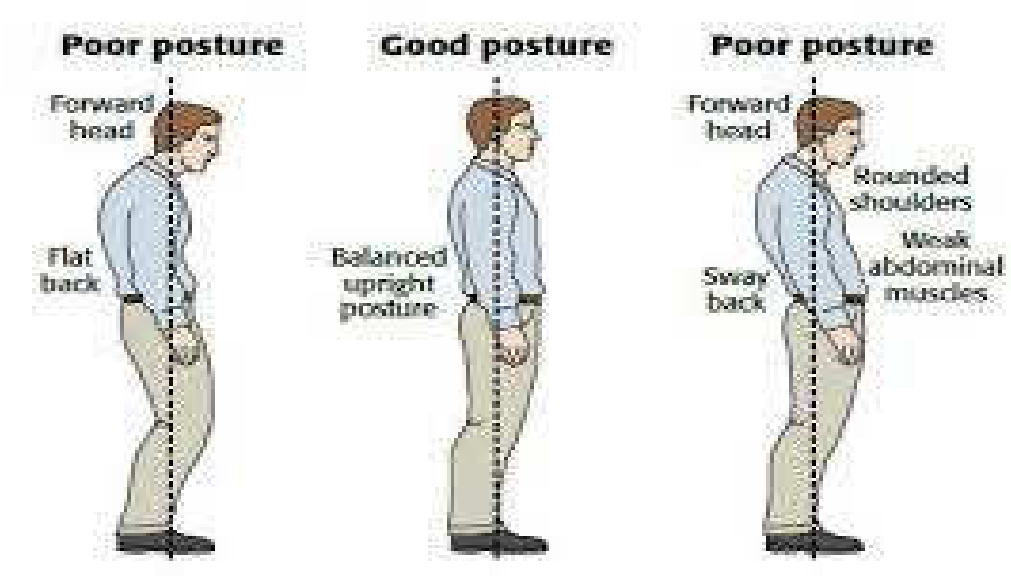

Figure 49: Illustration of a good (middle) and poor (at the ends) standing postures.

Posture means position. Human body which is a multi-segmented structure cannot have a single posture. Every activity you engage in favours a particular posture. So, No single posture allows us to carry out everything we want to do and we adopt many different postures in order to do different tasks. The ability to arrange and rearrange the segments of the body to form an infinite variety of postures to a very great extent depends on the condition of the neuromuscular system and the integrity of the joints. The neuromuscular and skeletal systems form the postural control system. The function of this system is to maintain your upright bipedal (two feet) stance. This task is essentially one of generating a series of muscular contraction which produces moment of force around the joints of the musculo-skeletal system to counteract the force of gravity. Bipedism (that is, standing and walking on two feet) has its merit and demerit. The most outstanding advantage is that it allows you to use the upper limb for other functional activities. You can comfortably pass the ball in handball or receive a pass in basketball while standing.

Bipedism reduces stability. This perhaps appears to be a disadvantage. The weight of your body is shared between your two lower limbs. This gives your body a reduced support base found between the tips of the heels posteriorly and the line joining the toes anteriorly. From this you will agree that the erect body is a poorly engineered model in terms of stability because the heavier portions of the body are placed upon a narrow base of support, (two feet). Just imagine how stable an inverted cone can be. Obviously, this position is far less stable than that of the four-legged vertebrates (quadrupeds), like dogs. When the feet are parallel and close together, the upright body is far less stable.

3.1.1 Importance of Good Posture

If you have the ability to maintain a good or correct posture, you indeed have a good assert that you must treasure and maintain. It is a big part of your health because it ensures that your bones are well aligned with the rest of the body, while the tension in your muscles and ligaments is properly distributed. More so, it keeps the body parts in their rightful positions with minimal stress.

Here are some specific values that come from maintaining good posture:

(1) A good posture uses less energy. It enables your muscles to coordinate in a more-efficient manner, ensuring that your body utilises less energy, thereby eliminating muscle fatigue. This allows you to undertake tasks for longer periods with minimal exhaustion.
(2) A good posture greatly reduces injury.
(3) It helps in preventing back and muscular pain which is one of the major signs of poor posture.
(4) A good posture reduces muscle and joints wear and tear by keeping them and the bones properly aligned. It is this wear or tear that is behind certain chronic risk called arthritis.
(5) The muscles that maintain your posture work more efficiently if they are properly aligned allowing you to move effortlessly. See figure 50 for a smart highlight of the benefits of good posture.

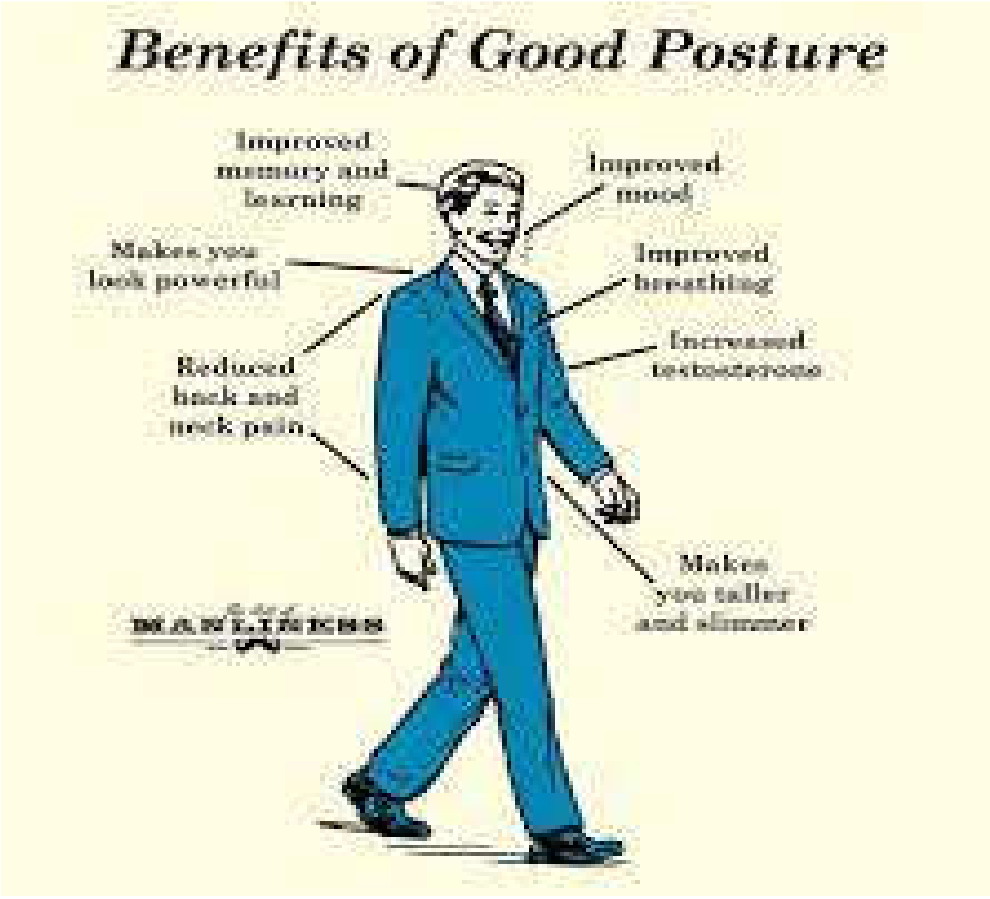

Figure 50: A presentation of the benefits of a good posture

Now experience firsthand the benefit of easier movement from maintaining a good posture. Figure 51 illustrates good (√) and bad (×) sitting postures. Try assuming these two postures. In the posture marked bad (×) slump forward then lift your arm above your head. Now try the good posture (√) by sitting straight and lifting your arm. In which of these postures did find it easier to lift your arm? Try this exercise again to confirm your observation.

Figure 51: Illustration of good (√) and bad or poor (×) postures. Source: https://kauveryhospital.com.

No doubt you found it easier to lift your arm when you assumed a good posture. Do you know why it was so? Lifting your arm was easier for you because your body was supported by its postural muscles and your shoulder blade was in a better position, which allows you to use your arm more freely. Try the exercise while assuming good and poor standing postures. Relate your experience to the one while standing.

3.1.2. Characteristics of Good Posture

It is important to make sure that you have good standing, sitting or lying posture. You may not be able to do that if you are not acquainted with the various characteristics of each of these postures. Consider now the characteristics of good standing, sitting and lying postures. To determine these characteristics, it is vital have a slight insight into the assessment of posture. In the assessment of posture, it is vital that you identify the key to the body's posture. The key which is the position of the spine, amplifies the posture of your body. The spine has three identifiable natural curves. The first curve is at your neck, second is between mid and upper back, and the third is at the lower back. Good posture usually maintains these curves, and does not increase them. To achieve this correct posture, your head should be above your shoulders, and the top of your shoulder should be over your hips.

Standing Posture: The weight of your body is borne by the soles of your feet, with your feet placed 4-5 inches apart from each other, your stomach is tucked in, and your hands hang naturally from the sides of body. This arrangement is a straight and tall structure called standing posture, (see figure 52). The head is well centred, chest high without being strained, the shoulders down and back, abdomen is flat, knees straight and relaxed, the feet are parallel with the ground and weight is properly balanced. Can you see these attributes in the image in figure 52?

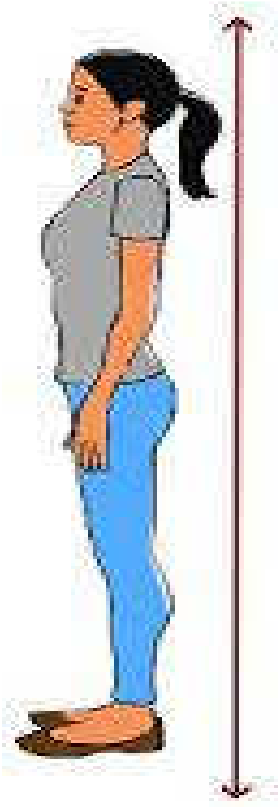

Figure 52: Side view of a good standing posture.

Sitting Posture: In the sitting posture your feet are on the floor, or on a footrest rather than hanging mid-air, your knees at your hip level, shoulders are relaxed with your forearms at a parallel position to the ground, and have your back supported entirely by the backrest. See figure 51for the illustration of a good (√) sitting posture.

Lying Posture**:** This is a sleeping or resting posture. As you learnt in the standing and sitting postures, your aim is to keep the spine well aligned when you are lying down. A major secret to sleeping right is having a good and comfortable pillow and mattress. The role of the mattress and pillows is to help support the natural curves in your spine. If you prefer a hard one, that's fairly okay, and if you feel comfy on a softer one, then that's fine. Always support your head with a pillow such that is at an elevated position to the rest of your body to aid in blood circulation. And avoid lying on your stomach. Conyers and Webster, (2015: 9 - 10), provides the following tips on what characterise and maintain a good lying posture:

1. When you lie on your back, try and lie symmetrically rather than with a twisted pelvis or with your legs to one side. Your legs should naturally stay straight when you are on your back, keep

pillow(s) under your knees to keep them in line with your spine, (see figure 53).

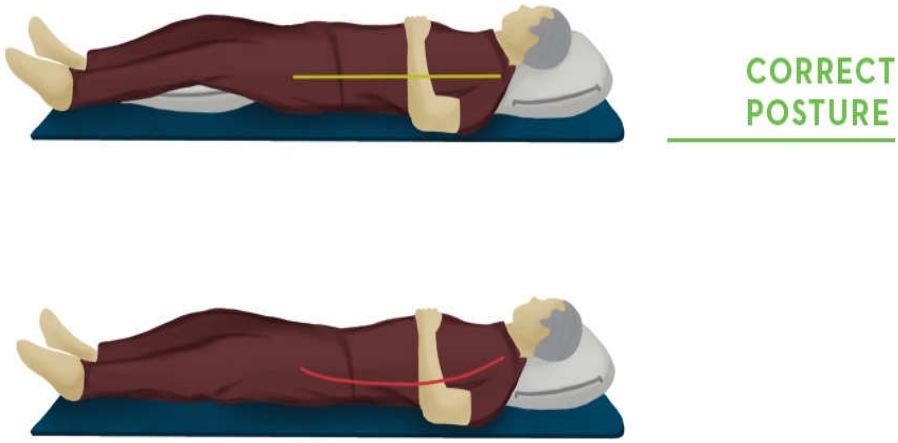

Figure 53: Illustration of good or correct and poor lying postures. Source: www.holmesplace.com.

2. Avoid too many pillows under your head when lying on your back or side, as this can push your head and shoulders up straining muscles and joints in your neck and back. See figure 54.

3. Avoid lying on your front because you cannot keep your spine in proper alignment in this position. This may cause neck pain because your head will be permanently turned to one side.

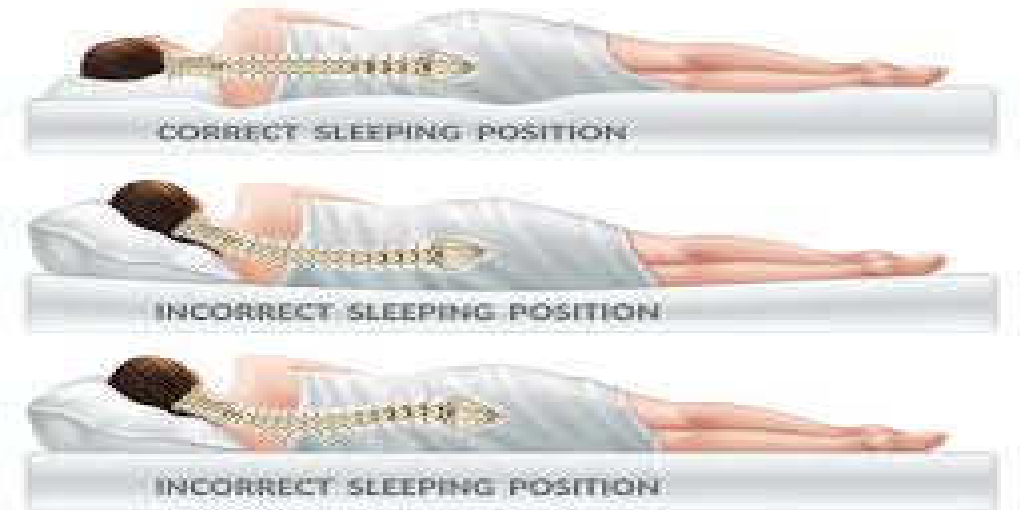

Figure 54: Illustration of correct lying posture with proper positioning of the pillow. Source: www.endisonspinecenter.com.

For your good spine health, your pillow should only be under your head as shown in the correct posture in figure 54, not under the shoulder as well as depicted in the incorrect positions in figure 54. The pillow

should fill the gap between your head and shoulder, keeping your head in line with your spine. This creates the least amount of strain.

3.2. Types of Posture

All along you have been considering perhaps standing, sitting and lying posture. These postures are one type of posture as you will soon see. Posture is basically classified into two types and they are static or inactive and dynamic or active postures.

3.2.1. Inactive or Static Posture

Inactive or static postures are the attitude you adopt for lying. They show how you arrange or package yourself when you are not moving, like when you are sitting (fig. 51), standing (fig. 52), kneeling or lying for rest or sleeping (fig. 53 and 54). Here the body segments are aligned and maintained in fixed positions. This is usually achieved by co-ordination and interaction of various muscle groups which are working statically to counteract gravity and other forces, (wwwphysio-pedia.com/Posture). Granted, it is important to give deserved attention to static posture. However, Human Kinetics focuses more attention on dynamic or active posture. The reason is well known to you. Kinetics has to do with movement and the forces that cause such movement.

3.2.2. Active or Dynamic Posture

Active or dynamic postures are the products of the integration of many muscles. This is achieved by the coordinated interaction of various muscles or muscle groups to bring about movement. Dynamic posture simply refers to postures in which the body or its segments are moving. It is how you hold yourself when you are moving. Muscles and non-contractile structures like bones have to work to adapt to changing circumstances. You see examples of dynamic or active postures when you are walking (figure 55), running (fig. 56), jumping, throwing, lifting (figure 57) or bending over to pick up something, (Fabrocini, 2016; wwwphysio-pedia.com/Posture).

3.3 Posture in Various Active Situations

Walking, running and lifting objects are common movements of interest to a human kinetics professional. The postures assumed in these actions are of great important to successful and efficient performance in sports.

3.3.1. Walking Posture

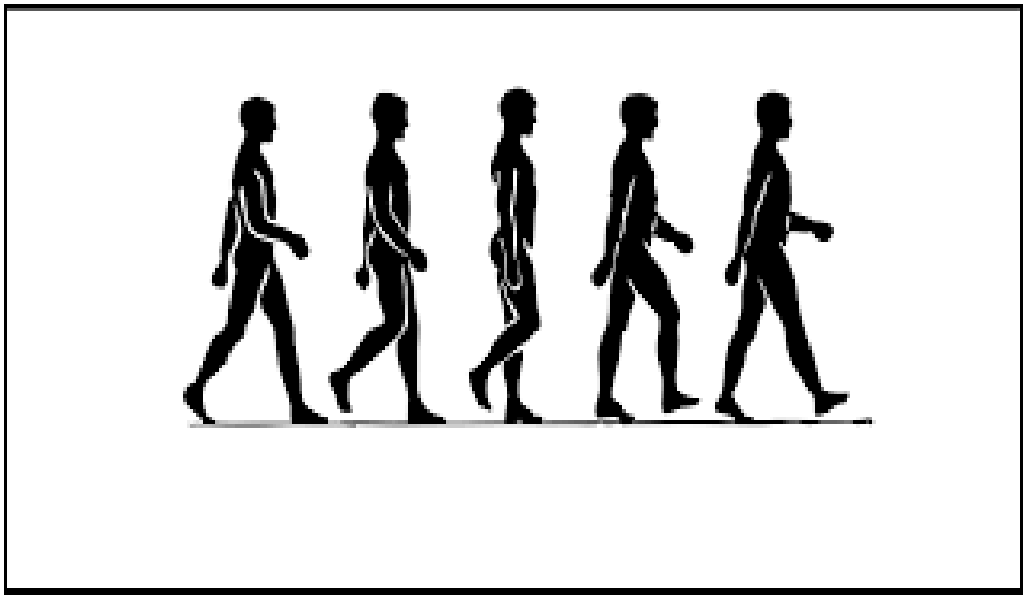

Figure 55: Illustration of a good walking posture. Source: www.optimumhealthrehab.com.

The correct walking posture (fig. 55) requires that you keep your chin parallel to the ground. Instead of looking down at your feet, look several meters ahead of you. Keep your back straight. Keep your stomach and buttocks in the same line with the rest of the body. As shown in the last picture in figure 55, hit the ground with your heel first and then roll onto your toes. It requires a conscious effort to maintain a correct posture while walking, but with constant effort you will succeed.

3.3.2. Running Posture

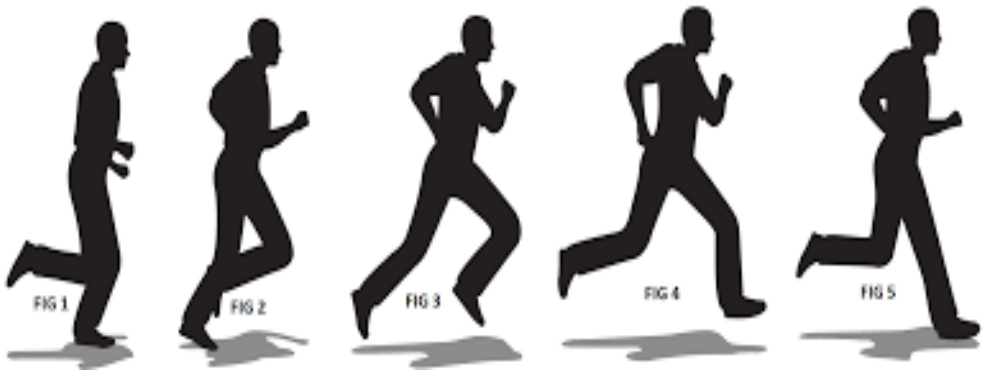

Figure 56: A good running posture. Source: www.blog.runpage.com.

When running the illustrations in figure 56 shows that you are to keep your head up and looking forward. You are to keep your arms relaxed

with the elbow flexed at about an angle of 90^0. Slightly lean your body forward without flexing your waist. The knees are not lifted too high but go with what seems natural for you. Finally, hit the ground with the middle of your foot, and then roll it forward to the toes.

3.3.3. Lifting Posture

Figure 57: Illustration of Incorrect and Correct Lifting Postures. Source: www.physio-pedia.com.

Figure 58: Correct lifting postures from squatting to standing.

Figures 57 and 58 illustrate the correct way of lifting a load to avoid injury that can reduce your freedom of movement. You are to stay close to the object you want to lift and maintain a wide base. Maintain a correct lordotic curve with your hip and knees flexed. Lordotic curve refers to the normal inward curvature of the spine. As you lift the object, keep it close to the body's centre of gravity. Avoid hyperextending the neck or back while lifting as shown in the

incorrect or poor lifting posture (×) in figure 57. This is because the poor leverage used in poor posture to lift a box of about 25 kg causes extreme forces to be imparted on the spine. It can cause about 375kg of tensile force (pull away) on the muscles of your low back and about 425 kg of compressional force (pull towards) on the lumbar disk. This impact can cause a life-long injury to a player.

SELF-ASSESSMENT EXERCISE

1. The values of maintaining a good posture include all except----
(a) Ease of movement
(b) Make for efficient use of energy
(c) Makes muscles larger
(d) Prevents injury.

2. Which of these is the body's posture control center?
(a) Cardiorespiratory system
(b) Neuromuscular and joint system
(c) Musculoskeletal system
(d) Posture system.

3. Active posture does not include----------
(a) Walking posture
(b) Lying posture
(c) Running posture
(d) Jumping posture

4.0 CONCLUSION

At this point you may have assessed your posture in various situations. You may have also adjusted your sitting posture several times to conform to the correct or good posture. That is highly commended. Good posture is one of the major keys to good health and performance. Granted, every aspect of human kinetics focuses on movement, good static postures are very necessary for the wellbeing and optimum performance of an athlete. When you make the needed effort to develop the postures you have learnt from this unit, you will be well prepared to render vital human kinetics service to your community. Therefore, carefully practice and master these postures. Doing so will help you be ever ready to provide these services when you are required to do so.

5.0 SUMMARY

This unit has prepared you to be able to identify and maintain good postures. It has also discussed the importance and characteristics of postures in various situations. You have learnt that active or dynamic and inactive or static postures are the two major classifications of posture. Dynamic postures are involved while walking, running, jumping, throwing or lifting, while static postures are used when standing, sitting (as you are sitting to consider this material), kneeling or lying. You also learnt that good postures prevent many posture-related sicknesses and injuries.

6.0 TUTOR-MARKED ASSIGNMENT

1. The law says that the acceleration of an object is directly proportional to the force causing it, is in the same direction as the force, and is inversely proportional to the mass of the object, is the ----------

(a) Newton's third law of motion.
(b) Newton's law Translatory Motion.
(c) Newton's second law of motion.
(d) Newton's first law of motion.

2. Which of the following laws explains that when two bodies are in contact, they exert equal forces on each other but in an opposite direction?

(a) Newton's third law of motion.
(b) Newton's law Translatory Motion.
(c) Newton's second law of motion.
(d) Newton's first law of motion.

7.0 REFERENCES/FURTHER READING

Conyers, H. & Webster, S. (2015). Understanding and Improving your Posture. www.mstrust.org.uk.

Hamilton, N. & Luttgens, K. (2002). *Kinesiology: Scientific Basis of Human Motion*, (10th ed.) Boston: McGraw Hill.

Hoffman, S. J. (2009). *Introduction to Kinesiology: Studying Physical Activity*, (3rd ed.). United States of America: Human Kinetics.

UNIT 2 MOVEMENT SKILLS (LOCOMOTOR)

CONTENTS

1.0 INTRODUCTION

The focus of kinesiology has been shown to be physical activity. Physical activity involves movement. Hence, movement is of critical consideration in kinesiology. It is therefore important that you understand the various skills that are involved in movement with respect to sports, game or exercise. This unit will teach you the movement skills that are important performance of movements. Previous unit introduced you to good postures in various situations, including sports, games and exercise situations. These postures are necessary for safe, effective and efficient movement performance.

2.0 INTENDED LEARNING OUTCOME (ILO)

By the end of this unit, you will be able to:

- describe the value of movement skills in human kinetics
- identify the three categories of movement skills
- demonstrate three locomotor skills.

3.0 MAIN CONTENT

3.1. Movement Skills

Every individual is eligible to develop basic movement or motor skills. These movement skills are essential successful performance of your daily activities. Your daily activities ordinarily should involve physical activities, so, movement skills are involved. Basic movement skill is the behaviour pattern of an individual that physically possess certain characteristics through the movement activities. Basic movement should be in line with an individual's growth process. The mastery of fundamental movement skills is commonly developed in childhood and subsequently refined into context and sport-specific skills. Movement skills enable movement in formal and informal activity sessions (play, games, dance and sport) in schools, sports clubs, community groups and at home. They include locomotor (e.g. running and hopping), non-locomotor or stability (e.g. balancing and twisting) and manipulative or object control (e.g. catching and throwing) skills, (Sari, 2019). You will consider non-locomotor and manipulative skills in Unit 3.

Fundamental movement skills are considered the basic building blocks for movement and provide the foundation for sport-specific movement skills required for participation in a variety of physical activities that make up sports, games, dance and exercise. They form the foundation for competent and confident participation in a range of physical activities. The fundamental movement skills to be developed through Human Kinetics include: locomotor, non-locomotor and manipulative skills, (Gallahue and Ozmun, 2006; Lubans, Morgan, Cliff, Barnett, and Okely, 2010).

Every movement you perform requires you to make use of your muscles. Depending on the muscles used, you can classify motor skills into two types, namely: fine and gross. Fine motor skills are a minor set of skills that are performed with small muscles. They are used to manipulate smaller objects, and require lesser energy. Some examples of fine motor skills include drawing, sketching, and cutting. Gross motor skills, on the other hand, are those motor skills which make use of comparatively bigger muscles in the body, and require high level of judgment and coordination. Some examples of gross motor skills are jumping, running and climbing.

The values of developing movement skills in health and performance cannot be ignored in serious human movement discussions. The mastery of movement skills has been shown to contribute to children's physical, cognitive and social development and provide the foundation for an active lifestyle. Furthermore, the successful development of FMSs is not

only essential to the acquisition of complex movement skills, but also promotes muscle coordination and assists in the development of interpersonal, cognitive, and emotional skills, (Lin and Yang, 2015). So, when movement skills are acquired and maintained from childhood through adulthood, it will be easier to lead a healthier active life.

3.2 Locomotor Skills

Locomotor skills are movement kills that make you move from a place, location or position to the other. When you stand up to open the door for a visitor, how do you move to the door? Perhaps you walk from where you were standing to the door. There are also many other locomotor skills that can take you to the door as well. Watch the locomotor skills video on YouTube at https://youtu.be/rCg-MkVkxyU?t=360.

Consider the description of some of the basic locomotor skills you watched in the video. As you consider them, practice them using the sequence shown in the accompanying illustrations.

3.2.1 Walk

You walk when you use your feet to move by steps from a location to the other. If you casually observe walking, you will conclude that it is a relatively simple task. You will observe from your consideration of this part that walking is a complex activity. A walk is performed the two lower limbs alternate, (see figure 59). It is an example of translator motion of the whole body, (Hamilton and Luttgens, 200). When walking, hold the head in line with the spine, the foot moves opposite to arm swing, arms swing through small arc, the leg pushes body forward, the heel of the foot hits or contacts the ground first and rolls to the toes, the knees are slightly flexed after hitting the ground with the toes face straight ahead. Figure 59 shows the patterns of flexion and extension of the hip, knee and ankle. Walking is a cyclic activity in which one stride follows another in a continuous pattern.

The kinematics of the walking gait is usually explained in terms of the strides and steps. What is the difference between strides and steps? A stride is one full lower limb cycle. A walking (and running) stride starts from touchdown of one foot to the next touchdown of the same foot, or from toe-off to toe-off. A stride length is the distance covered in a single stride. Step on the other hand starts with the heel strike on one limb and ends with the heel strike on the opposite limb, (Hamilton and Luttgens, 2002).

In walking, there is a single-support phase, when only one of your feet is on the ground, and a double-support phase, when both feet are in contact

with the ground. The single-support phase starts with toe-off of one foot and the double-support phase starts with touchdown of the same foot. The duration of the single-support phase is about four times that of the double-support phase. Alternatively, each leg can be considered separately. Each leg then has a stance and support phase, with similar functions to those in running, (Bartlett, 2007). You will consider running in this unit.

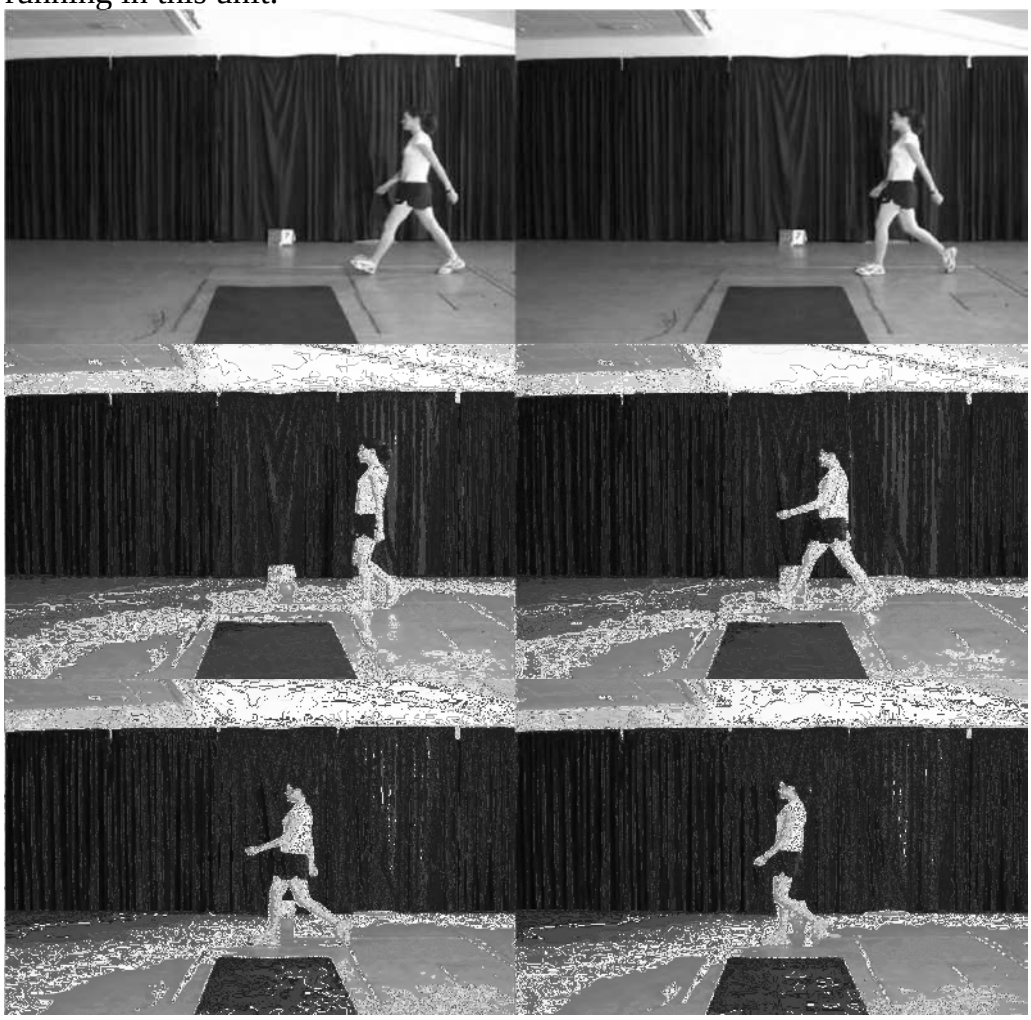

Figure 59: Walking over the ground. Source: Bartlett, 2007).

You will notice from figure 59 in the top left image that the left foot makes a touchdown with the heel. The top Right image shows the right foot toe-off. In the middle left image, the left foot is in a mid-stance, while in the middle right image, the right foot touches down similar to the top right image where the left leg hits the ground. Now carefully look at the bottom images and explain the images…….. Did you notice that in the bottom left image the left foot toe-off and in the bottom right image, right foot mid-stance?

Individuals do not always walk the same way. There are differences between males and females, between young and older adults and young

children, between walking ground and treadmill and at different speeds and treadmill inclines, and with various types of footwear – high, flat or balanced heel.

There are some common errors in walking. The foremost is swinging the right arm when the right foot is stepping or swinging the left arm when the left foot is stepping forward. It is also an error to contact the ground first with the ball of the foot. It is also an error when you are looking down instead of forward. Swinging your arms in crossing paths or across the front of the body is an error. When these errors are corrected, you can walk effortlessly. Safety should also be great concern while you walk. Be cautious of the space around you and avoid walking too close to people so that you will not step on others. Further, your arms should be closer to your body to avoid hitting other walkers.

3.2.2 Run

To run, you move fast by using your feet. When you run, you move with one foot off the ground at any given time. Bear the following points in mind while you run: Your trunk should slightly move forward as you swing the arms opposite to the feet stepping. Your arms swing large arc as the feet move the body upward and forward. In running the ball of your foot hits the ground first and at contact with the ground the knee is slightly flexed. Figure 60 illustrates a run.

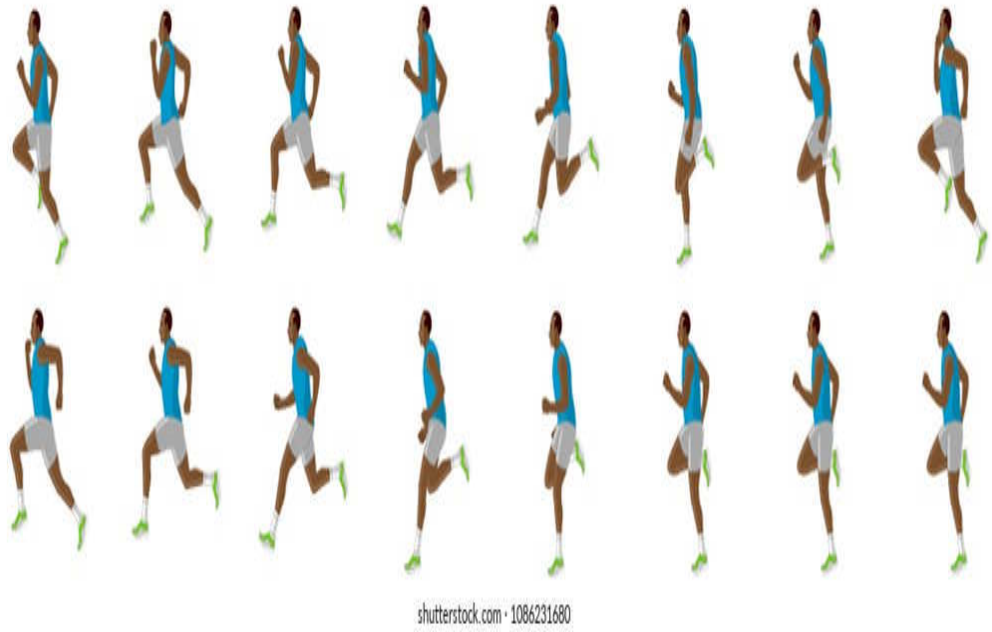

Figure 60: A Runner Illustrating a Run Sequence. Source: www.shutterstock.com.

Running, like walking, is a cyclic activity; one running stride follows another in a continuous pattern. A running stride starts from touchdown

of one foot to the next touchdown of the same foot, or from toe-off to toe-off. However, it defers from walking. Running is a fast movement and can basically be divided into a support phase, when one foot is on the ground, and a recovery phase, in which both feet are off the ground. The runner can only apply force to the ground for propulsion during the support phase, (remember the application of Newton's third law of motion).

There are some errors you must correct to enjoy running. These common errors include beginner runners over extending or stretching their leading legs. Additionally, swinging your arms uncontrollably, even hitting your body is an error. Swinging the arm and stepping the foot on the same side of the body at the same time is also an error in running. Running and throwing the legs to the sides is an error. While you take time to identify these errors and work hard to correct them, do not ignore safety. Give consideration to your dressing. Dress smart with appropriate footwear. Footwear is appropriate when it is not too loose or too tight on your feet and has a pressure absorbing sole. Be aware of the space you have to run. Ensure that the running environment or path to run is free of sharp objects and other materials that are dangerous to a runner. Avoid running on an unknown terrain and with people you know nothing about.

3.2.3 Hop

To hop, you push off one foot and land on same foot. You can hop vertically or horizontally. The knees and ankles are bent with the arms extended upward for take-off. The knees are slightly flexed throughout a hop. The ball of the foot softly makes contact with the ground. The knee and ankle flex when the foot makes contact or hit the ground. Learn to hop at least five times on one foot, (see figure 61), then switch to the other foot and continue the movement.

Figure 61: Illustration of one-foot hop. Source: www.workoutlabs.com.

There are few errors in hopping and they include not flexing knees slightly before take-off; difficulty switching and may be difficulty maintaining. This can be fun, but safety is important. Therefore, put on appropriate footwear that protects your ankle. Further, ensure that you have enough personal space to complete the hop properly.

3.2.4 Jump

To jump is more like to hop, but unlike hop in that you take off with one or two feet and land on your two feet. You can also jump vertically or horizontally. Jumps are often described as ballistic movements. Ballistic movements are rebounding movements initiated by muscle activity in one muscle group, continued in a coasting period with no muscle activation, and terminated by deceleration by the opposite muscle group or by passive tissue structures, such as ligaments. Many ballistic sports movements can be subdivided into three phases: preparation, action and recovery.

What is involved in jumping? Jumping starts with feet shoulder width apart, shoulders back and down with knees over your toes. At take-off, the arms are extended upward until arms reach full extension. Then, you extend your hip, knees and ankle. This is followed by the knee flexion as the body thrusts forward. The legs move forward, arms downward as the heels hit the ground first. Figure 62 illustrates the sequence of jump that you have considered.

Figure 62: Illustration of a jump. Source: https://www.dreamstime.com/stock-photo-jump-phases-man-different-jumping-image87446956

There are some common errors you must watch out for and avoid when jumping. They include - looking at the ground or your fit; takeoff done with one foot; landing on one foot; keeping your knees straight at takeoff or landing; putting your feet together when taking off or landing; loosing balance at landing. As you take time to observe and correct these errors, do not ignore safety. The following suggestions will help you to jump safely:

(1) Wear appropriate running shoes. A good running shoe will provide a good grip of the ground takeoff and landing.
(2) Take care to tie your shoe properly. If your shoe is carelessly tied, it might pull off your foot causing sports injury.
(3) Keep your head up and focused to avoid hitting others or objects.

3.2.5 Leap

In a leap, your body extends forward and upward; you take off with one foot with the other leg stretching forward and the arms out to the sides. You cover a large distance and land on the other foot with the knees and ankles flexed as the foot hits the ground. Several running steps lead to a leap. So, use several running steps to lead yourself into the leap. You can try five leaps in sequence. For a good leap, you must take these points to heart. Figure 63 provides an illustration of leaping sequence.

Figure 63: Illustration of leaping sequence. Source: https://www.canstockphoto.com/images-photos/leaping.html.

As you leap, avoid the following mistakes that are common among learners. These include –

(1) Uncontrolled landing which is as a result of exerting too much force on the ground at takeoff. If the force is too much on you, your movement will be awkward, make balance at landing difficult.

(2) Looking down at the ground or your feet. This will not only reduce your distance, but can make you hit other objects.

(3) Being unable to hit the ground at takeoff on one leg.

(4) Seeing hopping as leaping. This is taking off and landing on the same foot.

(5) Being unable to flex your hip, knees and ankle when landing.

There are some factors you must consider for your safety when leaping. You must wear appropriate and properly laced shoes. Ensure that you have adequate safe space for leaping; the surface must not be slippery or dusty. Always perform adequate warm up before leaping.

3.2.6 Gallop

To gallop, your feet face forward, step forward and close with the rear foot. The pattern is - step and close, step and close, step and close... The same foot always takes the leads. This means you have to keep the same foot in the lead as you perform the gallop. The rear foot always chases the leading foot and does not overtake it. Flex your knee. See the sequence of a gallop in figure 64. Watch the YouTube video on gallop from https://www.youtube.com/watch?v=RnTlBjNsHFg. The most common error in a gallop is converting it to a run. Others may be changing the leading leg with the rear leg, and may be leaning the body forward. Correct any of these errors whenever they are observed.

As a locomotor skill, gallop moves the entire body from one position to the other. So, it is important to give attention to some safety information. The laces on your shoes must be properly tied. It is equally important to do adequate warm-up. Make sure you have adequate galloping space and remain aware of your space throughout the gallop.

Figure 64: Illustration of the Sequence of a Gallop. Source: www.myactivesg.com.

Notice in figure 64 that the rear leg (in white coloured shoe) remained behind throughout the gallop. It did not move ahead of the leading leg (in ash coloured shoe). The knees are flexed without the body leaning forward.

3.2.7 Skip

For skip, you step forward, hop on that foot while bringing other foot forward to step and hop. After the hop you switch the feet. So, the leading leg steps forward then hop. The rear leg then steps forward and hops. You hit the ground softly with the balls of your feet while swinging your arms in direct opposition to the legs' movement in a rhythmic fashion. The YouTube video from https://www.youtube.com/watch?v=kBOJDqOIebY briefly shows the sequence of a skip. See the illustration of a skip sequence in figure 65.

Figure 65: Illustration of a Skip showing one leg. Source: www.wikihow.com.

Errors are common when performing a skip. For instance, there may be inability to step and hop using both legs but alternatively. It is also common to observe performers move swing right arm as the right leg is move making the movement non-rhythmical. Other errors include: landing on the heels or flat-footed and facing downward instead of forward.

Safety is very important in every movement. Therefore, certain safety concerns must be considered for effective skipping. You must wear appropriate footwear with lace properly tied. Adequate warn up is necessary for every activity and must not be ignored when skipping. Like other locomotor movements, skipping involves travelling, so, you must ensure that you have the required space for skipping. You must also be aware of the condition of the space.

3.2.8 Slide

This is another travelling skill which is usually a side-to-side movement, (figure 66). To slide, you step to the side, close with other foot, step to the side again, close with other. The leading footsteps rapidly to the side that is the preferred direction of travel. It is quickly followed by the other foot. The arms are move to the sides for balance. Watch the siding movement from https://www.youtube.com/watch?v=YvhOZdQwF-A.

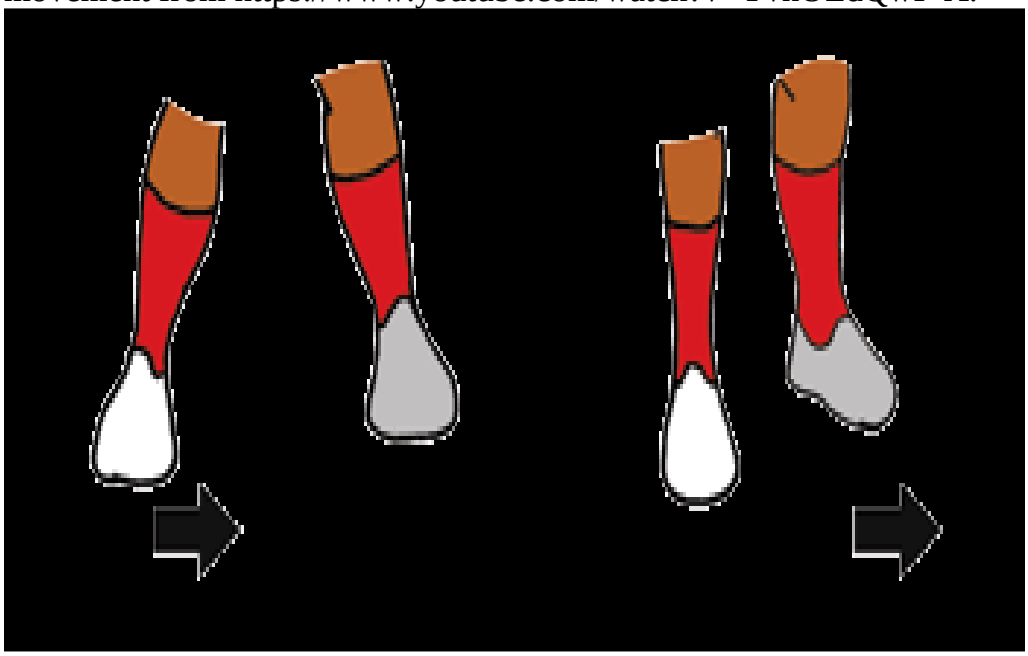

Figure 67: An illustration of the legs' movement when sliding. Source: www.myactivesg.com.

In figure 67, the arrows show the direction of travel. The legs are to follow this direction. The leg with the foot in ash-coloured footwear moves to the side and is quickly followed by the other foot in white-

coloured shoe. After about five (5) slides, you can change your direction of travel by changing the leading leg.

There are errors in sliding that you must watch out for. The most common is the crossing of the feet while moving in the same direction of travel. Remember, in sliding, the movement is always to the sides and one foot always takes the lead in one direction of travel while the other follows. Another common error is moving proficiently to one direction of travel, may be right side, but when direction is changed, the feet begin to cross. You should be able to move to both right and left directions of travel. Sliding is a quick movement. Therefore, you must ensure safety by sliding with appropriate footwear. The place you are sliding must be spacious and free from sharp materials or any other injury causing objects. You must be aware of your sliding environment.

SELF-ASSESSMENT EXERCISE

1. When your arms are extended upward until arms reach full extension with your hip, knees and ankle extended by the knee flexion as your body thrusts forward, you have performed a-------

(a) Leap
(b) Skip
(c) Jump
(d) None of the above

2. Which of the following is not part of locomotor skill?

(a) Walk
(b) Turn
(c) Skip
(d) a and c.

4.0 CONCLUSION

At this point you may have realised that some of the movements you perform without taking note of, are very important building blocks for most (if not all) movements in sports, dance and exercise. Locomotor skills are important part of your daily life. Therefore, your consideration of this unit has added movement skills to your knowledge and daily events. Take time to master these skills and correctly practice them in your day – to – day activities.

5.0 SUMMARY

This unit has prepared you to be able to identify and perform basic locomotor skills. It has also discussed the importance of avoiding the common errors in these movements. You have further learnt that observing safety guidelines are critical for your successful performance of these movements. Some of these movements are while walking, running, jumping, and lifting.

6.0 TUTOR-MARKED ASSIGNMENT

1. In a hop, you take off with one foot and land with ----------

(a) Both feet
(b) The other foot
(c) The same foot
(d) None of the above

2. The motor skill that you perform with small muscles is called ----

(a) Small Motor Skill
(b) Refined Motor Skill
(c) Gross Motor Skill
(d) Fine Motor Skill

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UNIT 3 NON-LOCOMOTOR AND MANIPULATIVE SKILLS

CONTENTS

1.0 INTRODUCTION

Unit 2 has introduced you to movement skills. In that unit, you considered locomotor skills as one of the classifications of movement skills. This unit will teach you the other two classifications of movement skills, which are non-locomotor and manipulative skills. These skills contribute to improved health and an active lifestyle and are very important in your successful performance of movements.

2.0 INTENDED LEARNING OUTCOME (ILO

By the end of this unit, you will be able to:

- identify five non-locomotor skills that contribute to improved health and an active lifestyle
- describe two non-locomotor movement skills
- demonstrate three manipulative skills.

3.0 MAIN CONTENT

3.1 Non-Locomotor Skills

Non-locomotor movement skills are non-travelling movements. They are movements in which the body doesn't travel; in other words, they can be performed while staying in the same space. Hey form one of the categories of the basic movement which is the basis of the movement of children and movements performed in various playing activities, sports, and dance. There are many non-locomotor skills. The following movements are some for your consideration:

3.1.1 Stretch

You may think of stretching as something performed only by runners or gymnasts. Note that you need to stretch in order to protect your movement and freedom. Stretching is a movement where you extend your limbs or the entire body without moving from place to place. When you stretch, you keep your muscles free, strong and ready to work. This enhances the flexibility of your joints. Without stretching and the resultant flexibility, your muscle will shorten, become hard and tight. In this condition, it becomes difficult to deploy the muscle for activity, because the muscles will be weak, (Harvard Medical School, 2019). Can you imagine what might happen to you? The weak muscles will put you at high risk of sports injuries like, joint pain, strain and muscle rupture. Stretching a muscle to the full extent of your ability and holding it for 15 to 30 seconds is what's called a static stretch and is very beneficial to your health and performance. Figure 68 illustrates stretching for different body segments.

Figure 68: Illustration of static stretching of different segments of the body. Source: www.shutterstock.com

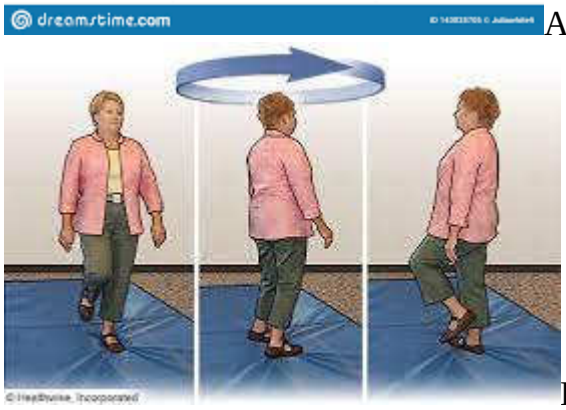
3.1.2 Twist

This is a rotation motion where you rotate your body or body parts around a stationary base. It is the rotation of a body part or whole body around its axis. You can twist your upper body back and forth while keep feet still or in place, (figure 69). Activities you twist on include dance, gymnastics, football, volleyball and tennis among others.

Figure 69: Illustration of upper body back and forth twisting. Source: www.shutterstock.com

3.1.3 Turn

This is a partial or complete rotation of the body while shifting the base of support. When you do a turn, you spin to make yourself dizzy, (figure 70A).



A

B

Figure 70: Turning the torso, (A) Spinning the whole body (B). Source: www.dreamstime.com; www.burlingtonent.com

Figure 70A illustrates a complete rotation of the body. It helps to develop balance. The following guidelines will help you to safely perform a turn:

(1) Stand with a chair in front of you and a wall behind you. If you begin to fall, you may use them for support.
(2) Stand with your feet slightly apart (as you normally stand) and your arms at your side.
(3) Turn one half-circle (180 degrees).
(4) Stop for 10 seconds or, if you feel dizzy, as the case may be, until the dizziness goes away.

Try this 5 times. The first time you perform this movement, start by turning to the right, and the second time, turn to the left. Which of these sides (right and left) makes you feel dizzier? Then focus on turning the direction that makes you feel dizzier, (Healthwise Staff, 2020). The chair in front of you at the beginning and wall behind you are for your support when feeling dizzy.

3.1.4 Punch

Punches are one of the most straightforward movements you can perform. A punch is a forceful action that can be performed with various body parts. The hands, elbows, feet, knees are common body segments

for a punch. It is common to hear exercise scientists instruct their clients to punch the air, (see figure 71). Punches are simultaneous push-pattern motions. Punches are usually directed horizontally rather than vertically, (Hamilton and Luttgens, 2002). You are designed in a way that favours punching. Punching requires a forward facing position. To perform a punch, keep your clichéd fists close to your chin, on either side of your face. Give a punch by moving the arm forward in an alternate fashion and return the fists to the chin position after executing each punch.

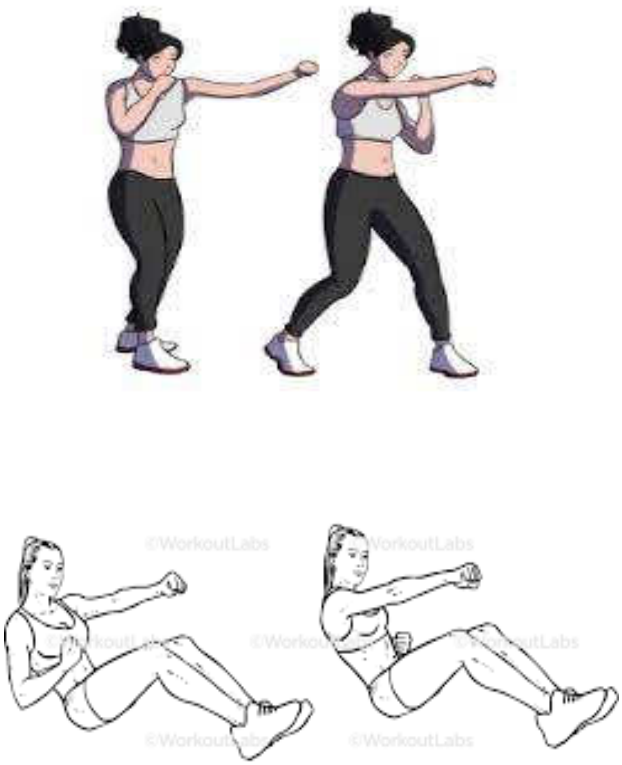


Figure 71: Illustration of standing and modified punches. Source: www.yourfitnesstools.com

3.1.5 Push

A push movement is performed when your muscle pushes something (weight) away from the body during the concentric phase of the movement and then lengthens in the eccentric phase when the weight is moved back toward the body in this non-travelling motion, you try to move something away by pressure. You imagine you are pushing something. You can push forward, sideways or upward. You can also push downward, (see figure 72). Pushing movement is used during push-ups, bench presses, back squats, and forward lunges. These activities use the following muscles as prime movers: the gluteus

maximus, quadriceps, calves, pectoralis major, deltoids, and triceps, (Davis, 2016).

Figure 72: Illustration of a push up sequence. Source: www.dao.alaska.gov.

3.1.6 Pull

In this motion, you exert force on an object to move it towards source of force, which is you. You can pull an imaginary object from the side, front, above or below your body. A pull is performed when your muscle pulls weight toward the body during the concentric portion of the movement and then lengthens as the weight moves away from the body during the eccentric portion of the exercise. You can also pull your body weight, (see figure 73). The prime movers of pulling are the hamstrings, latissimus dorsi, trapezius, biceps, forearms, obliques, and abdominals.

Figure 73: Illustration of a pulling movement. Source: www.reddeltaproject.com.

3.1.7 Balancing

This is a motion where the body stands still on increasingly smaller bases, like standing on one foot, (see figure 74). The muscles of free body parts held tightly to prevent rocking. Avoid looking down at the ground or your feet. Rocking on the support leg should also be avoided. Do not lean your trunk sideways or forward to support your balancing.

Figure 74: Balancing on one foot while standing. Source: www.self.com

3.2 Manipulative Skills

At this level of your training, you must have thrown and caught a ball. When you did, you illustrated manipulative skills. Manipulative skills are motor skills that involve handling and controlling objects with the hand, the foot or an implement like stick, bat or racquet. Manipulative skills include throwing and catching, striking with the hands, feet and an implement. Kicking, volleying, batting and dribbling are also examples of manipulative skills. They are movement skills that depend on your ability to handle an object (like ball) or piece of equipment with control. They are also called object control skills. It requires you to handle objects with precision in accordance with speed and control. So, hand and body coordination are very important for you execute manipulative skills.

3.2.1 Throwing

Throwing skill is used to propel an object through the air by a motion from your arm. The throwing motion, be it overhand or under arm, is a complex motor skill that involves the entire body in a series of linked but sequential movements starting from the legs, progressing up through the pelvis and trunk, and culminating in a ballistic motion in the arm that propels a projectile forward. It is a very common skill in most athletic events, (https://en.wikipedia.org). The throws in athletic field events exclusively use this skill. It is also an important skill in many team ball games. Find this out for yourself by watching a soccer (football) match and recording the number of throw-ins in that match. Also, note the

number of times the goalkeeper will throw the ball.

Figure 75: Throwing a fitness or medicine ball using an overhand throwing. Source: www.veloprosports.com.

3.2.2 Catching

You have learnt throwing. Catching is another fun-filled activity which is enjoyed by everyone. It is instrumental in developing hand-eye coordination. To begin, pick a fallen ball and throw it back to your partner, who in turn throws it back to you. This time try to catch the ball in the air, (figure 76). Practice is the key here, so the training must be consistent. Besides balls, you can use a variety of objects during catching, like balloons, ribbon strips, sponges, or folded cloths.

Figure 76: An illustration of a catching skill. Source: www.inquirer.com.

3.2.3 Kicking

Kicking is a manipulative motor skill that involves lower body or lower limb movements. It begins the moment you use your leg to move a stationary ball. Though the leg is the focal point in this activity, the arms are also involved. So, you must learn how to swing your arms, and steady their hips in order to maintain balance when performing a kicking skill, (figure 77). Once these movements are mastered, running can be combined with kicking a ball along an obstacle course.

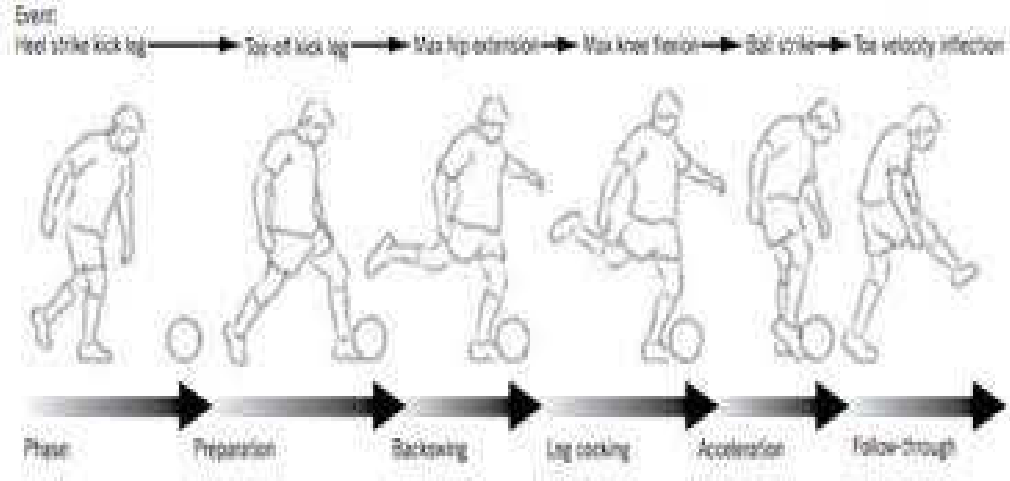


Figure 77: Illustration of a kicking motor skill. Source: www.ukessays.com.

3.2.4 Striking

In striking, an implement such as a bat, racquet or stick is used to contact an object, so as to propel it into the air. Mastering this skill begins with securely gripping the handle of the implement, and exerting enough force to propel the object. Start learning to strike with an implement that is light in weight held in your dominant hand. Striking is one of the toughest manipulative skill to master, so ensure that you give it adequate time and effort. Striking skill is important when you play tennis, table tennis, cricket, or squash.

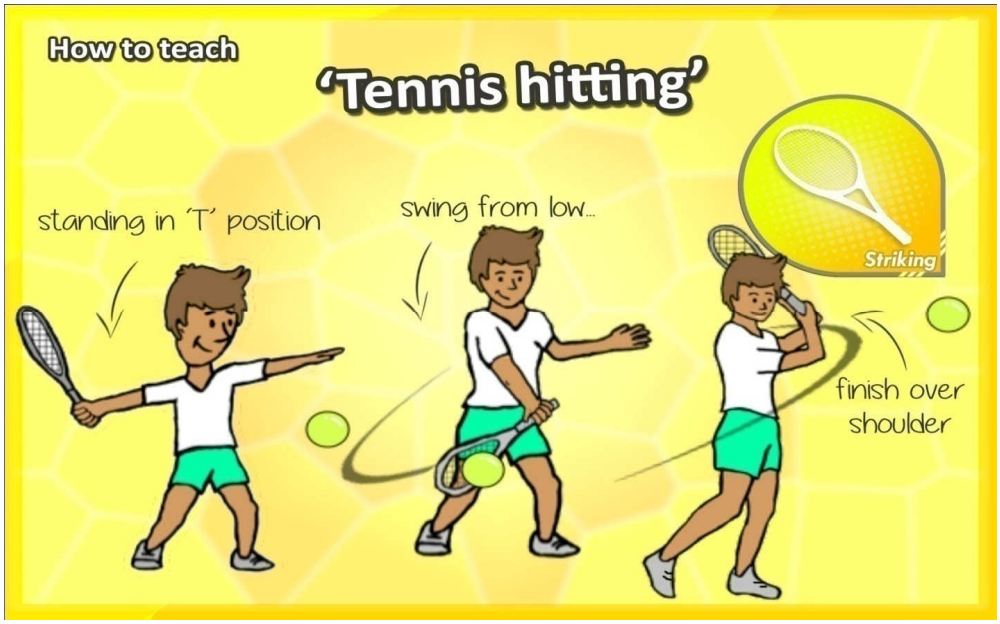


Figure 75: Illustration of striking sequence in tennis. Source: www.primecoachingsports.wordpress.co.

In human kinetics, manipulative skills are used efficiently to attain proficiency and expertise in a particular movement activity. In your skills and techniques courses, you perform basic manipulation skills in order to develop endurance, coordination and flexibility, along with accuracy. As you participate in these activities, you develop physical fitness. Also, they manage to understand their body well, and gauge its tolerance level. If you regularly engage in these movements, they will contribute to your overall health and well-being.

SELF-ASSESSMENT EXERCISE

1. Which of the following is non-locomotor skill?
(a) Walk
(b) Turn
(c) Skip
(d) a and c.

4.0 CONCLUSION

You have learnt that most skills used in sports and movement activities are advanced versions of fundamental motor skills. So, learning, develop and improve on your non-locomotor and manipulative skills will help you acquire skills that will lead to an active life later in life. It is therefore important that you put this knowledge to a good use in the field of play.

5.0 SUMMARY

This unit has identified some of the basic non-locomotor and manipulative skills. It illustrated turning, sliding, twisting, among others as non-locomotor skills. Catching, throwing, kicking and striking among others were also mentioned as manipulative skills. These skills were enable you visualise and practice them. You have also been exposed to the sports where those skills have dominant application.

6.0 TUTOR-MARKED ASSIGNMENT

1 In a strike, you contact the ball with ----------

(a) The head
(b) The ball
(c) The bat
(d) None of the above

2. Manipulative skills depend on ----------

(a) Your ability to control your body
(b) Your ability to run faster
(c) Your ability to control objects
(d) Your ability to control your hands.

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UNIT 4 BODY AWARENESS ACTIVITIES

CONTENTS

1.0 INTRODUCTION

You have considered movement skills in units 3 and 4. Some of those movements use different parts of your body. It is important that each you move or rest, those body segments involved be sensed. Unit 5 will teach you the concept of body awareness and other related concepts. You will see the benefits of body awareness and characteristics of poor body awareness.

2.0 INTENDED LEARNING OUTCOME (ILO)

By the end of this unit, you will be able to:

- mention three concepts related to body awareness
- discuss why you need to develop body awareness
- highlight 5 characteristics of poor body awareness
- demonstrate 2 body awareness activities.

3.0 MAIN CONTENT

3.1 Body Awareness

An active individual sometimes performs some movements in space. Different body parts are usually involved in these different movements. It is therefore important for you to learn to be aware of these body parts and the movements they are involved in. Body awareness refers to one's awareness of the body parts or dimensions, (Valenzuela-Moguillansky,

Bouhassira & O'Regan, 2011). It is the sensory awareness that originates from the body's physiological state, involving interactive processes (including pain and emotion), actions (including movement), and appraisal (as well as complex bottom-up and top-down neural activities) shaped by the person's attitudes, beliefs, and experience in their social and cultural context (Price and Mehlings, 2016).

The concept of body awareness involves different facets of the experience of being a body. It is the knowledge necessary to move your body through space; to relate to and interact with other objects and bodies; to know that your body is yours and not someone else's. Body awareness also concerns how you imagine your body, how you feel it, and how you feel *about* it. In your everyday life, all these aspects combine, and the fact that your body is there, and that you experience through it, becomes almost transparent to you. Has there ever been a time when someone told you that your hand is your's? It is obvious to you that your arm is your arm. When you want to lift it and reach for a glass for a drink or scratch your head, you do not need to think about the position or the movements of your arm. Why? This is because you are developing body awareness.

There are some concepts that are related to body awareness. These concepts include body schema, body image and body ownership. Body schema is a real time-time dynamic representation of one's own body in space, which is derived from sensory input and is integrated with motor systems for the control of action of the body. Body image is a conscious representation of the body, thought to be maintained by ongoing tactile, proprioceptive, and visual input. It can be modulated by memory, belief, and psychosocial factors. The sense of body-ownership on its own is the sense that it is your body that is undergoing a certain experience, (Price and Mehlings, 2016; Valenzuela-Moguillansky, Bouhassira & O'Regan, 2011).

Body awareness is concerned with both proprioception and interoception. It is necessary you know the meaning of these terms. Proprioception is the perception of joint angles and muscle tensions, of movement, posture, and balance. Interoception is the perception of all sensations from inside the body and includes the perception of physical sensations related to internal organ function such as heart beat, respiration, satiety and the autonomic nervous system symptoms related to emotions. The brain is the center for body awareness development. The brain has body "maps" or precepts which carry information about every body part and its relationship to each other. These maps help you to realize how your body feels like when vision is blocked. Body awareness tells about the condition of the segments of your body without looking at different body parts. Common example is seen when

scratching your back when it itches or wiping face when it has dirt or sweat on it. The many actions that go on in this example are usually taken as for granted by everyone, may be you do too. However, your brain and body do not take them for granted. They work together to process sensory information from the brain to various sensory systems. Consider the wiping of the face example to see how this works. In that example, the brain sends messages to elbow so that specific muscles can contract and relax to flex your elbow joint enabling your hand to go up to your face to clean the sweat or dirt. Hand muscles that are related also contract and relax in the wiping of your face. Your brain directs your hand to your face.

3.1.1 Benefits of Body Awareness

Body awareness is the ability to recognise where your body is in space. Your muscles and joints send your information to your brain about your body and how it moves. Have you wondered why you are considering body awareness in kinesiology? There are many reasons for this consideration.

(1) Because body Awareness is the foundation upon which children learn to coordinate their body parts and move through space and about objects in their environment, children who do not have adequate body awareness often appear clumsy or awkward, and they frequently have difficulty with gross and fine motor activities that require subtle changes in posture, strength or force, (Skill Builders, 2002; Price and Mehlings, 2016).

(2) Body awareness enables you to understand how best to relate to objects and people at home, at school and outdoors. For instance, proper body awareness tells you how far to reach for objects or how close to stand next to a person.

(3) Developing body awareness is very important in understanding and acquiring such abilities as mathematical skills and visual perceptual skills. It is also related to handwriting skills. It is best to develop body awareness throughout early and mid-childhood, reaching an adult state by 10 to 11 years. If it is missed at these stages, developing it may be a very difficult task, but not impossible.

3.1.2 Characteristics of Poor Body Awareness

When you observe any of the following characteristics in yourself or any child, it indicates poor body awareness:

(1) Persons with poor body awareness easily bump into others or stand in very close proximity to other people when interacting with them.

(2) They find it difficult to organise themselves in the classroom as well as home.

(3) The concept of right and left, up-down, under-over, or in-out is confusing for them to understand and learn therefore following directions is a difficult task. They easily get lost in a journey.

(4) Poor body awareness makes subjects like mathematics, physics difficult to understand. Persons with this condition find Geometry, shapes, volumes, calculations hard to understand.

(5) Copying from the blackboard is a struggle for people with poor body awareness due to midline crossing difficulties.

(6) There may also experience difficulty while playing games like football or cricket that involve judging distance and speed of ball.

(7) With poor body awareness child's brain is not able to do motor planning resulting in poor control over tasks, like, taking care of oneself. This interferes with their learning process.

3.1.2 Development of Body Awareness

How can you improve on your body awareness or help someone, like children, develop it? There are many approaches to helping children, for instance, develop body awareness. Start out by reviewing and identifying body parts. Begin with very simple commands such as kick your leg, wave your hand or shake your head. Then progress to motor commands such as "touch your elbow, touch your head" among others. Then progress to more difficult commands such as "touch your right knee". You can make the skills even more difficult by practicing touching different body parts to different body parts like touching your right ear with your left hand; putting your right elbow on your left thumb.

3.2 Body Awareness Activities

Body awareness has been presented to you as the foundation upon which you learn to coordinate your body parts and move through space and about objects in your environment. You have also learnt that it best developed during childhood. There are many game activities, (like Hula hoop and Simon says games) that help develop body awareness. Perhaps you missed it as a child; therefore, you will have to develop it to be able to help others to acquire it. The following activities will help you:

(1) Balance activities are very important in developing and maintaining body awareness. Improving balance is one way to activate both the proprioceptive and vestibular systems, thus increasing awareness of the body. Participating in heavy work exercises called proprioceptive input is beneficial for balance. This type of input gives your muscles and joints information about how your arms, legs, head and trunk move. Weight bearing activities, such as, wheelbarrow walking, jumping, stomping the feet, pushups, pushing-pulling and carrying heavy objects among others are technically proprioceptive input activities.

(2) Yoga activities within the realm of physical activities enhance body awareness. Globally, Yoga is one of the most well-known and widely practiced forms of body awareness exercise.

(3) Walking backward will also help you develop and maintain body awareness.

3.2.1 Hoop Games

Hoop games are very good in the development and maintenance of body awareness. Hoops are popular in many games and activities, whether it is a warm-up activity for skills acquisition classes for students, or a planned activity to keep you fit and active. Hoops are a great choice for you because they are inexpensive and versatile, making them perfect for many different physical activities, (see images of a hula hoop in figure 76). 

Figure 76: Illustration of different hoop activities. Source: www.hesston.edu; www.shutterstock.com.

Watch the following You Tube videos from https://www.youtube.com/watch?v=rHj3i41ehew; https://www.youtube.com/watch?v=EuwNgNiC4BY, where hoops are used as the main piece of equipment, or an important part of the activity. When watching, join in the activities to appreciate the use of hoops in developing body awareness.

After watching those videos, try the following activity through the hoop. For a start, break up the group into several small teams (about 3 children in each group). Give each group one hula hoop. Establish a starting line and another line about 10-20 feet away. The first person in each group runs to the line that is 10-20 feet away and holds the hoop several inches off the ground. Then the next person runs down, climbs through the hoop and back to the starting line. The third person runs down, climbs through the hoop and back to the starting line. The first person climbs through the hoop while holding it and runs back to start. The first team with all three players through the hoop is the winner.

3.2.2 Simon Says Game

Giving the benefits and the desire to help children develop body awareness, Simon says game has become very popular and both children and adults loved it. It is a game idea that develops body awareness in children and can be played at the park with friends, both at night and in the afternoon. How is “Simon says” game played? You may have on many occasions played or watched this game. For a start, designate one person in the group as Simon and the others as players. Simon stands in front of the players and tells others what they must do. It is important the players must only obey

commands from Simon that begin with the words "Simon says". For example, if Simon says, play imaginary guitar, players must pretend to play a guitar. Then if Simon says "kiss your elbow", you reach for your elbow to kiss it. Whoever follows the command that doesn't have Simon says, is out of the game.

Consider some of the funny but activity packed Simon says ideas that will help you develop and help others to develop body awareness, (https://playtivities.com/30-funniest-simon-says-ideas/). The activities you will consider are with some modifications. These are just ideas to help you create and develop your own game similar to the Simon says games. In the game, you can be the Simon, or ask someone in the group to be the Simon. These games are also funny games you can play at home and with friends. Watch Simon says game from https://www.youtube.com/watch?v=OxRfqmLJCXw.

Follow these commands to play the game:

1. Simon says wave your hands.
2. Simon says lift your feet up as high as you can.
3. Simon says play your imaginary guitar.
4. Simon says roll over.
5. Simon says shake your hip.
6. Simon says freeze.
7. Simon says rub your knees
8. Simon says pat your head with you two hands.
9. Simon says crawl like a baby.
10. Simon says pretend to climb a ladder.
11. Simon says punch the air.
12. Simon says cry like a baby.
13. Simon says freeze.
14. Simon says start singing your best song.
15. Simon says walk on your knees.
16. Simon says walk like a lion.
17. Simon says stomp your friend.
18. Simon says hug yourself.
19. Simon says hide your hands behind.
20. Simon says stand on 1 foot.
21. Simon says freeze.
22. Simon says kiss your knees.
23. Simon says hug your friend.
24. Simon says walk backwards.
25. Simon says say come in your language.
26. Simon says take off your imaginary cap.
27. Simon says kiss your elbow.

28. Simon says tickle your feet.
29. Simon says freeze.
30. Simon says do what your friend does.

SELF-ASSESSMENT EXERCISE

1. The perception of all The sensations from inside your body that includes your perception of physical sensations related to internal organ is known as ----------
(a) Body knowledge
(b) Interoception
(c) Proprioception
(d) Body Image

2. The ability to recognise where your body is in space is called ----------
(a) Posture
(b) Kinesiology
(c) Body awareness
(d) Proprioception

5.0 CONCLUSION

Mastering basic body awareness activities is an important step to sustaining development in Human Kinetics. This unit discussed specific benefits of body awareness. The unit exposed you to the discussion on body awareness as a quality that helps you move better. This was done to keep the benefits of body awareness fresh in your memory as you practice Human Kinetics.

6.0 SUMMARY

This unit has presented to you the characteristics that will help you to identify poor body awareness. You have also been exposed to the activities that develop body awareness. You are now very familiar with some concepts that are related to body awareness.

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https://playtivities.com/30-funniest-simon-says-ideas/

UNIT 5 KINESIOLOGICAL PERSPECTIVES OF EXERCISE AND FITNESS

CONTENTS

1.0 INTRODUCTION

The very focus of kinesiology is physical activity. Physical activity is the cause of the physiological changes that give rise to physical fitness. However, physical activities do not automatically bring these changes about. They have to be structured (exercise), and you must regularly participate in them for the purpose of developing and/or maintaining fitness. This unit will teach you how apply the concepts and principles of kinesiology in exercise programme to develop fitness.

2.0 INTENDED LEARNING OUTCOME (ILO)

By the end of this unit, you will be able to:

- explain the focus of kinesiology and exercise physiology in an exercise programme
- state two benefits of flexibility to the body
- differentiate between muscular strength and endurance
- demonstrate stretching activity for flexibility development.

3.0 MAIN CONTENT

3.1 Kinesiological View of Fitness and Exercise Programme

When you participate in an exercise programme, what motivates you to do so? No doubt, it is fitness. Yes! Fitness is the major objective of most exercise programme. Exercise programmes are designed to affect the musculoskeletal and cardiorespiratory systems positively. This positive effect is called adaptation. The adaptation makes for an increase in various fitness factors, such as, strength, endurance, flexibility and work capacity for efficient, safer and more enjoyable movement in work, play and activity of daily life. The focus of kinesiology in an exercise programme is on the forces that bring about the motions used in the exercise and the analysis of the techniques employed. Remember that exercise physiology which focuses on energy sources and demands is also involved in an exercise programme. Therefore, for an effective exercise programme, you need the knowledge of both kinesiology and exercise physiology. This unit will focus only on kinesiology of selected physical activities for developing and improving flexibility, muscular strength and endurance.

3.1.1 Joint Flexibility Development

You are able to sit, move and carryout some of your daily life activities because you have a measure of flexibility. Joint flexibility is an important factor of wellness. So, it contributes to your general health and physical fitness. It is one of the factors in the health related component of physical fitness. Adequate level of flexibility helps prevent low back pain and many other aches and pains that are associated with aging, (Hamilton and Luttgens, 2002).

What is flexibility? Your body is endowed with many joints. Joints are functional junctions formed by bones. They are points where two or more bones meet. Flexibility is the ability of a joint to move freely through its full range of motion, (Hoeger and Hoeger, 2005). It is the ability of the tissues surrounding a joint to yield to stretching without interference or opposition and then relax, (Hamilton and Luttgens, 2002). What are these surrounding tissues? You have learnt that joints are junctions formed by bones. The surrounding tissues are those structures found around a joint. They include ligaments, fasciae and other connective tissues related to the joint and antagonistic muscles. See figure 77 that shows that knee joint with the surrounding tissues.

Figure 77: Illustration of the structure of the knee joint with its surrounding tissues.

Development and maintenance of some levels of flexibility are very important in all health promotion exercise programmes. Unfortunately, this segment of an exercise programme is usually overlooked or ignored. Note that many skeletal problems and injuries especially in adults are related to a lack of or low level of flexibility. So, how will develop flexibility? You can develop joint flexibility through stretching. You have considered stretching in unit 3 under non-locomotor skills. Using stretching as part of your warm up and cool down for your exercise programme will help reduce pain and other injuries, at the same time improve joint flexibility.

You have learnt that there are many joints in your body. The flexibility of a joint depends on (1) the anatomy (structure) of the joint, and (2) the type of movement the joint allows and is required to perform. So, flexibility of one joint does not translate to flexibility of all joints. From this it is not out of place to conclude that flexibility is joint and activity specific. Attention is focused on specific joints that involved in an exercise programme during stretching. For a good exercise programme, flexibility activities must be able to stretch the tissues that cross the lower, hip, knees, ankle and shoulder.

Stretching may be ballistic or static. Ballistic stretching involves bouncing motions that mount great pressure on the joint. Though effective in developing flexibility, it has a high risk of injury. It is therefore, not recommended for beginners in exercise programme. Static stretching involves gradual stretching of the joint tissues up to the point of discomfort and the position where the discomfort is felt is held for a period of 10 to 30 seconds. For instance, to stretch your shoulder, back, hip and joints of lower limbs, assume a sitting position on a flat surface; extend your knees; reach forward to touch your toes with your fingers; continue reaching forward until fill a discomfort; then hold the position for a period of 10 to 30 seconds, (see figure 78). Be sure to warm up before doing any stretching. Good examples of warm up activities are slowly running in place or walking briskly, or burpee for about five minutes.

Figure 78: Illustration of an activity for developing flexibility. Source: www.pinterest.com.

3.2 Muscular Strength and Endurance Development

You may have thought that development of muscular strength and endurance is only good for athletes and those who do hard jobs like wood braking, wheelbarrow pushing among others. Note that muscular strength and endurance are important factors that define your physical fitness. They are important for your wellbeing now and throughout life. For you to be able to sit, stand, walk, run, jump, lift, carry objects, do chores and enjoy recreational activities, you need strength.

Intelligent selection of physical activities will be done when due consideration is given to muscular strength and endurance. This

consideration involves knowing the meaning of muscular strength and endurance. Although muscular strength and endurance are interrelated, there is a great difference in their meanings. Muscular strength is the force a muscle or muscle group exerts against a given resistance or load in one repetition maximum, (1-RM) or maximum effort. A repetition maximum is a concept made popular in the late 1940s by Daloma and Watkins. It is a maximum resistance or load a muscle group can lift a given number of times before fatigue sets in, (Hamilton and Lutgens, 2002). 1 – RM is the maximum amount of weight lifted one time using proper form during a standard weight lifting exercise, (McArdle, Katch and Katch, 2010: 492). Hoeger and Hoeger, (2005), described it as the ability to exert maximum force against a resistance. From these views, the important consideration for muscular strength is maximum force or effort.

Muscular endurance on its own is the ability to carry out repeated contractions by a muscle or muscle group. It is the ability to sustain a contraction against a sub-maximal resistance over an extended period of time. So, when a muscle sustains an exertion of a sub-maximal force repeatedly over a period of time, it indicates a level of muscle endurance. Muscle endurance depends to a very large extent on muscular strength. A muscle with low strength level will find it very difficult to repeat an action or movement several times or sustain a contraction for an extended period of time. Therefore, it is very important to incorporate these two factors of health-related physical fitness component into any exercise programme. In strength development, the important factor will be the amount of load or weight employed to overload the muscles, while in the development of endurance, it is the number of repetitions of the movement that is of great concern, (Hoeger and Hoeger, 2005).

In an exercise programme for the development of muscular strength and endurance, some terms define the type of training involved. These terms are progressive-resistance weight training, isometric training, and isokinetic training. There are basically two types of muscle actions involved those training approaches. They are static and dynamic muscle actions.

3.2.3 Static Action

Static action is a muscle action that does not result in an observable motion. It is also called isometric action and occurs when a muscle generates force and attempts to shorten but cannot overcome the external resistance. There is no change in the length of the muscle involved, hence, no observable motion, (McArddle, Katch and Katch, 2010). There are many isometric exercises. Figure 79 illustrates the

plank as an example of isometric muscle action. The isometric muscle action does not produce mechanical work. However, it can generate considerable force despite the absence of observable lengthening or shortening of muscle sarcomeres and subsequent joint movement.

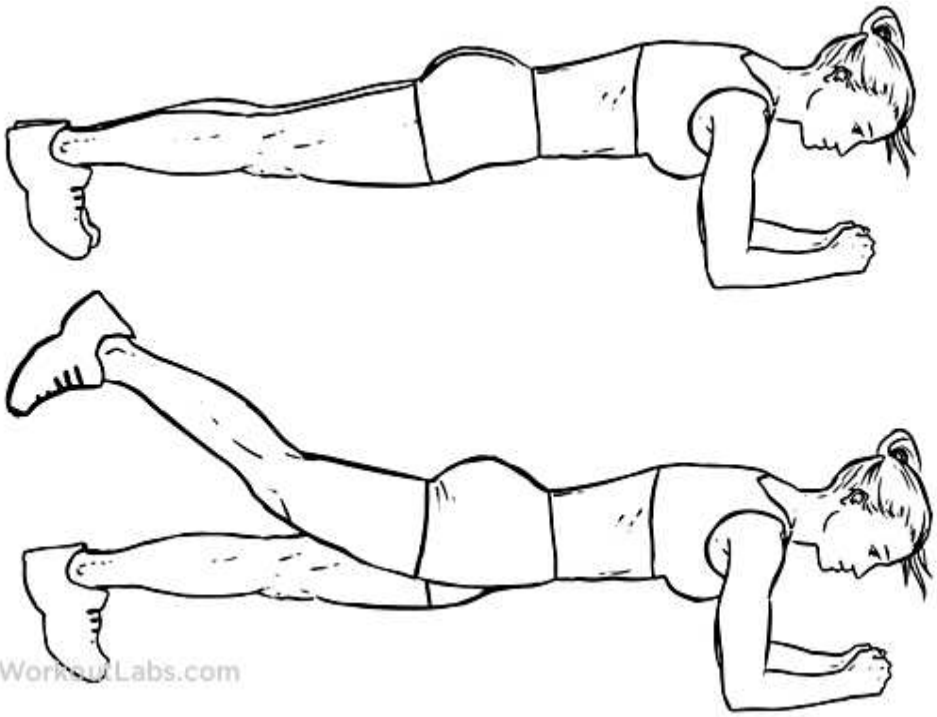


Figure 79: Illustration of isometric exercise (plank). Source: www.workoutlab.com

Isometric training has serious disadvantages that, sometime, becloud its strength development capabilities. Some of these disadvantages are:

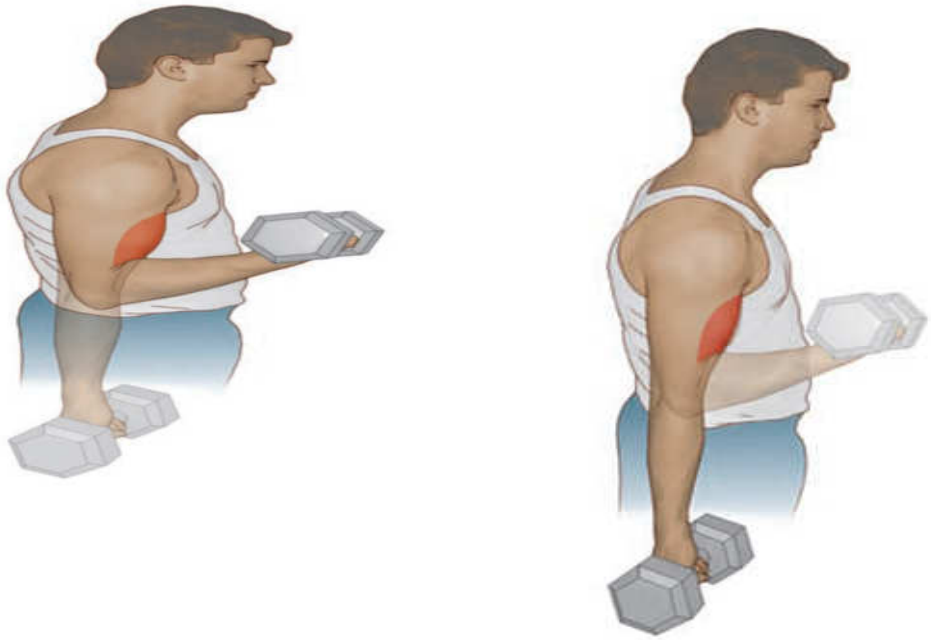
1. It improves muscular strength only without having any effect on flexibility and cardiovascular endurance.
2. It works on the red muscles mainly. So, it is not suitable for any who wants to improve on speed of motion.
3. It causes great pressure to build inside the body affecting breathing. This is its greatest disadvantage that has made it unsafe for persons above 35 years of age to engage in it. It is also dangerous for people with heart disease or weak abdominal wall to embark on isometric action.

3.2.2 Dynamic Action

Dynamic muscle action, unlike static muscle action, produces noticeable movement of a body part, such as an upper or lower limb or the trunk, as a result of muscle contraction. There are two types of dynamic action of the muscle - Concentric and eccentric actions.

Concentric action involves the lifting of a load or weight through a specified range of motion. This weight could be dumbbells, disk weight or stack weights that usually come as part of multi-gym or Universal Gym. In this action, the muscle shortens and joint movement occurs as tension develops. In figure 80a, the biceps shorten as the weight is lifted, (↑). As the dumbbell is raised, the elbow is flexed. In the concentric action, the resistance or load moved by the contracting muscle is not only the weight of the dumbbell, but the product of the weight of the load and the length of the load or resistance arm of the anatomical lever (bone) involved in the action.

Eccentric action is a reverse movement to the concentric action, which is the lowering of the load or weight. Figure 80b shows the lowering of the weight, where the triceps contracts to extend the elbow. It is done in a slow but controlled fashion and occurs when external resistance exceeds muscle force and the muscle lengthens while developing tension. This action uses the eccentric contraction of the antagonistic muscle, which in the case of elbow flexion is the triceps. The eccentric contraction is more effective in strength development because the slow fashion in which it is performed makes the contraction to sustain more tension than in the concentric contraction.



a↑ b ↓

Figure 80: Muscle actions showing (a) concentric (shortening), and (b) eccentric (lengthening). Source: McArddle, Katch and Katch, (2010).

In weight lifting, muscles frequently act eccentrically (figure 80b) as the weight slowly returns to the starting position to begin the next concentric (shortening) action, (figure 80a). If in the eccentric phase of weight lifting, the weight is slowly lowered, it may produce less muscle soreness than concentric action, (Hamilton and Luttgens, 2002). However, using eccentric contraction solely as training activity for strength development will be counterproductive, unless the activity being trained for contains eccentric contraction movement form.

SELF-ASSESSMENT EXERCISE

i. Range of motion is related to ----------
   a. Muscular endurance
   b. Joint flexibility
   c. Eccentric contraction
   d. Concentric contraction

ii. The development of flexibility is done through what?

   a. Running
   b. Jumping
   c. Stretching
   d. Sliding

4.0 CONCLUSION

Mastering basic kinesiological concepts and principles in fitness and exercise programme is an important step to sustaining development in Human Kinetics. This unit discussed specific approaches you need for the development of flexibility, muscular strength and endurance which are foundations of fitness development. You are now better prepared to apply the principles and skills of kinesiology.

5.0 TUTOR-MARKED ASSIGNMENT

1. The focus of muscular strength is ----------

(a) Physical activity
(b) Maximum effort
(c) Number of repetition
(d) Weight training

2. The flexibility of a joint depends on which of the following?

(a) Length of the bone
(b) Training programme
(c) Relationship between anatomy and joint
(d) Anatomy of the joint

6.0 SUMMARY

This unit has presented to you the concern of kinesiology in fitness and exercise programme. You have also been exposed to, in very specific terms, the benefits of flexibility, muscular strength and endurance to your health and wellbeing.

7.0 REFERENCES/FURTHER READING

Hamilton, N. & Luttgens, K; (2002). *Kinesiology: Scientific Basis of Human Motion*, (10th ed.). Boston: McGraww Hill.

Hoeger, W. W. K. & Hoeger, S. A., (2005). *Fistness and Wellness*, (6th ed.). Australia: Thomson Wadsworth.

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