FUNDAMENTAL KINESIOLOGY MADE PLAIN AND SIMPLE:

A PROGRAMMED TEXT FOR STUDENTS

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Abstract

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Kinesiology, the science of human movement, is taught to give anyone basic understanding and concepts concerning how and why the human body moves as it does. Kinesiology is a foundation class for the college undergraduate or graduate student in any of several areas of study including sports medicine, nursing, physical therapy, coaching, physical education, safety, fitness and wellness, aerobics, sports training, risk management, or any of the lifetime sports. However, students often have little or no background in science and even more frequently have difficulty in identifying essential concepts and understandings particularly when confronted with a verbose, technical textbook that is very intimidating. This programmed text is one solution. It is designed to enable the student to build a foundation of knowledge, one step at a time, while feeling confident that upon completion of the text, the more important concepts, essential facts, understanding, and vocabulary will have been mastered. Application of concepts and principles of anatomy, physiology, and the mechanics of human activity are incorporated. Topics covered include beginnings of kinesiology, joints, muscles, muscular action, machines of the body, stability and motion, force and work, factors of stability, and classification of

activities. Upon completion of the text, students should have an understanding of the anatomic background essential for understanding human movement, should understand the fundamentals of mechanics as they apply to movement analysis, and should understand kinesiologic analysis of human movements.

ACKNOWLEDGEMENTS

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INTRODUCTION

Kinesiology, the science of human movement, is taught to give basic understanding and concepts concerning how and why the human body moves as it does. Kinesiology is a foundation class for the college undergraduate or graduate student in any of several areas of interest including sports medicine, nursing, physical therapy, coaching, physical education, safety, fitness, risk management, aerobics, sports training, or any of the lifetime sports. The need for knowledge of kinesiology is important to an increasing number of professions. Current trends also suggest the subject of kinesiology will be increasingly beneficial for many professions. Educators would do well to consider major trends for the future in preparing their kinesiology classes.

John Naisbitt (1982), author of the bestseller Megatrends, identified ten megatrends which included the population shift from North to South and to specific areas such as the sun belt, the importance of the computer in office and home, decentralization of institutions, and increased diversity among groups, institutions, and people. Cetron and O'Toole (1982) made specific forecasts of, among others, a 32-hour work week and then a 25-hour work week, an increase in number of older people, increased use of computers, increases in life-spans and increases in number of divorces, free universal

day-care, and welfare subsidies only for the disabled and handicapped. Templin (1987), in compiling demographics from several sources, noted the percentage of traditional nuclear families will continue to decline, more people are working, more children live with just one parent because of the high divorce rates, 25 percent of children are 'latchkey' ones, and the average age of Americans is increasing. Even in the so-called popular press, similar trends are forecast. Writing for the April 1991 Saturday Evening Post, Judith Waldrop predicted increased diversity of population, non-traditional definitions of family, more people working in smaller businesses or from home or with flexible time, more older people, more workers with more leisure time, the increased importance of health and of leisure time, and the continuation of the population shift from rural or small town areas to urban metropolitan areas.

Several of these trends have special significance for educators. First, the total population will increase and average ages will increase as well as the percentage of elderly. Along with this, there will be increased diversity of population, in part because of immigration. Next, more people will be working but the time spent working may be shorter. Employers will also use more part-time workers. Third, use of computers and high technology equipment will become more and more common. Advances in technology, communication methods, and computer applications will continue. Next,

leisure activities will be of increasing importance. Also, health and fitness will be actively sought by more of the population. Sixth, more dollars will buy less. One implication of this is the likelihood that office and work areas will become smaller. Another implication is that students will have to wait longer to go to college or will have to go to school part-time in order to work. Another is that students will have a more difficult time paying for the costs of college. Seventh, the shifting from North to South and rural to urban will continue. Eighth, jobs related to manufacturing will continue to decline while jobs in service oriented or health-care related professions increase.

These trends are important to educators in planning a course or curriculum in kinesiology because they help answer the questions of who and where and help determine what and how. Educators will have more older students, more part-time students, more women students, and more students from varied backgrounds. More students will find it necessary to have a better background in the health sciences. Lifetime fitness and health skills or interests and leisure activities will also become increasingly important. Because of more leisure time, higher levels of stress and shrinking personal space, students will need lifetime sports, stress reduction, leisure activities, and fitness to maintain good mental health. Higher education will not be limited to the locale of the local university campus.

Colleges will work with local schools to provide instruction in topics for leisure, entertainment, and academic interests. Colleges will also work with employers to bring training programs directly to the workplaces, perhaps even using video teleconferencing. Class scheduling will be changed to allow more classes at non-traditional school hours. Developing technology may allow classes to be held with students in their homes receiving broadcasts but able to interact with the instructor or other students.

Preparing students for the future should mean some changes in teaching methods as well. Educators need to move away from lecture dominated classes and make use of class discussion, projects, problem solving, group dynamics, data gathering and analysis, and other techniques that have been proven more effective. The professor droning away at the front of the room while students drowse will not prepare them for their future. Students need to be participants, not just an audience.

Considering these trends important to education and the probability of more accountability to the "customers" of higher education including students, governing bodies, state and federal governments, businesses, and taxpayers, a shift away from the traditional text in kinesiology is needed. Instructors already face increasingly diverse student groups. Students are easily intimidated by the typical kinesiology textbook which many compare

to a medical school manual. Most traditional text books are too scientific and certainly contain too much material for the average student to comprehend in one semester.

The purpose of this programmed text is to enable students to work at their own pace while taking a classroom course in kinesiology. It prepares students in fundamental kinesiology. This programmed text is designed to give an undergraduate the essentials for a base in kinesiology on which to build. Possible uses include as an outline, a reference, a guideline, a lab guide, and a text. It may readily be used to review for tests including comprehensive exams in kinesiology. The text includes material that is practical and applicable, adding breadth and depth to a student's base of knowledge. Because the instructor is freed from identifying for students the important sections, concepts, and vocabulary in a traditional text, more classroom time can be devoted to examples, demonstrations, experiments, lab activities, analysis, and discussion. This rewards both students and instructors by making classes more interesting and meaningful. Students will complete the course with the knowledge base needed to go to more complex texts and comprehend them. Instructors will be pleased to see students have gained knowledge from being in the class.

PREFACE

How to Use This Text

Essential to the use of this text is understanding that each chapter is a building block or foundation for the next. Students should start with the first chapter, reading explanatory statements and learning information presented for each segment. Information is presented in boxes which contain three sections. Each top section contains the information being presented. The right side of the lower section contains a question with the lower left section containing the answer. The size and position of the question and answer sections allow the student to cover the answers when ready to attempt answering the question. When the materials are learned well enough that questions can be answered without looking at the answers, a student is ready to continue.

Frequent review sections, charts, diagrams, and student assignments and worksheets allow anyone using this programmed text to know and feel confident about the information learned before proceeding. It is easy for students to review from the start of the text each time to reinforce their knowledge base of information. Each chapter includes a glossary of key words with working definitions that are also easily understandable. A

master glossary is in the appendices. Some key words may also have a one word reference answer supplied or a simple phrase for association. These one word references and phrases provide students with additional learning aids. Another important feature, inclusion of student worksheets, allows flexibility for the student and the instructor because of design and placement of the worksheets. Instructors can vary the task for a worksheet or even use one worksheet for multiple tasks by providing additional copies.

As students establish the knowledge base of this programmed text, they can begin to follow an instructor's lecture with ease, fill in any necessary gaps, and expand on areas of interest. If used as designed, this programmed text may make keeping a classroom notebook for kinesiology obsolete. Although an instructor may choose to assign a project to verify that the student has developed a working and usable knowledge of fundamental kinesiology, few other materials would be necessary to complete the course.

CHAPTER 1

Introduction

Chapter 1 introduces the student to the history of kinesiology and its foundations, the basic reference points, and the initial vocabulary needed in kinesiology. Each additional chapter is designed to be a building block to be added to the previous chapter. This first chapter is the foundation for the rest because of the concepts and vocabulary.

Kinesiology

1. The term "kinesiology" is derived from Greek words: "kinesis" meaning "motion" (from the verb "kinein" meaning "to move") and "-logy" for "the study of" (from "logos" meaning "word"). Combining these root words and applying kinesiology to human movement, kinesiology becomes the scientific study of human movement.

TO MOVE

The Greek word "kinein" means _____ _____.

2. As in other sciences, kinesiology has a beginning that can be traced to the times of Aristotle, the Greek philosopher, who is considered by most instructors to be the "Father of Kinesiology."

ARISTOTLE

_____ is considered the "Father of Kinesiology."

3. To study kinesiology, it is essential that one understands certain concepts and uses the same vocabulary to verify certain points. As in the use of human movement, there needs to be a way to identify movement. Kinesiology is the scientific study of human movement.

SCIENTIFIC STUDY

Kinesiology is the _____ _____ of human movement.

4. Kinesiology is a science supported by other main sciences. A one word reference definition for kinesiology would be movement.

MOVEMENT

_____ is a one word definition for kinesiology.

Class Notes:

5. The five main sciences that support kinesiology can also be defined with a one word reference answer. These five sciences and their references are: Anatomy—structure, Biology—life, Physics—mechanics, Physiology—function, and Psychology—mind.

Write in the correct one word reference definition under each science listed in the diagram below.

LIFE	**FUNCTION**
STRUCTURE	**MIND**
MECHANICS	**MOVEMENT**

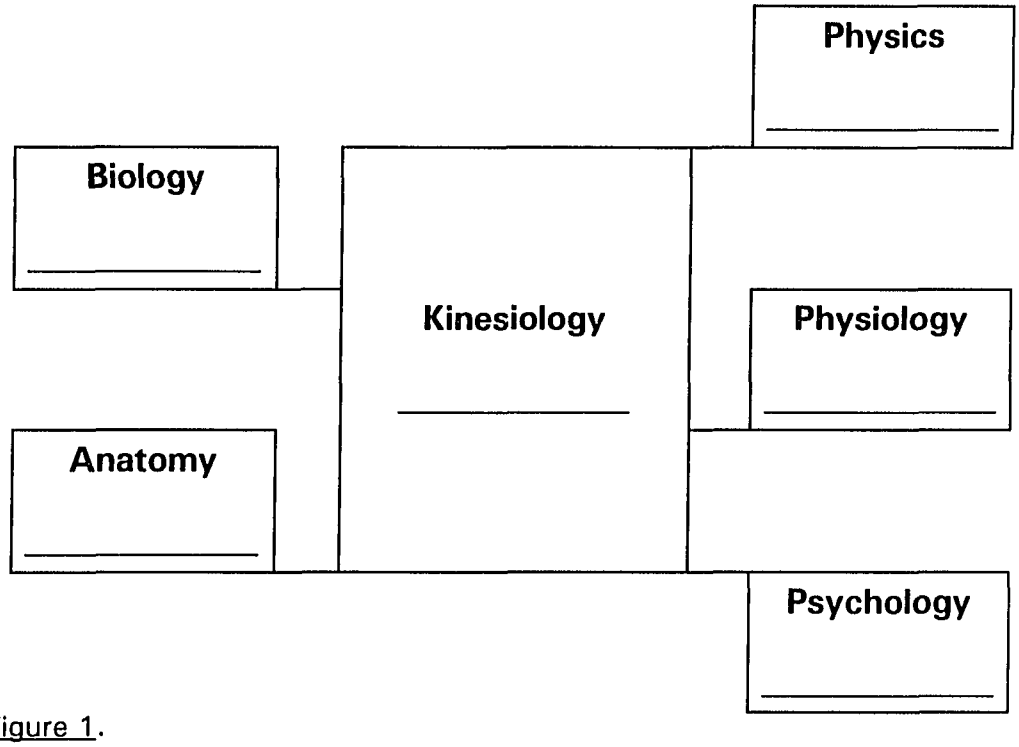


Figure 1.

Kinesiology and its Related Sciences.

6. In the sciences, a principle is a basic and comprehensive concept. A concept usually develops from an idea or notion gained from scientific evidence and/or philosophical ideas.

IDEA

NOTION

A concept usually develops from an _____ or _____.

7. Some principles on which kinesiology is based are derived from the five basic sciences anatomy, biology, physiology, psychology, and physics.

SCIENTIFIC

EVIDENCE

The principles on which kinesiology is based are derived from _____ _____ established in anatomy, biology, physiology, psychology, and physics.

8. Principles of kinesiology are derived from scientific evidence and/or philosophical ideas. Philosophical ideas are gained from insight, experience, and understanding.

INSIGHT

EXPERIENCE

UNDERSTANDING

Contributing to the development of philosophical ideas are _____, _____, and _____.

Class Notes:

Below is a diagram illustrating the concept of a principle.

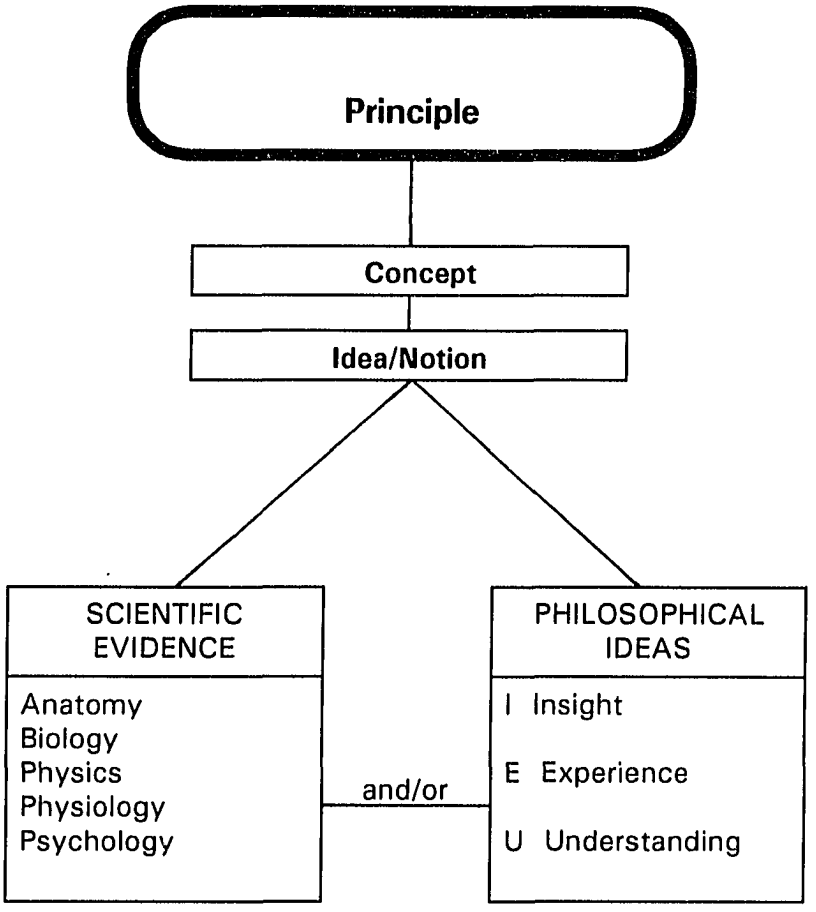


Figure 2.

Development of a Principle.

Review Questions

_____ was the "Father of Kinesiology."

Kinesiology is the _____ _____ of human movement.

A one word reference answer for physiology is _____.

A concept usually develops from an _____ or _____.

Contributing to the development of philosophical ideas are _____,

_____, and _____.

Reference Points

9. Points of reference or starting points are needed to analyze human movement. There are three starting positions (standing positions) that should be considered in analyzing kinesiologic movements.

THREE

There are _____ starting or standing positions accepted for points of reference.

10. The first of the standing/starting positions is the fundamental standing position. This is an erect position that is relaxed and comfortable for an individual. The second standing position is the military position which is more formal or tense, like standing at attention. The third standing position, the medical position, is also called the anatomical position.

1. **FUNDAMENTAL**
2. **MILITARY**
3. **ANATOMICAL**

Name in order the three standing/starting positions.

1. _____
2. _____
3. _____

11. The anatomical position is the main starting position accepted as a point of reference for a kinesiologic analysis.

ANATOMICAL POSITION

The _____ _____ is usually the one depicted in textbooks.

12. The anatomical position is composed of the following descriptive characteristics:

1. standing erect
2. head and shoulders square facing forward
3. arms to the side palms forward (fingers together)
4. feet slightly apart and parallel (shoulder width)
5. little or no movement

1. STANDING ERECT
2. HEAD AND SHOULDERS SQUARE FACING FORWARD
3. ARMS TO THE SIDE, PALMS FORWARD AND FINGERS TOGETHER
4. FEET SLIGHTLY APART AND PARALLEL
5. LITTLE OR NO MOVEMENT

List in order the five identifying characteristics of the anatomical position.

1._____

2._____

_____

3._____

_____

4._____

_____

5._____

Class Notes:

13. There are three relevant reference points associated with the anatomical position. These are the center of gravity, the line of gravity, and the mid-line of the body.

1. CENTER OF GRAVITY
2. LINE OF GRAVITY
3. MID-LINE OF THE BODY

List in order three reference points for the anatomical position.

1._____

2._____

3._____

14. The center of gravity is one of the three basic reference points associated with the anatomical position. The center of gravity has five identifying characteristics and three points of location.

CHARACTERISTICS

LOCATION

There are five identifying _____ and three points of _____ for the center of gravity.

Review

The three starting positions are fundamental, military, and anatomical. Starting positions may be called standing positions. The anatomical position is the reference starting position. Five characteristics that make up the anatomical position are: standing erect, head and shoulders square facing forward, arms to the side with palms forward and fingers together, feet slightly apart and parallel (shoulder width), little or no movement.

Class Notes:

15. To identify the center of gravity there are five characteristics. These should be learned in order. First, recognize that the center of gravity is an imaginary point. Second, it is the center of mass or weight center of an object. Third, it is the most concentration of weight in the object. Fourth, it is the geometric center of an object. Fifth, it is the balance point.

1. IMAGINARY POINT
2. CENTER OF MASS OR WEIGHT CENTER
3. MOST CONCENTRATION OF WEIGHT
4. GEOMETRIC CENTER
5. BALANCE POINT

List in order the five identifying characteristics of the center of gravity.

1._____
2._____
3._____
4._____
5._____

Class notes:

16. There are three key points in locating the center of gravity in the human body. The center of gravity is anterior to the sacrum, lower in women than men, and is where all three cardinal planes intersect.

1. ANTERIOR TO THE SACRUM
2. LOWER IN WOMEN THAN MEN
3. WHERE THE THREE CARDINAL PLANES INTERSECT

List in order the three key points of location of the center of gravity.

1._____

2._____

3._____

_____

17. The line of gravity and the mid-line of the body are both imaginary vertical lines, but the line of gravity is internal while the mid-line of the body is external.

EXTERNAL

INTERNAL

Of the two imaginary vertical lines associated with the anatomical position, the mid-line of the body is _____ and the line of gravity is _____.

18. The line of gravity is an imaginary internal vertical line that passes through the center of gravity through the base of support to the center of the earth and where both cardinal vertical planes intersect. The line of gravity is usually associated with balance.

1. IMAGINARY
2. INTERNAL
3. VERTICAL
4. PASSES THROUGH THE CENTER OF GRAVITY, THROUGH THE BASE OF SUPPORT, TO THE CENTER OF THE EARTH
5. WHERE BOTH CARDINAL VERTICAL PLANES INTERSECT

List in order five identifying characteristics of the line of gravity.

1. _____
2. _____
3. _____
4. _____
5. _____

19. The third reference point is the mid-line of the body. This is an imaginary external vertical line that divides the body or body parts into right and left sections. The mid-line of the body is movable. The left and right sections may or may not be equal.

1. IMAGINARY
2. EXTERNAL
3. VERTICAL
4. DIVIDES THE BODY OR BODY PARTS INTO LEFT AND RIGHT SECTIONS

List in order the four identifying characteristics of the mid-line of the body.

1._____
2._____
3._____
4._____

_____

Class Notes:

Planes

20. Planes of the body are used to correspond with movement, motion, and actions. A plane is a flat, imaginary surface. Human movement occurs in a plane. Planes are used to divide the body and body parts into identifiable sections.	
FLAT	A plane is a _____ imaginary surface.

21. In the study of kinesiology, the names of three types of planes are sagittal, frontal, and transverse. These planes of the body correspond to the three dimensions of space.	
1. SAGITTAL **2. FRONTAL** **3. TRANSVERSE**	In kinesiology the primary three types of planes are: 1._____ 2._____ 3._____

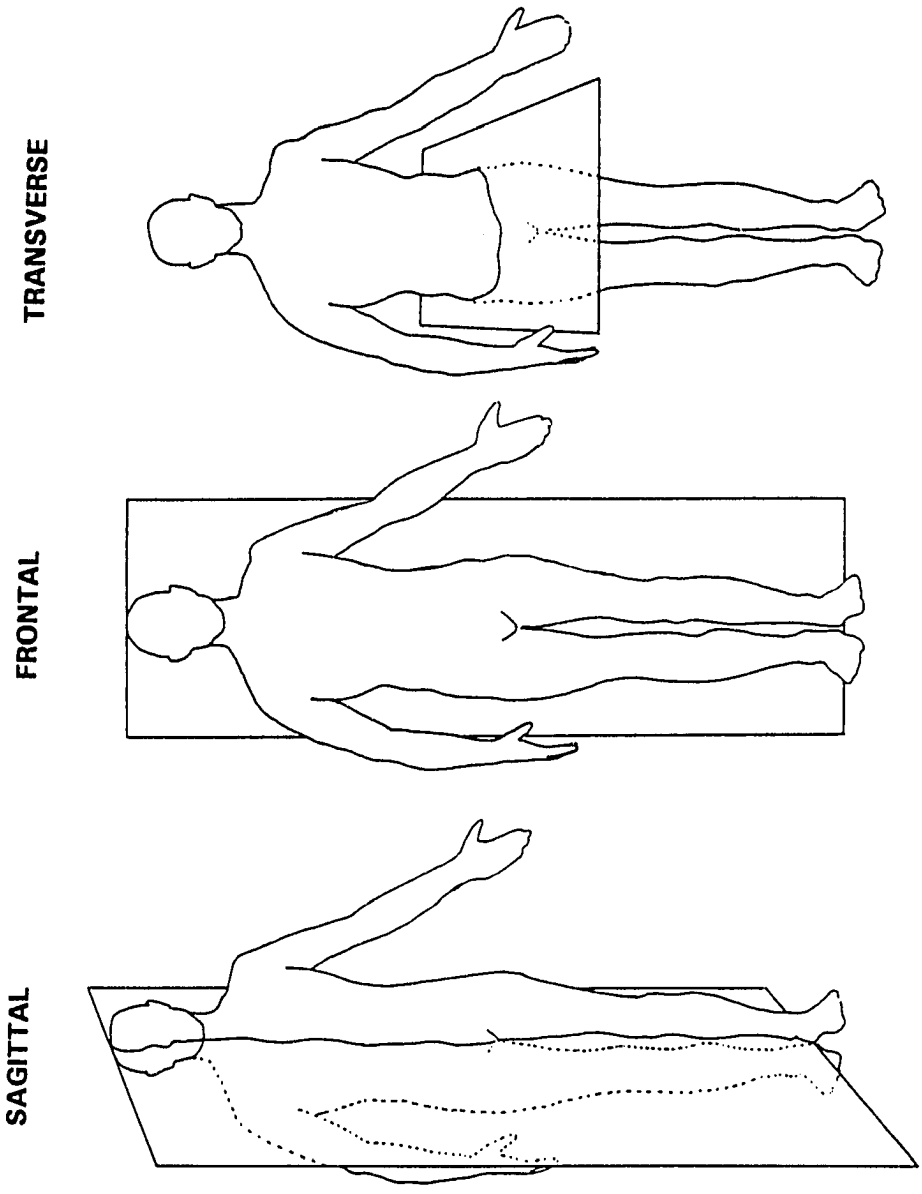


Figure 3.

Primary Planes in the Body.

22. Sagittal, frontal, and transverse planes bisect the body and are each perpendicular to the other two planes. Each sagittal, frontal, or transverse plane that passes through the center of gravity is also referred to as a cardinal plane. Cardinal planes divide the body in half.

CARDINAL

A sagittal plane that also passes through the center of gravity is called a _____ sagittal plane.

Review

Plane: A flat, imaginary surface.

Three types of planes are: sagittal, frontal, and transverse. These three planes correspond to the three dimensions of space.

Each plane that passes through the center of gravity is referred to as a cardinal plane. Cardinal planes divide the body in half.

23. The sagittal plane is a vertical plane that passes through the body anterior to posterior dividing it into right and left sections.

VERTICAL

The sagittal plane is a _____ plane.

24. The frontal plane is a vertical plane that passes through the body from side to side, dividing it into anterior and posterior sections.

VERTICAL

The frontal plane is the second _____ plane.

25. The transverse plane is a horizontal plane that passes through the body, dividing it into superior and inferior sections.

HORIZONTAL

The transverse plane is a _____ plane.

The chart below in Figure 4 is a building block concerning planes of the body. In the heading, "KM" refers to kinesiology and movement. As additional information is learned, this chart will be expanded.

KM	DIRECTION	PLANES
1	VERTICAL	SAGITTAL
2	VERTICAL	FRONTAL
3	HORIZONTAL	TRANSVERSE

Figure 4.

Primary Planes in Kinesiology.

26. An important concept in kinesiology that will be a foundation for further exploration of the topic of movement is:

Movement occurs in a plane and is always parallel to that plane.

PLANE

PARALLEL

Movement occurs in a _____ and is _____ to it.

Review

Earlier in this chapter planes were defined and the three primary planes of the body were described. A plane is an imaginary flat surface. The basic planes are the sagittal, frontal, and transverse planes. The sagittal and frontal planes are both vertical planes, while the transverse plane is a horizontal plane. Movement occurs in a plane and is always parallel to that plane.

27. There is a fourth plane of the body. This is an oblique plane that lies tilted between the other planes so that movement is always parallel to a plane.

OBLIQUE

An _____ plane lies tilted between the other three planes.

28. The movements that occur in the three basic planes each have a corresponding axis. An axis is a fixed point or line around or about which a body revolves.

A FIXED POINT OR LINE AROUND OR ABOUT WHICH A BODY REVOLVES

Define axis. _____

29. Each plane has a corresponding axis that is perpendicular to that plane. Each axis, like the planes, has a name. A sagittal plane has a frontal axis. A frontal plane has a sagittal axis. A transverse plane has a vertical axis.

FRONTAL

VERTICAL

A sagittal plane has a _____ axis.

A transverse plane has a _____ axis.

30. An oblique plane has an oblique axis which is perpendicular to the plane.	
OBLIQUE	An oblique plane has an _____ axis.

31. Building on the concept stated in 26, movement occurs in a plane and around or about an axis.	
PLANE **AXIS**	Movement occurs in a _____ and around or about an _____.

KM	DIRECTION	IN PLANES	AROUND AXIS
1	VERTICAL	SAGITTAL	FRONTAL
2	VERTICAL	FRONTAL	SAGITTAL
3	HORIZONTAL	TRANSVERSE	VERTICAL

Figure 5.

Primary Planes and Axes in Kinesiology.

Review

A vertical sagittal plane has a perpendicular frontal axis while a vertical frontal plane has a perpendicular sagittal axis. A horizontal transverse plane has a perpendicular vertical axis. The vertical axis of a horizontal transverse plane is also perpendicular to the horizon. An oblique plane has an oblique axis.

32. Movement may be broken down with other key words that lead to a more precise point. Motion is a part of movement and action is a part of motion. Action, therefore, would be a more precise part of movement.

ACTION

MOTION

Motion is part of movement and _____ is a more precise part of _____.

33. Movement in a plane is referred to as action. Each plane is associated with a certain type of action. Flexion and extension are the actions in a sagittal plane with a frontal axis. Abduction and adduction are the actions in a frontal plane with a sagittal axis. Horizontal rotating and twisting are the actions in a transverse plane with a vertical axis.

FLEXION

EXTENSION

Actions in a sagittal plane with a frontal axis are _____ and _____.

ABDUCTION

ADDUCTION

Actions in a frontal plane with a sagittal axis are _____ and _____.

HORIZONTAL ROTATING

TWISTING

Actions in a transverse plane with a vertical axis are _____ _____ and _____.

Class notes:

KM	DIRECTION	PLANES
1	VERTICAL	SAGITTAL
2	VERTICAL	FRONTAL
3	HORIZONTAL	TRANSVERSE

Figure 6.

Primary Planes in Kinesiology.

KM	DIRECTION	PLANES	AXIS
1	VERTICAL	SAGITTAL	FRONTAL
2	VERTICAL	FRONTAL	SAGITTAL
3	HORIZONTAL	TRANSVERSE	VERTICAL

Figure 7.

Primary Planes and Axes in Kinesiology.

KM	DIRECTION	PLANES	AXIS	ACTIONS
1	VERTICAL	SAGITTAL	FRONTAL	FLEXION—EXTENSION
2	VERTICAL	FRONTAL	SAGITTAL	ABDUCTION—ADDUCTION
3	HORIZONTAL	TRANSVERSE	VERTICAL	HORIZONTAL TWISTING

Figure 8.

Primary Planes, Axes, and Actions in Kinesiology.

Glossary

Abduction	Away from the mid-line of the body.
Adduction	Toward the mid-line of the body.
Anatomical position	An erect standing position related to anatomy and medicine; a position used for identifying points of reference or locations. See page 10 for a detailed description of the anatomical position.
Anatomy	Structure; the structure of the human body and not limited to the skeletal or muscular systems of the body.
Anterior	Front.
Aristotle	A Greek philosopher from 384—322 B.C. who is considered by most kinesiology instructors to be the "Father of Kinesiology."
Axis	A fixed point or line about or around which a body revolves or rotates.
Biology	Life; the science of life; the branch of knowledge which is concerned with living organisms.
Cardinal Plane	Any plane that passes through the center of gravity.
Center of gravity	The balance point of an object; where the weight center of an object is located.
Extension	Increase of an angle at a joint.
Flexion	Decrease of an angle at a joint.

Horizontal	Parallel to the horizon; on a level; flat line or surface.
Inferior	Lower or below; bottom.
Joint	In reference to the skeleton, where two or more bones come together or meet. Joints can be classified as movable or nonmovable.
Kinesiology	Movement; the scientific study of human movement.
Lateral	Away from the middle; outside.
Line of gravity	An imaginary **internal** vertical line that passes through the center of gravity and the base of support.
Medial	Toward the middle; relating to the middle.
Mid-line of the body	An imaginary **external** vertical line which is used as a reference line to divide the body or body parts into left and right sections.
Oblique plane	A plane that lies tilted between the three primary planes associated with kinesiology: sagittal, frontal, and transverse.
Parallel	Lying evenly everywhere in the same direction, but never meeting, however far extended.
Perpendicular	At right angles to a given surface.

Physics	Mechanics; the science which deals with the most general and fundamental of such phenomena, namely motion; the science of matter and motion.
Physiology	Function; the science branch of biology that deals with the study of functions of the organs, tissues and cells during life.
Plane	A flat imaginary surface.
Plumb line	A line weighted with a plumb bob. It is used to indicate true vertical directed to the center of gravity of the earth.
Posterior	Back.
Psychology	Mind; the science which deals with the mind of man or other organisms in any of its aspects.
Right angle	The angle bounded by two radii that intercept a quarter of a circle; one quarter of a round angle; one half of a straight angle.
Superior	Upper or above; top.
Vertical	A line perpendicular to the horizon. A plumb line is a true vertical line.

CHAPTER 2

Introduction

In the human skeleton a joint is where two or more bones come together or make contact. This chapter is focused on joints and how joints are classified. Before proceeding a student needs a complete understanding and working knowledge of all the concepts, information, and materials previously covered. Knowledge gained there is essential to following the new information in this chapter. The student should also supplement Chapter 2 with first-hand study or review of a human skeleton to identify and concentrate on the formation of the bones at each type of joint.

Joints

34. From birth through adulthood, all bone ends in the human skeleton are either fused or protected. This prevents damage to the bone ends during movement.

FUSED

PROTECTED

All bone ends are either _____ or _____ from birth through adulthood.

35. Earlier, kinesiology was defined as the scientific study of human movement. The study of bones is osteology, while the study of muscles is myology. The study of joints or articulations is arthrology.

OSTEOLOGY

MYOLOGY

_____ is the study of bones while _____ is the study of muscles.

36. Arthrology is the study of joints. Visualizing the action of the joints during movement gives a clearer understanding of human motion.

ARTHROLOGY

The study of joints is _____.

37. In arthrology a joint may be classified according to its structure and the way the bones are separated or united.

STRUCTURE

The _____ of the joint determines one type of joint classification.

38. The point where bones unite to form a joint is referred to as an articulation. The surfaces which come together are called the articulating surfaces.

ARTICULATION

_____ is the point where bones unite to form a joint.

39. A second way of classifying joints is whether there is a space or separation between the articulating surfaces of joints. The separation or space between articulating surfaces is called a cavity (articular cavity).

CAVITY

Joints are also classified according to the presence or absence of a _____ between the articulating surfaces of the joint.

40. Joints can be classified as movable or nonmovable. This would depend on the actions the joint can make. Movable joints are capable of a free range of action. Nonmovable joints are those capable of slight or no movement.

MOVABLE

NONMOVABLE

A third type of classification of joints is _____ or _____.

Review

Bone ends are always protected or fused.

Joints are where two or more bones come together.

Three ways to classify joints:

1. structure
2. presence or absence of an articular cavity
3. movable or nonmovable

41. Each type of joint may be further subdivided according to the shape and location.

SHAPE

LOCATION

When classifying joints, each type of joint may be further subdivided by _____ and _____.

Class Notes:

42. Arthur Steindler said the shape of a joint is the chief factor in determining its function (Wells, 1971).	
SHAPE	According to Arthur Steindler, the chief determining factor in determining a joint's function is its _____.

43. The articulating surfaces form a pathway for movement where bones join together or articulate.	
ARTICULATING SURFACE	For a joint to move, the bones must have an _____ _____.

Class Notes:

44. Pathways for each joint are determined by the shape of articulating surfaces or the type of tissues connecting or joining the bones.

SHAPE

TISSUES

The _____ of the joint or its articulating surfaces and the types of _____ determine the pathways of each joint.

45. The articulating surfaces or pathways are influenced by the ligaments, tendons, and cartilage that surround the joint and serve as its "restraining factors."

1. **LIGAMENTS**
2. **TENDONS**
3. **CARTILAGE**

List in order the three restraining factors of joints.

1._____

2._____

3._____

46. The jobs of the three restraining factors are:

1. ligaments link bone to bone
2. tendons tie muscle to bone
3. cartilage cushions bone ends

1. LINK BONE TO BONE

2. TIE MUSCLE TO BONE

3. CUSHIONS BONE ENDS

Identify the jobs for each of the three restraining factors.

1. Ligaments _____

2. Tendons _____

3. Cartilage _____

Review

In joint classification, each type of joint may be further subdivided by shape and location. The chief determining factor of a joint's function is its shape. For a joint to move, the bones must have an articulating surface. The shape of the joint or its articulating surfaces and the types of tissues determine the pathways of each joint. The ligaments, tendons, and cartilage that surround the joint serve as its restraining factors.

47. There are four factors responsible for joint cohesion. These four factors of joint cohesion that help hold a joint together to allow movement are: joint ligaments, fascia, muscle tension, and atmospheric pressure.

1. JOINT LIGAMENTS
2. FASCIA
3. MUSCLE TENSION
4. ATMOSPHERIC PRESSURE

List in order the four factors of joint cohesion.

1._____
2._____
3._____
4._____

48. Fascia is a connective tissue that surrounds, supports, separates, and binds muscle, bone, skin, and other tissues.

CONNECTIVE TISSUE

Fascia is a _____ _____ that supports, surrounds, and binds other tissues such as bones and muscles.

Classification of Movable Joints

49. Movable joints are referred to in kinesiology as diarthrosis or diarthrodial joints.

DIARTHROSIS

DIARTHRODIAL

Another name for movable joints is _____ or _____ joints.

50. A main factor in defining a diarthrodial joint is the presence of an articular cavity or separation.

A JOINT THAT HAS AN ARTICULAR CAVITY OR SEPARATION PRESENT

Define a diarthrodial joint.

_____

_____

Class notes:

51. There are five characteristics associated with each diarthrodial joint. There is an articular cavity present that is surrounded by a capsule ligamentous. The capsule ligamentous is lined with a synovial membrane that secrets synovial fluid to lubricate the joint. Synovial fluid is stored in a bursa sac. The articular surfaces are smooth and lined with hyaline or fibrous cartilage.

1. ARTICULAR CAVITY PRESENT
2. SURROUNDED BY CAPSULE LIGAMENTOUS
3. CAPSULE LINED WITH SYNOVIAL MEMBRANE WHICH SECRETS SYNOVIAL FLUID TO LUBRICATE THE JOINT WITH SYNOVIAL FLUID STORED IN BURSA SACS
4. ARTICULAR SURFACES SMOOTH
5. ARTICULAR SURFACES LINED WITH HYALINE OR FIBROUS CARTILAGE

List in order the five characteristics of a diarthrodial joint.

1._____

2._____

_____

3._____

_____

_____

_____

_____

4._____

5._____

_____

_____

	NAME	EXAMPLE OF LOCATION
1.	IRREGULAR	CARPALS AND TARSALS
2.	HINGE	HUMERUS AND ULNA
3.	PIVOT	HUMERUS AND RADIUS
4.	CONDYLOID (TRUE WRIST)	RADIOCARPAL
5.	SADDLE	FIRST CARPOMETACARPAL
6.	BALL & SOCKET	SHOULDER OR HIP

Figure 9.

Sub-classes of Diarthrodial Joints by Name and Example of Location.

52. Movable joints have an articular cavity or separation present to allow movement.

ARTICULAR CAVITY

SEPARATION

The first determinant of whether a joint is movable or nonmovable is the presence of an _____ _____ or _____.

Review

A movable joint is also called a diarthrodial joint or diarthrosis. There are five characteristics or descriptive functions of movable joints or diarthrosis. These characteristics are:

1. Articular cavity present.
2. Surrounded by capsule ligamentous.
3. Capsule lined with synovial membrane which secrets its fluid to lubricate the joint; synovial fluid is stored in bursa sacs.
4. Articular surfaces are smooth.
5. Articular surfaces are lined with hyaline or fibrous cartilage.

53. Each joint or articulation has degrees of freedom. These degrees of freedom are associated with the number of axes the sub-classes of joints have. Irregular joints have no axis and are called nonaxial. Both hinge and pivot have one axis and are called uniaxial. Both condyloid and saddle have two axes and are referred to as biaxial. A ball and socket joint has three axes and is referred to as triaxial.

AXES

UNIAXIAL

BIAXIAL

Degrees of freedom relate to the number of _____ a joint or articulation has. A hinge joint is _____ while a saddle joint is _____.

Class notes:

NUMBER OF AXES	0	1		2	3
	NONAXIAL	UNIAXIAL		BIAXIAL	TRIAXIAL
JOINT SUB-CLASS	IRREGULAR	HINGE PIVOT		CONDYLOID SADDLE	BALL & SOCKET
LOCATION	CARPAL	ELBOW		WRIST RADIUS/ULNA CARPALS	HIP SHOULDER
		TROCHLEAR & ULNA	CAPITULUM & RADIUS		
MOVEMENT	GLIDE	FLEX & EXTEND	INWARD OR OUTWARD ROTATION	FLEX & EXTEND AB & ADD CIRCUMDUCTION	ALL ROTATION

Figure 10.

Joint Sub-Classifications with Number of Axes, Location, and Movement.

54. Circumduction is defined as a movement with the stationary point on a line and the distal end moving in a circle forming a cone. This creates a combination of movements in all planes. Circumduction may be as obvious as rotating a rigid upper limb (arm) in a circle or as subtle as rotating the eye in a circle.

A STATIONARY POINT ON A LINE WITH THE DISTAL END MOVING IN A CIRCLE FORMING A CONE. THIS CREATES A MOVEMENT IN ALL PLANES.

Define circumduction. _____

Diagram an example of circumduction:

Classification of Nonmovable Joints

55. Nonmovable joints are referred to in kinesiology as synarthrosis or synarthrodial joints.

SYNARTHROSIS

SYNARTHRODIAL

Another name for nonmovable joints is _____ or _____ joints.

56. A main factor in defining a synarthrodial joint is the absence of an articular cavity or separation.

A JOINT THAT HAS NO ARTICULAR CAVITY OR SEPARATION PRESENT.

Define a synarthrodial joint. _____

_____

_____

Class notes:

57. There are three characteristics associated with synarthrodial joints. The surface of synarthrodial joints continues with cartilage or fibrous cartilage. Some synarthrodial joints are not a true joint, just a ligamentous connection. There is no capsule ligamentous, no synovial membrane or fluid, no bursa sac, and no articular surface.

1. JOINT SURFACE CONTINUES WITH CARTILAGE OR FIBROUS CARTILAGE
2. JOINT MAY NOT BE A TRUE JOINT, JUST A LIGAMENTOUS CONNECTION
3. NO CAPSULE LIGAMENTOUS, NO SYNOVIAL MEMBRANE OR FLUID, NO BURSA SAC, AND NO ARTICULAR SURFACE

List in order the three characteristics of a synarthrodial joint.

1._____

2._____

3._____

	NAME	EXAMPLE OF LOCATION
1.	CARTILAGINOUS	THE CARTILAGE CUSHION BETWEEN THE VERTEBRAE OF THE SPINE
2.	FIBROUS	THE SUTURES OF THE SKULL OR THE CONNECTING POINTS OF THE SIX BONES IN THE PELVIC GIRDLE
3.	LIGAMENTOUS	MID-UNION OF THE FOREARM BETWEEN THE ULNA AND RADIUS

Figure 11.

Sub-classes of Synarthrodial Joints by Name and Example of Location.

Review

Nonmovable joints are referred to as synarthrosis or synarthrodial joints. There is no articular cavity or separation in synarthrodial joints. Three characteristics of synarthrodial joints are:

1. Joint surface continues with cartilage or fibrous cartilage.
2. Joint may not be a true joint, just a ligamentous connection.
3. No capsule ligamentous, no synovial membrane or fluid, no bursa sac, and no articular surface.

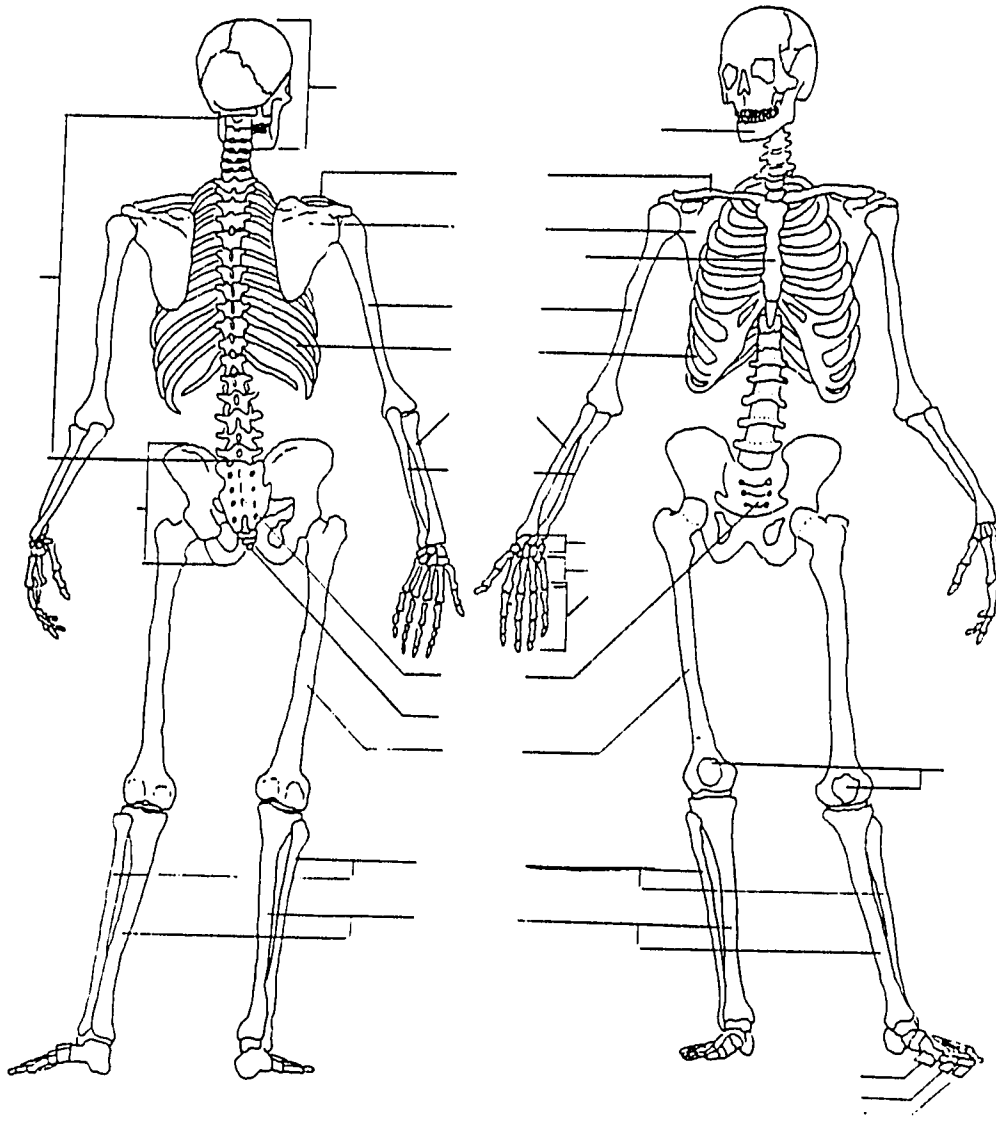


Figure 12.

Student Worksheet on the Human Skeleton, Front and Back Views.

Glossary

Arthrology	Joints; the study of joints.
Cavity	A hollow space or hole.
Circumduction	A stationary point on a line with the distal end moving in a circle forming a cone. This is a combination of movements in all planes.
Condyle	A rounded protuberance at the end of a bone forming an articulation.
Diarthrosis	Movable joints.
Fascia	A connective tissue that surrounds, separates, supports, and binds muscle, skin, and other tissues.
Foramen	A hole in a bone for passage of vessels or nerves.
Fossa	A furrow or shallow depression.
Joint	Where two or more bones come together.
Myology	Muscles; the study of muscles.
Orifice	Entrance or outlet of any opening such as the mouth or the eye.
Osteology	Bone; the study of bones.
Synarthrosis	Nonmovable or slightly movable joints.
Tubercle	A small, rounded elevation or eminence on a bone.

CHAPTER 3

Introduction

Chapter 3 concerns the muscles of the body especially the striated or skeletal muscles that apply the force for body movement. The unique features of the striated muscles will be covered. Knowledge about how muscles work is essential to learning how muscles move the body.

The Study of Muscles

58. Kinesiology is the scientific study of human movement. Myology is the study of muscles. Muscles are essential for human movement.

MYOLOGY _____ is the study of muscles.

59. Osteology is the study of bones. Bones are essential for human movement.

OSTEOLOGY _____ is the study of bones.

Review

Myology is the study of muscles. Osteology is the study of bones. Kinesiology is the scientific study of human movement. Arthrology is the study of joints.

60. In osteology, there are three primary purposes of the human skeleton that are studied for kinesiology: support, movement, and protection. Support is provided by the framework which also furnishes soft tissue support and points of attachment for muscles. Movement occurs due to movable joints and some bones serving as levers. The skeleton also protects vital organs and vessels.

1. **SUPPORT**
2. **MOVEMENT**
3. **PROTECTION**

List in order the three functions of the skeleton studied for kinesiology.

1. _____
2. _____
3. _____

Class Notes:

61. In the study of muscles, myology, there are three types of muscle tissues in the body. Smooth involuntary muscle is located around orifices and organs of the body. Cardiac muscle is also involuntary and is usually referred to as the heart muscle because it is only found in the heart. Striated muscles are voluntary and are attached directly to the skeleton. Striated muscles are often called skeletal muscles because of their attachment to the skeleton.

1. SMOOTH - AROUND ORGANS AND ORIFICES
2. CARDIAC - THE HEART
3. STRIATED - ATTACHED TO THE SKELETON

List in order the three types of muscle tissue and where each is located.

1. _____
2. _____
3. _____

Review

Myology is the study of muscles and osteology is the study of bones.

The skeleton provides support, movement, and protection.

Three types of muscle tissue in the body are smooth, cardiac, and striated.

Striated or Skeletal Muscles

62. Kinesiology is more concerned with the striated muscles that apply the force of human movement. Striated muscles are called skeletal muscles because they are attached directly to the skeleton. They are voluntary muscles.

SKELETAL MUSCLES

The striated muscles are usually known as _____ _____ and provide the force needed to move the body.

MUSCLE TYPE	LOCATION	TYPE OF ACTION
SMOOTH	ORGANS AND ORIFICES	INVOLUNTARY
CARDIAC	HEART	INVOLUNTARY
STRIATED/SKELETAL	ATTACHED TO SKELETON	VOLUNTARY

Figure 13.

Muscle Types, Locations, and Types of Action.

63. Muscles apply force by contracting and pulling on bones. Force is the instigator of movement, a push or pull, or a tendency to distort.

THE INSTIGATOR OF MOVEMENT, A PUSH/PULL, OR A TENDENCY TO DISTORT.

Define force. _____

64. When muscle force is applied, work is not necessarily accomplished. Work is the process of exerting a force which moves a resistance through a distance. Heat is a by-product of work as it is in other types of contractions.

WORK IS THE PROCESS OF EXERTING A FORCE WHICH MOVES A RESISTANCE THROUGH A DISTANCE. HEAT IS A BY-PRODUCT OF WORK.

Define work. _____

Class notes:

Review

Force is the instigator of movement, a push/pull, or a tendency to distort. Work is the process of exerting force which moves a resistance through a distance. Heat is a by-product of work. Skeletal muscles are attached to the skeleton and apply force to accomplish work.

65. Skeletal muscles have three properties that are necessary for movement: extensibility, elasticity, and contractility. Extensibility is the ability to be extended or stretched. Elasticity is the ability to be extended or twisted and yet return to the original or resting length. Contractility, a feature unique to skeletal muscles, is the ability to contract or shorten to less than the original or resting length.

1. EXTENSIBILITY
2. ELASTICITY
3. CONTRACTILITY

List in order the three properties of skeletal muscles.

1. _____
2. _____
3. _____

66. The three properties of skeletal muscles have three factors which relate to applying force and generating movement. The unique ability of muscles to contract and the placement of muscles' attachments are important to the type and extent of movement. The muscle's line of pull is directly related to the direction of movement.

1. UNIQUE ABILITY TO CONTRACT
2. POINTS OF ATTACHMENT
3. RELATIONSHIP OF THE LINE OF PULL

List in order the three factors of how skeletal muscles apply force and generate movement.

1. _____
2. _____
3. _____

Review

Three properties of skeletal muscles are extensibility, elasticity, and contractility. Three factors of the three properties of skeletal muscles relate to applying force and generating movement: unique ability to contract, placement of attachments to skeleton, relationship of line of pull.

67. A muscle contracts by the individual contraction of muscle fibers. This is often called the all or none law. This means that when a muscle fiber receives threshold or supra threshold stimuli, it will contract all the way or not at all.

GIVEN THRESHOLD OR SUPRA THRESHOLD STIMULI, A MUSCLE FIBER WILL CONTRACT ALL THE WAY OR NOT AT ALL

Define the all or none law. _____

_____

_____

_____

68. Muscle connections or attachments are where muscles join the bones. In kinesiology connections or attachments are known as origins (the more stable end or more proximal end) and insertions (the more movable end or more distal end).

ORIGINS

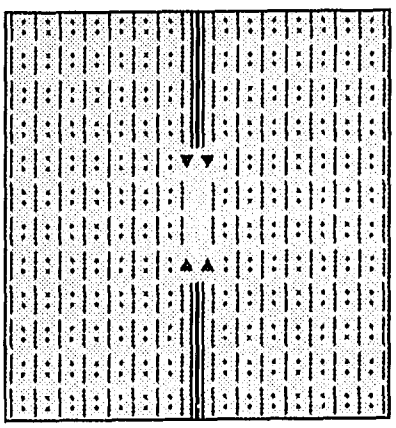
INSERTIONS

Muscle attachments in kinesiology are referred to as _____ and _____.

69. The line of pull is the direction of force a muscle produces. This is caused by the shortening of a muscle along the pattern of the muscle fibers toward the center of a muscle. This action is also referred to as the action line.

THE SHORTENING OF A MUSCLE ALONG THE PATTERN OF MUSCLE FIBERS TOWARD THE CENTER OF THE MUSCLE, THE ACTION LINE

Define line of pull. _____



MUSCLE FIBERS - |:|:|:| LINE OF PULL - ▲▲ ▼▼

Figure 14.

Diagram of the Line of Pull in a Contracting Muscle.

70. Learning the origins and insertions of just the large muscles can take an extended period of time because it is not uncommon for origins and insertions to become reversed.

REVERSED

It is not uncommon for origins and insertions of muscles to become _____.

Review

Muscles contract by individual contraction of muscle fibers. The all or none law is used to describe how muscles contract: given threshold or supra threshold stimuli, a muscle fiber will contract all the way or not at all. Connections or attachments where muscles join the bones are known as origins and insertions. The line of pull (action line) is determined by the shortening of a muscle along the pattern of muscle fibers toward the center of the muscle and is the direction of force a muscle produces.

71. Muscles work within a range. This range is the amplitude of a muscle. Amplitude of a muscle is determined by its ability to extend or shorten up to half the original or resting length. A muscle with an original or resting length of six inches can extend to nine inches or shorten to three inches. The amplitude of this six-inch muscle would therefore be three to nine inches.

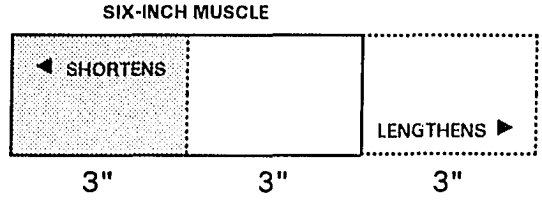
A MUSCLE CAN EXTEND OR SHORTEN UP TO ONE-HALF THE ORIGINAL OR RESTING LENGTH.

Give a statement that explains the amplitude of a muscle.

_____

_____

_____



AMPLITUDE OF SIX-INCH MUSCLE

Figure 15.

Diagram of the 3" to 9" Amplitude of a Six-Inch Muscle.

Classification of Skeletal Muscles

72. All skeletal muscles have a structural classification. There are six classifications, each with four parts. The four parts to a classification are scientific name, shape name, diagram, and example.

SIX

FOUR

There are _____ classifications of muscle structures and _____ parts to each classification.

73. The fusiform classification is for spindle shaped muscles. An example is the brachialis.

SPINDLE

BRACHIALIS

The fusiform classification is a _____ shaped muscle. An example is the _____.

Class notes:

74. The penniform classification is a half feather shaped muscle. An example is the extensor digitorum longus.

PENNIFORM

EXTENSOR DIGITORUM LONGUS

The _____ classification is a half-feather shaped muscle such as the _____ _____ _____.

75. The bipenniform classification is a whole feather shaped muscle. One example is the rectus femoris.

BIPENNIFORM

WHOLE FEATHER

The _____ classification is a _____ _____ shaped muscle. An example is the rectus femoris.

Draw and name the shapes of the first three structural classifications of skeletal muscles.

76. The triangular classification is a triangle shaped muscle. An example is the deltoid.

TRIANGLE

DELTOID

The triangular classification of muscle structure is a _____ shaped muscle. An example is the _____.

77. The rhomboidal classification is a rhomboid (tilted rectangle or square) shaped muscle. Examples include the rhomboid major and minor.

RHOMBOIDAL

RHOMBOID MAJOR

The _____ classification is a rhomboid shaped muscle such as the _____ _____ and minor.

78. The rectangular classification is a rectangle shaped muscle. An example is the pronator quadratus.

RECTANGULAR

RECTANGLE

The _____ classification is a _____ shaped muscle. An example is the pronator quadratus.

Draw and name the shapes of the last three structural classifications of skeletal muscles.

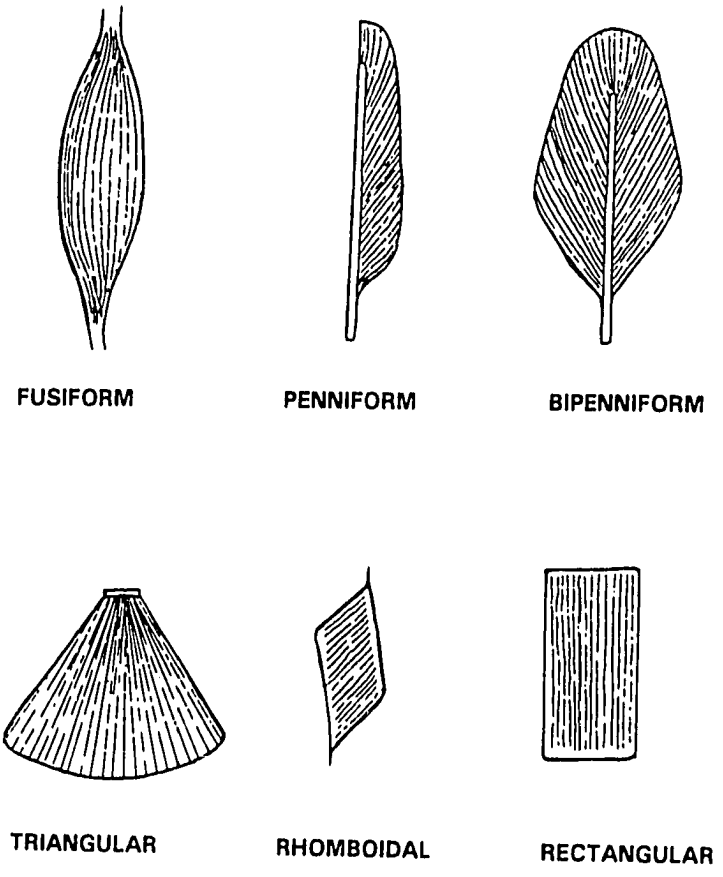


Figure 16.

Classifications of Skeletal Muscles.

Movement of Muscles

79. In kinesiology contraction is the shortening of a muscle from the maximum extended range to the shortest length. Contraction can range from partial to complete shortening of a muscle within the range or amplitude of that muscle.

THE SHORTENING OF A MUSCLE

Define contraction as it is used in kinesiology.

_____

_____

80. Cocontraction or coinnervation occurs when two opposing muscles contract at the same time and will not allow movement.

COCONTRACTION

Coinnervation is another name for _____ which is when opposing muscles contract at the same time.

81. Contracture is the permanent contraction of a muscle due to spasm or paralysis. Depending on the cause of contracture, it can range from a temporary to a life-long condition.

THE PERMANENT CONTRACTION OF A MUSCLE DUE TO SPASM OR PARALYSIS

Define contracture. _____

_____

_____

Review

The amplitude or range of a muscle is that it can extend or shorten up to one-half the original or resting length. The six structural classifications of muscles are the fusiform (spindle shaped), the penniform (half feather shaped), the bipenniform (feather shaped), the triangular (triangle or fan shaped), the rhomboidal (rhomboid shaped), and the rectangular (rectangle shaped).

In kinesiology contraction is a shortening of a muscle. Cocontraction occurs when two opposing muscles contract at the same time.

82. For movement in the human body to occur, muscles or muscle groups must work together. Reciprocal innervation is the term used when muscles work in groups or pairs. When one muscle or a group of muscles contracts, the opposing muscle or group of muscles must relax to allow movement.

MUSCLES WORK IN GROUPS OR PAIRS. WHILE ONE GROUP OR MUSCLE CONTRACTS, THE OPPOSING GROUP OR MUSCLE MUST RELAX.

Explain reciprocal innervation. _____

Class notes:

83. Ballistic movement is one type of movement studied in kinesiology. Ballistic movement is initiated by the contraction force of a muscle. The muscle must then relax and allow the momentum generated to complete the movement. Follow through relates to the second half of ballistic movement.

IT IS INITIATED BY THE CONTRACTION FORCE OF A MUSCLE, THEN THE MUSCLE MUST RELAX AND ALLOW MOMENTUM TO COMPLETE THE MOVEMENT (FOLLOW THROUGH).

Explain ballistic movement. _____

Review

Reciprocal innervation is the term to use when muscles work in groups or pairs. While one group or muscle contracts, the opposing group or muscle must relax. Ballistic movement is initiated by the contraction force of a muscle which must then relax and allow the momentum generated to complete the movement.

84. Ballistic movement may be terminated in three ways. It may be terminated by the opposition by contraction of antagonistic muscle groups. Ballistic movement terminates when moving parts reach their limit or range of motion. Interference of an obstacle also terminates ballistic movement.

1. CONTRACTION OF ANTAGONISTIC MUSCLE GROUPS
2. MOVING PARTS REACHING THEIR LIMIT OF MOTION
3. INTERFERENCE OF AN OBSTACLE

List in order the three ways in which ballistic movement may be terminated.

1. _____

_____

2. _____

_____

3. _____

Class notes:

85. In kinesiology there are three iso— types of contraction. Iso— is a combining form meaning equal. Isometric, isokinetic and isotonic were popular contraction exercises in an earlier era of body conditioning.

1. ISOMETRIC
2. ISOKINETIC
3. ISOTONIC

List in order the three types of iso— contractions.

1. _____
2. _____
3. _____

Review

Ballistic movement may be terminated by the opposition by contraction of antagonistic muscle groups, by moving parts reaching their limit of motion, or by the interference of an obstacle.

Three types of iso— contractions are isometric, isotonic, and isokinetic.

86. An isometric contraction is one in which tension is developed, but no mechanical work is performed. All energy is liberated as heat.

ISOMETRIC CONTRACTION A contraction in which tension is developed but no mechanical work is performed is an _____ _____. All energy is liberated as heat.

87. An isokinetic contraction is one where a muscle shortens or lengthens, but maintains a constant speed throughout the movement.

ISOKINETIC CONTRACTION In an _____ _____ a muscle shortens or lengthens but maintains a constant speed throughout the movement.

88. An isotonic contraction is one in which the muscle maintains constant tension. Isotonic also refers to osmotic pressure.

ISOTONIC CONTRACTION The muscle maintains constant tension in an _____ _____.

89. One definition of concentric is having a common center. The contraction of a muscle as it shortens from its original or resting length is a concentric contraction.

CONCENTRIC CONTRACTION A _____ _____ is the contraction of a muscle as it shortens from its original or resting length.

Class notes:

90. Eccentric can be defined as not having a common center or having an axis which is not centered. An eccentric contraction describes the gradual lengthening against resistance of a concentrically contracted muscle.

ECCENTRIC CONTRACTION

The gradual lengthening against resistance of a concentrically contracted muscle is an _____ _____.

91. Dynamics refers to the mechanical study of objects in motion. A division of dynamics is called kinetics. Kinetics involves the description of moving objects with regard to the forces causing their motion.

KINETICS

_____ is a division of dynamics.

DYNAMICS

_____ is the mechanical study of objects in motion.

Superficial Striated Muscle Worksheets

The following two pages illustrate the front and back views of superficial striated muscles. These are to be used as worksheets for identification of muscles or muscle groups. This can be accomplished by the use of color pencils to identify and key to the instructor's request or drawing lines and labeling. Your instructor will identify the muscles or muscle groups to be located and the method to use. It may be necessary to go to an outside source such as Gray's Anatomy or The Anatomy Coloring Book to properly identify and locate muscles. These worksheets may also be used to identify muscle shape classifications.

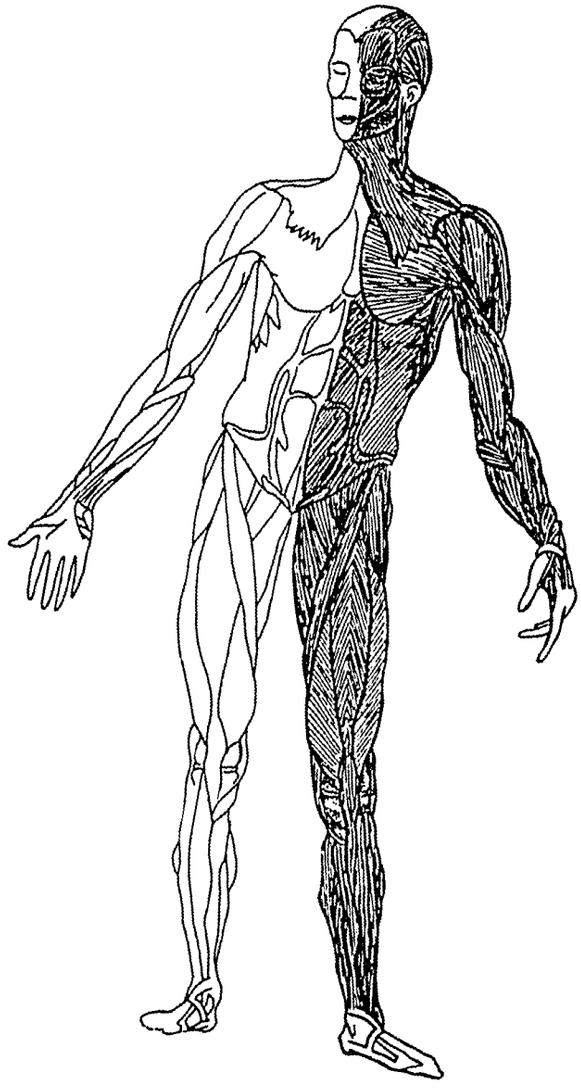


Figure 17.

Anterior View of Superficial Striated Muscles.

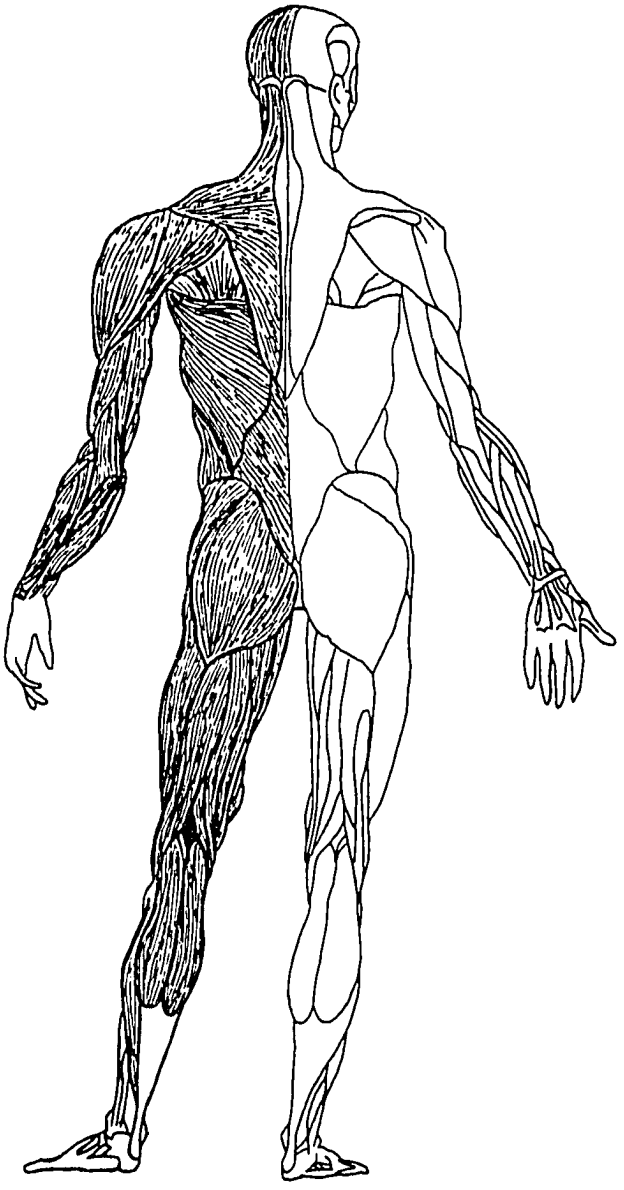


Figure 18.

Posterior View of Superficial Striated Muscles.

Glossary

Action line	The line of pull; the shortening of a muscle along the pattern of muscle fibers toward the center of the muscle.
All or none law	Given threshold or supra threshold stimuli, a muscle fiber will contract all the way or not at all
Amplitude of muscle	A muscle can extend or shorten up to one-half the original or resting length.
Ballistic movement	A type of movement initiated by the contraction force of a muscle; then the muscle relaxes and allows momentum to complete the movement (follow through).
Cardiac muscle	Heart muscle; involuntary muscle found only in the heart.
Cocontraction	Coinnervation; opposing muscles contracting at the same time and not allowing movement.
Coinnervation	Cocontraction; opposing muscles contracting at the same time and not allowing movement
Concentric	Having a common center.
Contractility	The unique ability of a muscle to contract or shorten to less than the original or resting length.
Contracture	Permanent contraction of a muscle due to spasm or paralysis.
Dynamics	The mechanical study of objects in motion.

Eccentric	Not having a common center or axis not centered.
Elasticity	The ability of a muscle to be extended or twisted and yet return to the original or resting length.
Extensibility	The ability of a muscle to be extended or stretched.
Force	The instigator of movement; a push, a pull or a tendency to distort.
Insertions	More movable end of a skeletal muscle that is more distal or inferior.
Involuntary muscle	A muscle whose movement is independent of or contrary to conscious desire; examples are the smooth and cardiac muscles.
Isokinetic contraction	A muscle shortens or lengthens but maintains a constant speed throughout the movement.
Isometric contraction	A muscle contracts but is not allowed to shorten or lengthen even with increased tension.
Isotonic contraction	A muscle contracts and maintains constant tension; also refers to osmotic pressure.
Iso—	Combining form meaning equal.
Kinetics	The description of moving objects with regard to the forces causing their motion; a division of dynamics.

Line of pull	The action line; the shortening of a muscle along the pattern of muscle fibers toward the center of the muscle.
Origins	More stable end of a skeletal muscle that is more proximal or superior.
Reciprocal innervation	Muscles work in groups or pairs; while one group or muscle contracts, the other group or muscle relaxes.
Skeletal muscle	Muscles which are attached to the skeleton; striated muscle; voluntary muscle.
Smooth muscle	Involuntary muscles located around organs and orifices of the body.
Striated muscle	Muscles which are attached to the skeleton; skeletal muscle; voluntary muscle.
Voluntary muscle	Muscle controlled by will or thought; examples are striped, striated, cross-striated, or skeletal muscles.
Work	The process of exerting a force which moves a resistance through a distance. A by-product of work is heat.

CHAPTER 4

Introduction

Using information presented in the previous chapter, the student will add knowledge of classes of skeletal muscles and how these muscles use the simple machines of the body to complete movement. The concept that through work the body develops motion will also be covered in this chapter.

Classes of Skeletal Muscles

92. There are four classes of skeletal muscles that have a special function in human movement. The four classes are the prime movers, the antagonists, the synergists, and the fixators.

1. **PRIME MOVERS**
2. **ANTAGONIST**
3. **SYNERGIST**
4. **FIXATOR**

List in order the four classes of skeletal muscles.

1. _____
2. _____
3. _____
4. _____

Class notes:

93. The prime mover is responsible for a definite motion. An example is the latissimus dorsi.

DEFINITE

MOTION

LATISSIMUS DORSI

The prime mover is responsible for a _____ _____. An example is the _____ _____.

94. The antagonist muscle is responsible for opposition to the prime mover. An example is the pectoralis major working in opposition to the latissimus dorsi.

OPPOSITION

PRIME MOVER

The antagonist muscle is responsible for _____ to the _____ _____.

Class notes:

95. The synergist muscle aids the prime mover by keeping the joint steady while the prime mover applies force to a neighboring joint.

IT AIDS THE PRIME MOVER BY KEEPING THE JOINT STEADY WHILE THE PRIME MOVER APPLIES FORCE TO A NEIGHBORING JOINT.

Briefly explain the function of the synergist muscle class. _____

_____

_____

_____

96. The fixator keeps the bone at the origin steady as the prime mover applies force for movement.

FIXATOR

FORCE

The _____ keeps the bone at the origin steady as the prime mover applies _____ for movement.

Class notes:

Review

A prime mover is responsible for a definite motion. The antagonist is responsible for opposition to the prime mover. The synergist aids the prime mover by keeping the joint steady while the prime mover applies force to a neighboring joint. The fixator keeps the bone at the origin steady as the prime mover applies force for movement.

Newton's Laws of Motion

97. Sir Isaac Newton (1642-1727), the English mathematician and physicist, developed and refined what are usually called Newton's three laws of motion. These are the laws of inertia, mass and acceleration and action/reaction.

1. **INERTIA**
2. **ACCELERATION**
3. **REACTION**

List in order Newton's three laws of motion.

1. _____
2. _____
3. _____

98. The law of inertia is stated in this way: An object at rest will remain at rest and an object in motion will remain in motion, unless acted upon by some external force.

AN OBJECT AT REST WILL REMAIN AT REST AND AN OBJECT IN MOTION WILL REMAIN IN MOTION UNLESS ACTED UPON BY SOME EXTERNAL FORCE.

Explain or state Newton's law of inertia.

_____

_____

_____

_____

99. Gravity is a constant force toward the center of the earth. In considering the law of inertia, gravity would be a force to overcome in human movement.

TOWARD

CENTER

Gravity is a constant force _____ the _____ of the earth.

100. The law of acceleration is that a distance transversed per unit of time will remain constant unless a force acts upon the moving object. Acceleration is directly proportional to the force produced and is inversely proportional to the mass while moving in the same direction as force produced.

DIRECTLY

INVERSELY

FORCE

Based on Newton's law of acceleration, acceleration is _____ proportional to the force produced and _____ proportional to the mass while moving in the same direction as the _____ produced.

Class notes:

101. The law of reaction or action/reaction relates to every action having an equal and opposite reaction.

TO EVERY ACTION THERE IS AN EQUAL AND OPPOSITE REACTION.

Explain Newton's law of action/reaction.

Review

Newton's three laws of motion are stated as follows:

Inertia: An object at rest will remain at rest and an object in motion will remain in motion unless acted upon by some external force.

Acceleration: A distance transversed per unit of time will remain constant unless a force acts upon the moving object. Acceleration is directly proportional to the force produced and inversely proportional to the mass while moving in the same direction as force produced.

Reaction: For every action there is an equal and opposite reaction.

Simple Machines of the Body

102. The human skeleton contains simple machines. The lever is the most common simple machine. A lever is any rigid bar which turns about a fulcrum or axis when force is applied to it. A lever overcomes a resistance.

ANY RIGID BAR WHICH TURNS ABOUT A FULCRUM OR AXIS WHEN FORCE IS APPLIED TO IT. IT OVERCOMES A RESISTANCE.

Define lever. _____

Class notes:

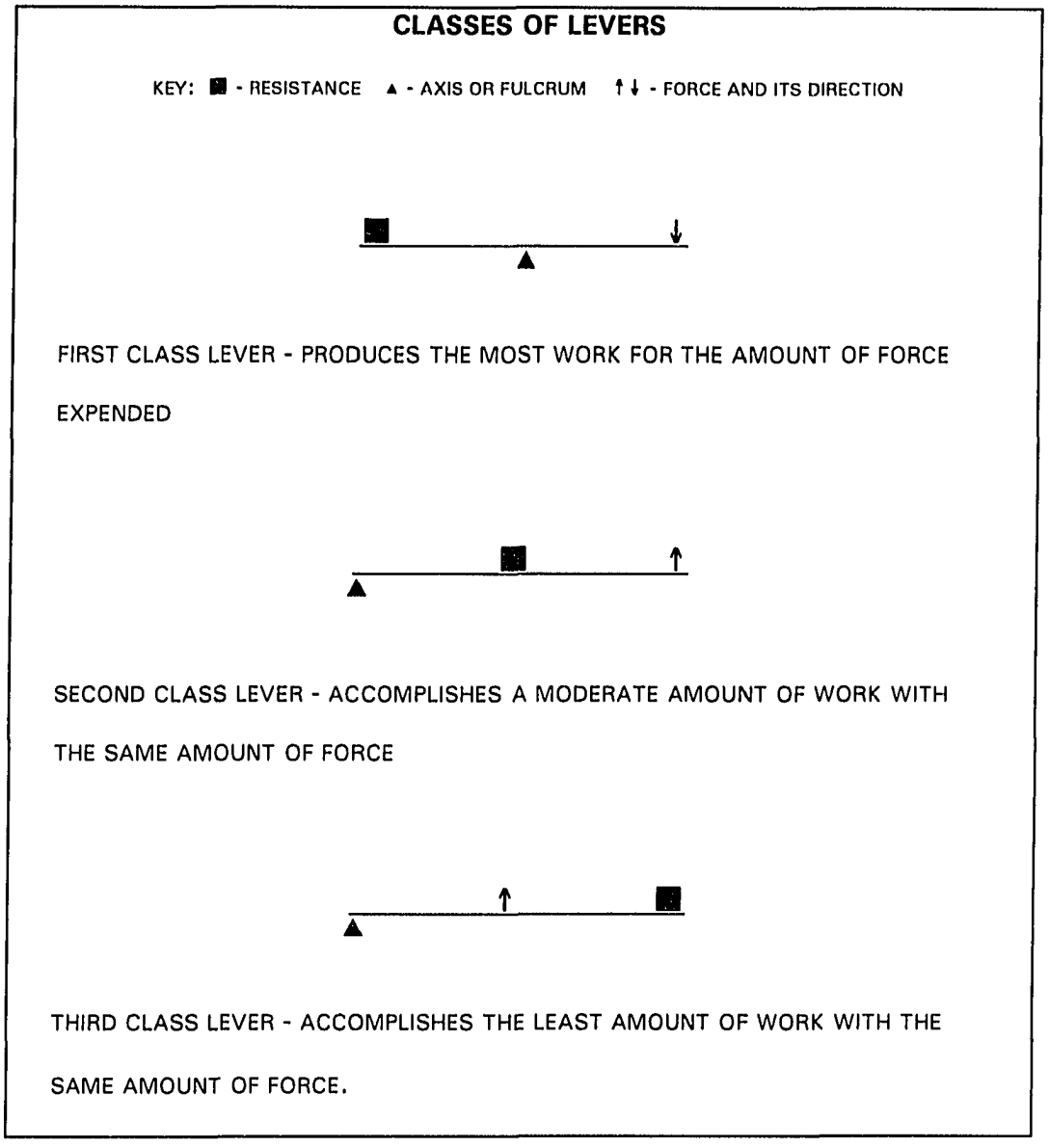


Figure 19.

Diagram of Classes of Levers.

103. There are three classes of levers in the human body. The first class lever accomplishes the most work for the amount of force applied. The second class lever accomplishes a moderate amount of work with the same amount of force. The third class lever accomplishes the least amount of work with the same amount of force.

1. FIRST CLASS
2. SECOND CLASS
3. THIRD CLASS

List in order the three types of levers found in the human body.

1. _____
2. _____
3. _____

104. The third class lever is the most common in the human body.

THIRD CLASS

The most common lever found in the human body is the _____ _____ lever.

105. Most kinesiology instructors agree that all three classes or types of levers may be found at the elbow of the human body.

ELBOW

All three types of levers may be found at the human _____.

In the space below diagram and classify the three types of levers. Use the key indicated. The indicator for force should include one direction only.

KEY: ■ - RESISTANCE ▲ - AXIS OR FULCRUM ↑↓ - FORCE AND ITS DIRECTION ___ - LEVER

_____ _____ _____

106. There are four parts of a circle important to understanding the concepts of movement. The first is the circumference, the bounding line or perimeter of a circle. The diameter is a straight line passing through the center of a circle from circumference to circumference. The radius is a straight line from the center of a circle to the circumference. An arc is any part or portion of the circumference of a circle.

1. CIRCUMFERENCE - BOUNDING LINE OR PERIMETER
2. DIAMETER - STRAIGHT LINE PASSING THROUGH THE CENTER OF THE CIRCLE FROM CIRCUMFERENCE TO CIRCUMFERENCE
3. RADIUS - STRAIGHT LINE PASSING FROM THE CENTER OF THE CIRCLE TO THE CIRCUMFERENCE
4. ARC - ANY PORTION OF THE CIRCUMFERENCE

List and define the four main parts of a circle.

1. _____
2. _____
3. _____
4. _____

107. There are two forces that relate to rotating motion in a circle or an arc. Centripetal force is the force tending toward the center of a circle or arc. Centrifugal force is the force tending to move from the center of a circle or arc.

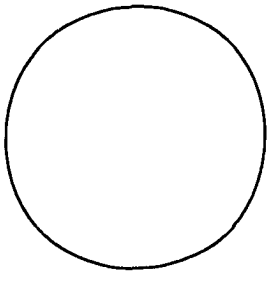
CENTRIPETAL

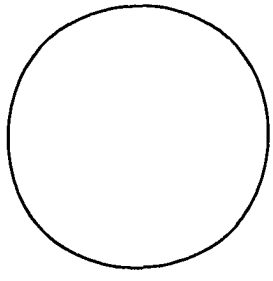
CENTRIFUGAL

FROM

_____ force is the force tending toward the center of a circle while _____ force is the force tending to move _____ the center of a circle.

On each circle below indicate a radius and show the direction of rotating motion on the circumference. On the radius in one circle show the direction of centripetal force. On the radius of the other circle show the direction of centrifugal force. Label each circle as to the type of force depicted.





108. In circular rotating motion, the longer the radius the slower the rotation. The shorter the radius, the faster the rotation will be.

SHORTER

The _____ the radius, the faster the rotation.

109. If an object such as a key on the end of a string is released while in rotating motion, the object or key would leave the circle at a right angle. Another example other than the key on a string would be the rotating motion of a softball pitch and release.

RIGHT ANGLE

If a key on a string is released while in a circular rotating motion, it would leave the circle at a _____ _____.

Class notes:

Review

The lever is the most common simple machine in the human body. A lever is any rigid bar that turns about a fulcrum or axis when force is applied to it. A lever overcomes a resistance. The three types of levers are first, second, and third class. A first class lever accomplishes the most work for the amount of force applied. With the same amount of force, a second class lever accomplishes a moderate amount of work while a third class lever accomplishes the least. The third class lever is the most common in the body. All three types may be found at the human elbow.

Circumference - the bounding line or perimeter of a circle.

Diameter - a straight line through the center of a circle from circumference to circumference.

Radius - a straight line from the center of a circle to the circumference.

Arc - any portion of the circumference of a circle.

In rotating motion, centripetal force tends to move toward the center of a circle or arc, while centrifugal force tends to move away from the center. In rotating motion, the longer the radius, the slower the rotation or the shorter the radius, the faster the rotation will be. An object released while in rotating motion leaves the circle at a right angle.

Types of Movement

110. Translatory movement occurs when all parts of an object move in the same direction at the same speed and for the same distance.

ALL PARTS MOVE IN THE SAME DIRECTION AT THE SAME SPEED AND FOR THE SAME DISTANCE

Describe translatory movement. _____

_____

_____

111. Two types of translatory movement are rectilinear movement and curvilinear movement. Rectilinear movement occurs when translatory movement follows a straight line. Curvilinear movement occurs when translatory movement follows a curved path or an orbit around an external axis.

RECTILINEAR MOVEMENT

_____ _____ is occurring when an object follows a straight line.

112. Curvilinear movement can be in either a complete circle or an arc (part of a circle). Rotary motion is curvilinear movement in a complete circle, while angular motion is curvilinear movement in an arc.

1. **ROTARY - MOVEMENT IN A COMPLETE CIRCLE**
2. **ANGULAR - MOVEMENT IN AN ARC OR PART OF A CIRCLE.**

Name and identify two types of motion associated with curvilinear movement.

1. _____

_____

2. _____

_____

Class notes:

Review

Translatory movement occurs when all parts of an object move in the same direction at the same speed for the same distance. Two types are rectilinear, translatory movement following a straight line, and curvilinear, translatory movement following a curved path or orbit around an external axis. Curvilinear movement may be further described as rotary motion, movement in a complete circle, or angular motion, movement in an arc.

113. Two other types of motion associated with rectilinear and curvilinear translatory movement are reciprocating and oscillating motions. Reciprocating motion is a repetitive rectilinear translatory movement. Oscillating motion is a repetitive rotary curvilinear translatory movement.

RECIPROCATING _____ is a repetitive rectilinear translatory movement.

114. There are four factors that modify all motion in the human body. Friction, air, and water are the external forces while the anatomical factor is internal.

1. **FRICTION - EXTERNAL**
2. **AIR - EXTERNAL**
3. **WATER - EXTERNAL**
4. **ANATOMICAL - INTERNAL**

List the four factors that modify motion and identify each as internal or external.

1. _____
2. _____
3. _____
4. _____

Class notes:

115. The anatomical factor that modifies motion has four sub-classes: synovial fluid that lubricates joints, antagonistic muscle tension, tension of ligaments and fascia, and atmospheric pressure.

1. SYNOVIAL FLUID THAT LUBRICATES JOINTS
2. ANTAGONISTIC MUSCLE TENSION
3. TENSION OF LIGAMENTS AND FASCIA
4. ATMOSPHERIC PRESSURE

List in order the four sub-classes of the anatomical factor that modifies motion.

1. _____
2. _____
3. _____
4. _____

Review

Reciprocating motion is a repetitive rectilinear translatory movement.

Oscillating motion is a repetitive rotary curvilinear translatory movement.

Four factors that modify motion are friction, air, and water, the external forces, and the anatomical factor, the internal force.

Glossary

Angular motion	Curvilinear movement occurring in an arc or part of a circle.
Antagonist muscle	Works opposite the prime mover's application of force for movement by resisting.
Arc	Any portion of the circumference of a circle.
Centrifugal force	A force tending to move from the center of a circle in curvilinear movement.
Centripetal force	A force tending to move toward the center of a circle in curvilinear movement.
Circumference	The bounding line of a circle.
Curvilinear movement	Translatory movement that follows a curved path or orbit around an external axis.
Diameter	A straight line passing through the center of a circle from circumference to circumference.
Fixator	Muscle that keeps the bone at the origin steady while the prime mover applies force for movement.
Fulcrum	The axis point on a lever.
Law of reaction	For every action, there is an equal and opposite reaction.
Law of inertia	An object at rest will remain at rest and an object in motion will remain in motion, unless acted upon by some external force.

Law of acceleration	Distance transversed per unit of time will remain constant unless a force acts upon the moving object. Acceleration is directly proportional to the force produced and inversely proportional to the mass while moving in the same direction as force produced.
Lever	Any rigid bar which turns about a fulcrum or axis when force is applied. It overcomes a resistance.
Newton, Sir Isaac	Newton (1642—1727) was an English physicist and mathematician who developed important concepts about motion, mass and movement, including the existence of gravity.
Oscillating motion	Angular curvilinear translatory movement.
Prime mover	Muscle responsible for a definite movement.
Radius	A straight line from the center of a circle to the circumference.
Reciprocating motion	Repetitive rectilinear translatory movement.
Rectilinear movement	Translatory movement following a straight line.
Rotary motion	Curvilinear movement occurring in a complete circle.
Synergist muscle	Muscle keeps the joint steady while the prime mover applies force to a neighboring joint.
Translatory	All parts of an object moving in the same direction at the same speed and for the same distance.

CHAPTER 5

Introduction

Chapter 5 is the top of the kinesiology pyramid that began with the foundation laid in Chapter 1. The information provided here puts into perspective knowledge gained in Chapters 1 through 4. If kinesiology could be described as having a heart, its heart would be in the factors of stability. Additional supportive information is also included in this final chapter.

Equilibrium, Balance, and Stability

116. In body positioning, whether moving or stationary, three terms that are often used interchangeably are equilibrium, balance, and stability.

EQUILIBRIUM

BALANCE

STABILITY

_____, _____, and _____ are terms that may be used interchangeably for body positioning.

117. For the purposes of kinesiology, there are degrees of difference between equilibrium, balance, and stability.

DEGREES

In relation to kinesiology there are _____ of difference between equilibrium, balance and stability.

Class notes:

118. Equilibrium can be compared to a balance scale as used in a candy store. With the scale, a weight is placed on one side and candy is added gradually to the other side until the sides become equal or the scale reads zero.

BALANCE

Equilibrium can be compared to a _____ scale in a candy store.

119. Using the same analogy, balance would be when the balance scale reaches zero. Equilibrium is used to reach the point of balance.

BALANCE

Equilibrium is used to reach the point of _____.

Class notes:

120. Balance is sub-divided into two types, static and dynamic.

STATIC

DYNAMIC

_____ and _____ are two types of balance.

121. Static balance is the type of balance if there is little or no movement and balance is maintained under unfavorable conditions.

LITTLE OR NO MOVEMENT AND BALANCE IS MAINTAINED UNDER UNFAVORABLE CONDITIONS

Describe or define static balance. _____

_____

_____

122. Dynamic balance is the type of balance in movement in which there is a loss and regaining of balance. An example is walking.

MOVEMENT BY LOSING AND REGAINING BALANCE

Define dynamic balance. _____

_____

123. Stability is the anchor of equilibrium and balance. Whether the body is in motion or stationary, stability is maintaining the position or direction even with added forces acting against it.

MAINTAINING A BODY POSITION OR DIRECTION EVEN WITH ADDED FORCES ACTING AGAINST IT

Define stability. _____

_____

_____

124. In kinesiology, equilibrium may be described as "getting there," balance as "got there," and stability as "staying there."

1. **GETTING THERE**
2. **GOT THERE**
3. **STAYING THERE**

List in order the three simple phrase explanations of equilibrium, balance, and stability as related to kinesiology.

1. _____
2. _____
3. _____

125. In considering balance and stability, a higher degree of skill is needed to maintain little or no movement.

STABILITY
LESS
HIGHER

Balance and _____ require that the _____ the movement, the _____ the degree of skill.

Review

Three terms used in moving or stationary body positioning are equilibrium, balance, and stability. Equilibrium, bringing the body to a state of balance in which there is no change in speed or direction, is used to reach the point of balance. Balance involves control of equilibrium. Balance has two types, static and dynamic. Static balance involves little or no movement and balance is maintained under unfavorable conditions. Dynamic balance is movement by loss and regaining of balance, as in walking. Stability is maintaining the body's position or direction even with additional forces acting against it. In considering balance and stability, it takes a higher degree of skill to maintain little or no movement.

126. Kinesthetic sense is an awareness of one's body position in space or water without the aid of sight or touch.

ONE'S BODY POSITION IN SPACE OR WATER WITHOUT THE AID OF SIGHT OR TOUCH

Define kinesthetic sense. _____

_____

_____

127. There are degrees of kinesthetic sense. For example there may be a blur of an object in vision or a slight feel in touch. In playing basketball, players use their arms and hands to judge the position of an opponent.

DEGREES

With kinesthetic sense, there are _____ if there is a blur or slight feel.

Class notes:

Review

Center of gravity is an imaginary point that is the center of mass (weight center). It represents the most concentration of weight, the geometric center, and the balance point. It is located anterior to the sacrum, is lower in women than men, and is where all three cardinal planes intersect.

Line of gravity is an imaginary, internal vertical line that passes through the center of gravity through the base of support to the center of the earth. It is where both cardinal vertical planes intersect.

Factors of Stability

128. When dealing with the factors of stability, keep in mind the phrase, "All other things being equal," which can also be referred to with the acronym AOTBE.

AOTBE "All other things being equal" can be referred to as _____.

129. There are nine factors of stability which will be considered in a specific order. The nine factors are the height of the center of gravity, the size of the base of support, the relation of the line of gravity to the base of support, the mass of the body, the momentum and impact of an external force, friction, segmentation, visual and psychological factors, and physiological factors.

1. HEIGHT OF THE CENTER OF GRAVITY
2. SIZE OF THE BASE OF SUPPORT
3. RELATION OF THE LINE OF GRAVITY TO THE BASE OF SUPPORT
4. MASS OF THE BODY
5. MOMENTUM AND IMPACT OF AN EXTERNAL FORCE
6. FRICTION
7. SEGMENTATION
8. VISUAL AND PSYCHOLOGICAL FACTORS
9. PHYSIOLOGICAL FACTORS

List in order the nine factors of stability.

1. _____
2. _____
3. _____
_____
4. _____
_____
5. _____
6. _____
7. _____
8. _____
9. _____

130. The height of the center of gravity can be too high or too low. If it is too high, stability becomes too difficult. If it is too low, it takes more muscle force to raise the center of gravity to the most stable and movable point.

HIGH

LOW

The center of gravity can be too _____ or too _____.

131. The size of the base of support can reach a point where it is a disadvantage to balance and stability. If the base of support is too small, it reduces the ability to maintain stability. If the base of support is too large, a greater amount of muscle force is required to move.

SMALL

LARGE

The base of support can be too _____ or too _____ for effectiveness.

Class notes:

132. The relation of the line of gravity to the base of support directly relates to equilibrium, balance, and stability. If the line of gravity moves outside the base of support, equilibrium is lost. When the line of gravity is on the near edge of the base of support, balance and stability become more difficult to maintain.

BASE OF SUPPORT

If the line of gravity moves outside the _____ _____ _____, equilibrium is lost.

133. When considering the factor of mass of the body, it is important to keep in mind "all other things being equal." If all else is equal, a larger mass of body will overcome a smaller body mass.

LARGER

SMALLER

If all other things are equal, a _____ body mass will overcome a _____ body mass.

134. Momentum and impact can be applied to any contact activity. A smaller body mass with greater momentum and selected point of impact can overcome a large body mass.

MOMENTUM
IMPACT

_____ and _____ will make a difference in body mass upon contact.

135. Friction or lack of friction may be controlled in many ways. Types of clothing to reduce friction or gloves and shoes to increase friction can be found in use in many activities.

FRICTION
LACK

_____ or _____ of friction may be controlled in many ways.

Class notes:

136. Segmentation is the use of a weight to offset another weight. For example, when bending at the waist, a person may extend an arm or leg (or both) in the opposite direction to offset the upper body weight. A simple way to look at segmentation is "For every zig, there is a zag."

ARMS
LEGS

Segmentation of body weight may be accomplished by extending _____ or _____ of the body in the opposite direction to the mass of the body.

137. Visual and psychological factors often work together. Through vision, size and speed can be realized. Then the psychological factor or mind can use this as an advantage or disadvantage.

VISUAL
PSYCHOLOGICAL

_____ and _____ factors work in conjunction with each other.

138. Physiological factors can range from muscle strength and speed to the intricacies of the inner ear.

PHYSIOLOGICAL _____ factors cover the complete range of body functions.

Review

In dealing with the factors of stability, keep in mind the phrase "all other things being equal" or AOTBE.

The nine factors of stability are the height of the center of gravity, the size of the base of support, the relation of the line of gravity to the base of support, the mass of the body, the momentum and impact of an external force, friction, segmentation, visual and psychological factors, and physiological factors.

139. Using the first three factors of stability, a body can assume a starting position good for most athletic activities. Bent knees to lower the center of gravity, feet approximately shoulder width apart for the base of support, and the line of gravity near the center of the base of support may be described as the universal athletic starting position.

UNIVERSAL ATHLETIC STARTING POSITION

The starting position that can be applied to most activities is referred to as the _____ _____ _____ _____.

Class notes:

140. Professional calm is often called an athlete's ability to concentrate. Concentration relates to timing, relaxation, and desire, all of which make up professional calm.

CONCENTRATION
TIMING
RELAXATION
DESIRE

Professional calm is a combination of _____, _____, _____, and _____.

Modes of Body Support

141. There are four basic modes of body support in activities. These are the ground, water, suspended, and the body unsupported.

1. **GROUND**
2. **WATER**
3. **SUSPENDED**
4. **UNSUPPORTED**

List in order the four basic modes of body support in activities.

1. _____
2. _____
3. _____
4. _____

142. The ground can be classified into firm, as in a hardwood floor; soft, as in a rubber track or sawdust pit or mats; or elastic, as in the use of a trampoline.

1. FIRM
2. SOFT
3. ELASTIC

List in order the classes of ground as a means of support.

1. _____
2. _____
3. _____

143. Water as a mode of support can be changed by the addition of salt. There is less body buoyancy in fresh water than in salt water.

1. FRESH WATER
2. SALT WATER

List the two types of water as a mode of body support.

1. _____
2. _____

144. The suspended mode of body support can often be seen in gymnastics and other activities. This mode usually refers to hanging by the hands which are attached to a support. During uneven bar exercises, women use the suspended mode. Men use the suspended mode during exercises on the high bar and rings.

HANGING

ATTACHED

The suspended mode of body support usually refers to _____ by the hands which are _____ to a support.

Review

The universal athletic starting position uses the first three factors of stability. An athlete's professional calm is a combination of timing, relaxation, desire, and concentration.

The four basic modes of body support in athletic activities are the ground, water, suspended, and the body unsupported.

145. The body unsupported mode occurs when the body is traveling through the atmosphere, as in jumping or diving. The important thing to remember when a body leaves its base of support is the center of gravity of that body has a predetermined destination.

CENTER OF GRAVITY

When a body leaves its base of support, the _____ _____ _____ has a predetermined destination.

Categories of Activities

146. In kinesiology, there are three major categories of activities.

THREE ACTIVITIES

There are _____ major categories of _____ in kinesiology.

147. The first category is a continued application of a force as in pushing, pulling, or lifting.

PUSHING
PULLING
LIFTING

A continued application of a force applies to _____, _____, and _____.

148. The second category is the development of kinetic energy followed by the release of an object at the moment of maximum desired velocity. This would consist of all throwing motions, including those using an implement.

THROWING MOTIONS

The development of kinetic energy followed by the release of an object at the moment of maximum velocity applies to all _____ _____.

149. The last category is the momentary contact made with an object by a moving part or segment of the body or an implement attached to the body. This category covers kicking and striking of objects.

KICKING

STRIKING

The momentary contact made with an object by a moving part of the body or an implement attached to the body covers _____ and _____.

150. There are two exceptions to the three major categories of activities. These are the slingshot and archery. In both, the force applied is stored in either the rubber bands of the sling shot or the limbs of a bow.

SLINGSHOT

ARCHERY

The two exceptions to the three major categories of activities are the _____ and _____.

Review

Of the modes of body support, the ground can be classified as firm, soft, or elastic. The body is more buoyant in salt water than it is in fresh. In suspended mode, the body is hanging by the hands which are attached to a support. In unsupported mode, such as jumping or diving, the body is traveling through the atmosphere; however, when the body leaves its base of support, it has a predetermined destination.

There are three major categories of activities in kinesiology. These are: continued application of a force (pushing, pulling, lifting), the development of kinetic energy followed by the release of an object at the moment of maximum desired velocity (throwing), and momentary contact made with an object by a moving part or segment of the body or an implement attached to the body (kicking and striking of objects). The two exceptions to the three major categories are the slingshot and archery. In both of these the force applied is stored in either the rubber bands of the slingshot or the limbs of the bow.

Glossary

AOTBE	"All other things being equal." This phrase is important to remember when dealing with the factors of stability.
Balance	"Got there;" control of equilibrium.
Body unsupported	A mode of body support in which the body is traveling through the atmosphere as in jumping or diving; also called unsupported mode.
Center of gravity	The balance point of an object; where the weight center of an object is located.
Dynamic balance	The type of balance in movement in which there is a loss and regaining of balance, as in walking.
Equilibrium	"Getting there;" bringing the body to a state of balance where there is no change in speed or direction.
Factors of stability	The nine factors are: the height of the center of gravity, the size of the base of support, the relation of the line of gravity to the base of support, the mass of the body, the momentum and impact of an external force, friction, segmentation, visual and psychological factors, and physiological factors.

Friction	The resistance to relative motion between the contact of two or more bodies or body parts.
Impact	Contact, collision, striking or coming together of bodies or body parts.
Kinesthetic sense	Awareness of one's body position in space or water without the aid of sight or touch.
Kinetic energy	The energy associated with motion.
Line of gravity	An imaginary **internal** vertical line that passes through the center of gravity and the base of support.
Momentum	Impetus; amount of motion developed.
Professional calm	Combination of concentration, timing, relaxation, and desire; used to describe an athlete's ability to concentrate.
Segmentation	Use of a weight to offset another weight; "For every zig, there is a zag."
Stability	"Staying there;" anchor; maintaining a position or direction even with forces acting against it; resistance to a disturbance of equilibrium.
Static balance	The type of balance during which there is little or no movement, and balance is maintained under unfavorable conditions.

Suspended mode	A mode of body support usually referred to as hanging by the hands which are attached to a support. Often seen during exercises on the uneven bars, high bar, or rings.
Unsupported mode	A mode of body support in which the body is traveling through the atmosphere as in jumping or diving; also called body unsupported.
Velocity	Speed.
Zig-zag	"For every zig, there is a zag." A reference word for segmentation of body weight in which one weight is used to offset another weight.

APPENDIX A

Kinesiology Projects

There are several types of projects to choose from if an instructor requires students to show they can apply what they have learned from this programmed text. Some instructors are very lenient in what is considered acceptable for a project, but others have stricter guidelines. One possibility acceptable to most instructors is to focus on a specific activity or type of movement in the human body and to complete a notebook project on this activity.

Kinesiology Notebooks

Students would first select an activity for study. The next step would be to search for pictures of that activity with a goal of obtaining six to fifteen usable pictures. Then students should make a primary statement about what each picture depicts in terms of kinesiology. Any other information on the picture should be added to the explanation. Using the statements and explanations, a glossary should also be prepared for the key words and terms used. When satisfied with the statements and information, students should type the primary statements, explanations, and glossary.

When ready for assembly into a notebook, each picture should be placed on a separate page with its accompanying statement pasted on the same page. Each page needs to be placed in a sheet protector or laminated. Eye appeal in the choice of background colors, placement on the pages, and neatness of assembly are important as well as the accuracy of the statements accompanying each picture.

The finished notebook should be given a title. On the cover page the title, the student's name, the instructor's name, the course number and course title, and the date should all be included. A table of contents should be next. The pictures and statements about each picture follow the table of contents. Last is the glossary of the key words and terms used in the explanations. All materials are then ready to be transferred to a three-ring notebook and presented to the instructor.

APPENDIX B

BONES OF THE ADULT HUMAN SKELETON

1. SKULL	29 TOTAL
A. BONES OF THE CRANIUM	8
B. BONES OF THE INNER EAR	6
C. HYOID BONE	1
D. FACIAL BONES	14
2. SPINAL COLUMN	26 TOTAL
A. CERVICAL	7
B. THORACIC	12
C. LUMBAR	5
D. SACRUM	1
E. COCCYX	1
3. STERNUM	1 TOTAL
4. RIBS	12/24 TOTAL
5. UPPER EXTREMITY	64 TOTAL
A. SCAPULA	2
B. CLAVICLE	2
C. HUMERUS	2
D. ILNA	2
E. RADIUS	2
F. CARPAL BONES	8/16
G. METACARPALS	5/10
H. PHALANGES	14/28
6. LOWER EXTREMITY	63 TOTAL
A. PELVIC GIRDLE—ILIUM, ISCHIUM, PUBIS	3
B. FEMUR	2
C. PATELLA	2
D. TIBIA	2
E. FIBULA	2
F. TARSALS	7/14
G. METATARSALS	5/10
H. PHALANGES	14/28

APPENDIX C

FUNCTIONS OF THE HUMAN SKELETON AS STUDIED FOR KINESIOLOGY

SUPPORT

- FRAMEWORK OF THE BODY
- SUPPORT TO THE SOFT TISSUES
- PROVIDE POINTS OF ATTACHMENT FOR MUSCLES

MOVEMENT

- BONE TO BONE, MOVABLE JOINTS (ACT AS FULCRUMS)
- BONES SERVE AS LEVERS

PROTECTION

- VITAL INTERNAL ORGANS
- EXAMPLES (PROVIDED BY INSTRUCTOR)

GLOSSARY

Abduction Away from the mid-line of the body.

Action line The line of pull; the shortening of a muscle along the pattern of muscle fibers toward the center of the muscle.

Adduction Toward the mid-line of the body.

All or none law Given threshold or supra threshold stimuli, a muscle fiber will contract all the way or not at all.

Amplitude of muscle A muscle can extend or shorten up to one-half the original or resting length.

Anatomical position An erect standing position related to anatomy and medicine; a position used for identifying points of reference or locations. See page 10 for a detailed description of the anatomical position.

Anatomy Structure; the structure of the human body and not limited to the skeletal or muscular systems of the body.

Angular motion Curvilinear movement occurring in an arc or part of a circle.

Antagonist muscle Works opposite the prime mover's application of force for movement by resisting.

Anterior Front.

AOTBE	"All other things being equal." This phrase is important to remember when dealing with the factors of stability.
Arc	Any portion of the circumference of a circle.
Aristotle	A Greek philosopher (384—322 B.C.) who is considered by most kinesiology instructors to be the "Father of Kinesiology."
Arthrology	Joints; the study of joints.
Axis	A fixed point or line about or around which a body revolves or rotates.
Balance	"Got there;" control of equilibrium.
Ballistic movement	A type of movement initiated by the contraction force of a muscle; then the muscle relaxes and allows momentum to complete the movement (follow through).
Biology	Life; the science of life; the branch of knowledge which is concerned with living organisms.
Body unsupported	A mode of body support in which the body is traveling through the atmosphere as in jumping or diving; also called unsupported mode.
Cardiac muscle	Heart muscle; involuntary muscle found only in the heart.
Cardinal Plane	Any plane that passes through the center of gravity.

Cavity	A hollow space or hole.
Center of gravity	The balance point of an object; where the weight center of an object is located.
Centrifugal force	A force tending to move from the center of a circle in curvilinear movement.
Centripetal force	A force tending to move toward the center of a circle in curvilinear movement.
Circumduction	A stationary point on a line with the distal end moving in a circle forming a cone. This is a combination of movements in all planes.
Circumference	The bounding line of a circle.
Cocontraction	Coinnervation; opposing muscles contracting at the same time and not allowing movement.
Coinnervation	Cocontraction; opposing muscles contracting at the same time and not allowing movement
Concentric	Having a common center.
Condyle	A rounded protuberance at the end of a bone forming an articulation.
Contractility	The unique ability of a muscle to contract or shorten to less than the original or resting length.
Contracture	Permanent contraction of a muscle due to spasm or paralysis.
Curvilinear movement	Translatory movement that follows a curved path or orbit around an external axis.

Diameter	A straight line passing through the center of a circle from circumference to circumference.
Diarthrosis	Movable joints.
Dynamic balance	The type of balance in movement where there is a loss and regaining of balance, as in walking.
Dynamics	The mechanical study of objects in motion.
Eccentric	Not having a common center or axis not centered.
Elasticity	The ability of a muscle to be extended or twisted and yet return to the original or resting length.
Equilibrium	"Getting there;" bringing the body to a state of balance where there is no change in speed or direction.
Extensibility	The ability of a muscle to be extended or stretched.
Extension	Increase of an angle at a joint.
Factors of stability	The nine factors are: the height of the center of gravity, the size of the base of support, the relation of the line of gravity to the base of support, the mass of the body, the momentum and impact of an external force, friction, segmentation, visual and psychological factors, and physiological factors.

Fascia	A connective tissue that surrounds, separates, supports, and binds muscle, skin, and other tissues.
Fixator	Muscle that keeps the bone at the origin steady while the prime mover applies force for movement.
Flexion	Decrease of an angle at a joint.
Foramen	A hole in a bone for passage of vessels or nerves.
Force	The instigator of movement; a push or a pull or a tendency to distort.
Fossa	A furrow or shallow depression.
Friction	The resistance to relative motion between the contact of two or more bodies or body parts.
Fulcrum	The axis point on a lever.
Horizontal	Parallel to the horizon; on a level; flat line or surface.
Impact	Contact, collision, striking or coming together of bodies or body parts.
Inferior	Lower or below; bottom.
Insertions	More movable end of a skeletal muscle that is more distal or inferior.
Involuntary muscle	A muscle whose movement is independent of or contrary to conscious desire; examples are the smooth and cardiac muscles.

Isokinetic contraction	A muscle shortens or lengthens but maintains a constant speed throughout the movement.
Isometric contraction	A muscle contracts but is not allowed to shorten or lengthen even with increased tension.
Isotonic contraction	A muscle contracts and maintains constant tension; also refers to osmotic pressure.
Iso—	Combining form meaning equal.
Joint	In reference to the skeleton, where two or more bones come together or meet. Joints can be classified as movable or nonmovable.
Kinesiology	Movement; the scientific study of human movement.
Kinesthetic sense	One's body position in space or water without the aid of sight or touch.
Kinetic energy	The energy associated with motion.
Kinetics	The description of moving objects with regard to the forces causing their motion; a division of dynamics.
Lateral	Away from the middle; outside.

Law of acceleration	Distance transversed per unit of time will remain constant unless a force acts upon the moving object. Acceleration is directly proportional to the force produced and inversely proportional to the mass while moving in the same direction as force produced.
Law of inertia	An object at rest will remain at rest and an object in motion will remain in motion, unless acted upon by some external force.
Law of reaction	For every action, there is an equal and opposite reaction.
Lever	Any rigid bar which turns about a fulcrum or axis when force is applied. It overcomes a resistance.
Line of gravity	An imaginary **internal** vertical line that passes through the center of gravity and the base of support.
Line of gravity	An imaginary **internal** vertical line that passes through the center of gravity and the base of support.
Line of pull	The action line; the shortening of a muscle along the pattern of muscle fibers toward the center of the muscle.
Medial	Toward the middle; relating to the middle.

Mid-line of the body	An imaginary **external** vertical line which is used as a reference line to divide the body or body parts into left and right sections.
Momentum	Impetus; amount of motion developed.
Myology	Muscles; the study of muscles.
Newton, Sir Isaac	Newton (1642—1727) was an English physicist and mathematician who developed important concepts about motion, mass, and movement, including the existence of gravity.
Oblique plane	A plane that lies tilted between the three primary planes associated with kinesiology: sagittal, frontal, and transverse.
Orifice	Entrance or outlet of any opening such as the mouth or the eye.
Origins	More stable end of a skeletal muscle that is more proximal or superior.
Oscillating motion	Angular curvilinear translatory movement.
Osteology	Bone; the study of bones.
Parallel	Lying evenly everywhere in the same direction, but never meeting, however far extended.
Perpendicular	At right angles to a given surface.
Physics	Mechanics; the science that deals with the most general and fundamental of such phenomena, namely motion; the science of matter and motion.

Physiology	Function; the science branch of biology that deals with the study of functions of the organs, tissues and cells during life.
Plane	A flat imaginary surface.
Plumb line	A line weighted with a plumb bob. It is used to indicate true vertical directed to the center of gravity of the earth.
Posterior	Back.
Prime mover	Muscle responsible for a definite movement.
Professional calm	Combination of concentration, timing, relaxation, and desire; used to describe an athlete's ability to concentrate.
Psychology	Mind; the science which deals with the mind of man or other organisms in any of its aspects.
Radius	A straight line from the center of a circle to the circumference.
Reciprocal innervation	Muscles work in groups or pairs; while one group or muscle contracts, the other group or muscle relaxes.
Reciprocating motion	Repetitive rectilinear translatory movement.
Rectilinear movement	Translatory movement following a straight line.
Right angle	The angle bounded by two radii that intercept a quarter of a circle; one quarter of a round angle; one half of a straight angle.

Rotary motion	Curvilinear movement occurring in a complete circle.
Segmentation	Use of a weight to offset another weight; "For every zig, there is a zag."
Skeletal muscle	Muscles which are attached to the skeleton; striated muscle; voluntary muscle.
Smooth muscle	Involuntary muscles located around organs and orifices of the body.
Stability	"Staying there;" anchor; maintaining a position or direction even with forces acting against it; resistance to a disturbance of equilibrium.
Static balance	The type of balance in which there is little or no movement and balance is maintained under unfavorable conditions.
Striated muscle	Muscles which are attached to the skeleton; skeletal muscle; voluntary muscle.
Superior	Upper or above; top.
Suspended mode	A mode of body support usually referred to as hanging by the hands which are attached to a support. Often seen during exercises on the uneven bars, high bar, or rings.
Synarthrosis	Nonmovable or slightly movable joints.
Synergist muscle	Muscle keeps the joint steady while the prime mover applies force to a neighboring joint.

Translatory	All parts of an object moving in the same direction at the same speed and for the same distance.
Tubercle	A small, rounded elevation or eminence on a bone.
Unsupported mode	A mode of body support in which the body is traveling through the atmosphere as in jumping or diving; also called body unsupported.
Velocity	Speed.
Vertical	A line perpendicular to the horizon. A plumb line is a true vertical line.
Voluntary muscle	Muscle controlled by will or thought; examples are striped, striated, cross-striated, or skeletal muscles.
Work	The process of exerting a force which moves a resistance through a distance. A by-product of work is heat.
Zig-zag	"For every zig, there is a zag." A reference word for segmentation of body weight by which one weight is used to offset another weight.

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